

# KERALA ENVIRONMENT CONGRESS 2013

9<sup>th</sup>, 10<sup>th</sup> & 11<sup>th</sup> October 2013 at Thiruvananthapuram

Focal Theme

**Culture and Heritage for Environment Management**

Organised by



**Centre for Environment and Development**

In Association with  
**Kerala State Biodiversity Board**

Sponsored by

**Kerala State Council for Science, Technology and Environment**

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#### Centre for Environment and Development

Thozhuvancode, Vattiyoorkavu P.O, Thiruvananthapuram-695 013, Kerala  
Phone : 0471-2369720, 2369721, Fax : 0471-2369720  
E-mail : [director@cedindia.org](mailto:director@cedindia.org), [office@cedindia.org](mailto:office@cedindia.org)  
URL : [www.cedindia.org](http://www.cedindia.org); [www.indiawastemanagementportal.org](http://www.indiawastemanagementportal.org)

#### CED Eastern Regional Centre

At: Naranpur, P.O. Belagachhia, Dist. Cuttack-753 001, Odisha  
Phone : 0674-2726132, E-mail: [cederc@cedindia.org](mailto:cederc@cedindia.org)

#### CED Regional Centre

Yeturu Towers, AC Guards, Hyderabad  
Phone : 040-23314341, E-mail: [cedhyd@cedindia.org](mailto:cedhyd@cedindia.org)



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FOCAL THEME  
**CULTURE AND HERITAGE FOR  
ENVIRONMENT MANAGEMENT**

9<sup>th</sup>, 10<sup>th</sup> & 11<sup>th</sup> October 2013  
at Co-Bank Towers Auditorium, Thiruvananthapuram

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Dr Babu Ambat

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**Kerala State Council for Science,  
Technology & Environment**

Sasthrabhavan, Pattom P.O.

Thiruvananthapuram-695 004, Kerala, India

Ph: +91 471 2543557 (Direct), Fax: +91 471 2540085

E-mail : rajasekharpillai@gmail.com

www.kscste.kerala.gov.in, www.kscste.org

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**Prof. V.N. Rajasekharan Pillai**

Executive Vice President

&

Principal Secretary, S&T Department

Govt. of Kerala

## FOREWORD

Nature has always been very vibrant, giving and resilient to a very large extent. We, as Indians, take pride in our strong cultural heritage. A culture is a way of life of a group of people--the behaviors, beliefs, values and symbols that they accept, generally without thinking about them, and that are passed along by communication and imitation from one generation to the next. Heritage is the environment, objects and places that we inherit from the past and pass on to future generations to use, learn from and be inspired by. Together these frame our understanding of the past and influence the decisions we make about what is worth keeping. India is a culturally rich and diverse country where people speak many different languages, with many communities which live in their respective social structures completely depending on their environment to ensure their livelihood.

The Convention for the Safeguarding of the Intangible Cultural Heritage, adopted by the 32nd session of the General Conference of UNESCO in September 2003, calls for safeguarding knowledge and skills that are recognized by communities, groups, and in some cases individuals, as forming part of their cultural heritage; are transmitted from generation to generation and constantly recreated; are crucial for the sense of identity and continuity of communities and groups; are in conformity with human rights, and, mutual respect and sustainable development. This is commonly known as traditional or indigenous knowledge. The UN Declaration on the Rights of Indigenous Peoples, endorsed by the UN Human Rights Council in June 2006, recognizes "that respect for indigenous knowledge, cultures and traditional practices contributes to sustainable and equitable development and proper management of the environment". In India, the Biological Diversity Act contains a framework provision for the protection of this rare knowledge of indigenous communities but it is always in the implementation part that we lag behind.

Traditional knowledge had contributed to sustenance of life and life management systems for centuries. Indigenous communities used to survive and adjust their agriculture, fishing and hunting in the event of changes in climate. It is ironical that now when the threat of climate change is so imminent we are looking for

solutions outside. With the indiscriminate exploitation of natural resources, traditional knowledge that managed to maintain sustainable levels of harvest has been sidelined. Issues of privatisation, alienation and 'bio-piracy' are major areas of concern. The existing policy and legal mechanisms to protect traditional knowledge usually does not involve these communities themselves. Hence they do little to safeguard local community needs, values and customary laws relating to traditional knowledge and genetic resources of indigenous and local communities. We have to preserve this aspect of culture and integrate it with modern methods for conserving the environment.

Culture and Heritage are integral part of our environment. The larger community consisting of researchers, academics, decision makers and common man should come forward to conserve, preserve and protect our culture, heritage, and traditional knowledge systems for mainstreaming into environment and sustainable development. Kerala is rich in its culture, heritage and traditional knowledge systems and can visualise its impacts on every sector, whether it is water resources management, biodiversity conservation, health, agriculture or industry. Our traditional knowledge systems have lead to many inventions and new resources in sectors like health and agriculture. The unfortunate side is that, the state is not in a position to fully utilize these knowledge systems. What is of needed is integrating these knowledge and principles in to country policies and programs as well to local level programs for bring in sustainable development.

It is in this context that the Kerala Environment Congress organized by Centre for Environment and Development in association with Kerala State Biodiversity Board becomes highly relevant. The 9<sup>th</sup> KEC being held from 9<sup>th</sup> to 11<sup>th</sup> October 2013 at Thiruvananthapuram aims at highlighting the importance of Culture and Heritage in Environment and Sustainable Development. The Centre for Environment and Development is once again focusing on the linkage of science, technology and knowledge systems with the most important aspect of human environment for sustainable development.

This Proceedings Volume contains detailed reviews and papers by eminent experts in the concerned fields focusing on 'Culture and Heritage for Environment Management'. This will be very useful in strengthening programs and activities for integrating cultural and heritage values and traditional knowledge systems into the development of the country, and State of Kerala in particular.

The inputs from the participants on the science and technologies, the processes and societal role in integrating cultural and heritage values in environmental conservation offer deeper insight into the issues and thus options for consideration in the State. This would help in appreciation of relevant facts for formulation of policies and programs in the field of culture, heritage and environment management for sustainable development in a more objective manner.



**Prof. V.N. Rajasekharan Pillai**

## **KERALA ENVIRONMENT CONGRESS-2013**

The Centre for Environment and Development(CED) initiated the Kerala Environment Congress in 2005 with the objective of bringing together Scientists and Technologists, Policy Planners, Decision Makers, Development Managers and Students for sharing of knowledge, expertise and experience in subjects of high relevance to the development of the country.

CED is an autonomous research, training and consultancy organisation established in 1993 and has been focusing both on environment and development related sectors bringing complementarity, leading to sustainable development. CED has wide network and collaboration with many state, national and international agencies. CED is working with 6 Program Areas viz., (i) Natural Resources and Environment Management (ii) Water, Sanitation and Health (iii) Climate Change and Energy Studies (iv) Urban and Rural Studies (v) Culture and Heritage Studies and (vi) Information and Knowledge Management.

CED has its Eastern Regional Campus at Bhubaneswar, Odisha and Regional Centre at Hyderabad. CED is the Centre of Excellence of Ministry of Urban Development, Government of India on Solid Waste and Waste Water Management, National Key Resource Centre on Water and Sanitation of Ministry of Drinking Water and Sanitation, Government of India and Regional Resource Agency of Ministry of Environment and Forests, Government of India. The Centre has its activities spread over the states of Odisha, Andhra Pradesh, Jharkhand, Bihar, West Bengal and Maharashtra apart from Kerala. CED is providing technical support to many local self government institutions in the country for Water Supply Engineering, Solid Waste Management, Waste Water Management, GIS Mapping, Biodiversity Conservation, Urban Planning etc. CED initiated the Odisha Environment Congress in 2010 and has completed three Congresses. During the last 20 years, CED has completed nearly 95 research, consultancy and training projects supported by different national and international agencies like the World Bank, UNDP, JICA, ADB, RNE, IDRC, Ministry of Environment and Forests, Ministry of Urban Development, Ministry of Science and Technology, Ministry of New and Renewable Energy, Ministry of Drinking Water and Sanitation, Kerala State Council for Science, Technology and Environment, Local Self Government Department, Kerala, Department of Housing and Urban Development, Odisha, Department of Municipal Administration and Urban Development, Andhra Pradesh and many other agencies.

The Kerala Environment Congress was initiated in 2005 with the focal theme 'Coastal and Marine Environment' . The second congress was held at Kozhikode in 2006 with the focal theme 'Forest Resources of Kerala' and the third KEC was organized in 2007 with 'Wetlands of Kerala' as the focal theme. The fourth congress focused on the theme 'Environmental Sanitation, Health and Hygiene' and the next one was held in 2009 with the focal theme 'Water Resources of Kerala'. The sixth, seventh and

eighth Congresses were held in 2010, 2011 and 2012 with the focal themes 'Solid and Liquid Waste Management', Energy and Environment, and Agriculture and Environment respectively.

This year's Kerala Environment Congress is being organized from 9<sup>th</sup> to 11<sup>th</sup> October 2013 with the focal theme 'Culture and Heritage for Environment Management'. The congress includes key note presentation, 3 special addresses and 22 invited paper presentations as well as presentations by young scientists. Since one of the major objectives of the KEC is to promote young researchers, we have instituted a young scientist award for the best paper and poster presentation. We expect nearly 300 researchers, policy experts, decision makers, students and development thinkers to actively participate and contribute in the congress.

This Proceedings Volume contains full papers of key note address, special addresses, invited presentations and student presentations prepared by eminent experts in the field.

CED gratefully acknowledges the support of Kerala State Biodiversity Board for joining with us to organize this congress. The Kerala State Council for Science, Technology and Environment is always supporting CED to organise such programs in the previous year's also and their support to organise this congress is gratefully acknowledged. CED takes this opportunity to place our sincere gratitude to all the institutions supported us to organize this program and all the distinguished participants and other invitees who have been supporting us for the last nine years to make this program a success.

We hope that the deliberations in the congress and the papers published in the Proceedings will help to identify the linkages and to evolve a strategy for integrating Culture, Heritage and Environment leading to Sustainable Development.

**Dr Babu Ambat**  
*Executive Director, CED*

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## ***Keynote Address***





# Culture Heritage and the Environment

## Dr. Nanditha Krishna

Director, C.P.R. Environmental Education Centre, Chennai

Email: nankrishna18@gmail.com

### INTRODUCTION

The housewife in Taminadu starts her day by sweeping the space outside the front door and decorating it with a *kolam* made of rice flour. Apart from beautifying her home and providing an outlet to her artistic talents, she is also feeding the ants that will not only consume the rice flour but keep her home clean, for ants are great scavengers. She hangs up a *toran* of mango leaves, which have antimicrobial activity and check infection (Nickel, 1959). The leaves also act as a collector of dust particles (Nayar et.al., 1989). When she bathes, she prays that the water may be as sacred as the River Ganga, which was once the cleanest, for its source was the rain and melting snows. She encircles the pipal tree seven times in a ritual binding the Indus-Sarasvati, Vedic, Hindu, Buddhist and Jain civilizations; the tree filters the impurities in the air and gives her clear oxygen to breathe. She pours water or milk over the tulsi plant in the centre of her home, for the *tulsi* is a herb that prevents coughs, colds and fevers. When she eats, she keeps a small bowl of rice for the crows, for they are the scavengers of the outside environment and live on rats, and she wants them to keep her compound clean. And so on. Every aspect of her life is intimately connected with environmental management.

Indian culture is very scientific. Yet we have discarded everything in the name of science. All the good that was preserved in the name of culture and tradition has been discarded in the name of rationalism.

One of the important beliefs of the Hindu religion – or Sanātana Dharma, the Eternal Truth – is that the Supreme Being is the underlying power of unity, pervading all creation. The nature hymns of the *Rig Veda* (1.115, 7.99 and 10.125) show a clear appreciation of the natural world and its ecology, the balance and beauty of the universe, the importance of the environment and the management of natural resources are repeated time and again in Vedic and post-Vedic literature. It is this all-pervading nature that is illustrated in the story of Prahlada. When his father, the demon Hiranyakashipu, kicks the pillar demanding to see God, Vishnu emerges from

the insignificant object, combining within Himself the forces of human and animal life, in fact creation, preservation and destruction themselves.

Nature is celebrated as the source and sustainers of life, for it is the creation and manifestation of the Supreme Being [“The Father of all creatures made the sky. From sky he made water, and from water he made fire and air. From fire and air, the earth came into existence. Mountains are His bones, earth is His flesh, sea in His blood, and sky is His abdomen. The sun and moon are His eyes. The upper part of the sky is His head, the earth is His feet, and the directions are His hands. (*Mahābhārata, Mokshadharmaparva*, 182.14-19)]. The *Bhagavad Gīta* (13.13) says “He resides everywhere”. “Ether, air, fire, water, earth, planets, all creatures, directions, trees, plants, rivers and seas, they are all organs of God’s body; remembering this, a devotee respects all species” (*Śrīmad Bhagavata Mahāpurāna* - 2.2.41). All life emerges from the Supreme Being:

“From Him too are the Shining Ones produced manifold,  
The celestials, men, cattle, birds...” (*Mundakopanishad*, 2.1.7).

The *Prithivī sūkta* (Book 12) of the *Atharva Veda* devotes 63 stanzas in praise of the earth and nature, human dependence on the earth and the respect that should be given to her.

- Earth is the abode of a family of all beings – *vasudaiva kutumbakam*: “O Mother Earth. Sacred are thy hills, snowy mountains and deep forests. Be kind to us and bestow upon us happiness. May you be fertile, arable and nourished of all. May you continue supporting all people and nations. May you protect us from your anger (natural disasters). And may no one exploit and subjugate your children” (12.1.11).
- Environmental sustenance, agriculture, biodiversity, water, air and soil are important to all beings. The earth’s attributes are for everybody and no single group or nation has special authority over it. Therefore people on this planet should strive for the welfare of all and hatred towards none (12.1.18).
- The natural legacy of the earth must be sustained for all time (“O, Mother Earth,” says the *Veda*, “May we possess the intellect and wisdom which enable us to speak in concord with heavenly beings, may we continue to enjoy your blessing of hidden riches, glory and realization of material and spiritual well-being” - 12.1.23-25).
- It is up to us, the children of the land, to live in peace and harmony: “O Mother Earth, You are the world for us and we are your children. Let us speak in one accord, let us come together so that we live in peace and harmony, and let us be cordial and gracious in our relationship with other human beings” (12.1.16).

## CULTURAL ASPECTS OF ENVIRONMENT MANAGEMENT

The basis of Indian culture is Dharma or righteousness, incorporating duty, cosmic law and justice. It is *sanātana*, or eternal, and supports the whole universe. Every person must act for the general welfare of the earth, all humanity and all aspects of the earth. *Prakriti*, cosmic matter, is central to all creation. The five elements that

constitute *prakriti* are earth, air, fire, water and space (*prithivī, vāyu, agni, āpa and ākāsha*). The world, and everything in it, is made up of these five elements, and their proper balance and harmony are essential for the well-being of man and matter. “Dharma exists for the general welfare of all living beings; hence, that by which the welfare of all living creatures is sustained, that for sure is Dharma” (*Mahābhārata, Shānti parva*, 109.10). Duty towards humanity and god’s creation is an integral part of dharmic ecology in Hinduism.

Dharma is a set of duties that holds the social and moral fabric together by maintaining order in society and creating an atmosphere of harmony and understanding in our relationships with all of creation. Moral action includes ecologically correct action. Right action, or dharmic action, has beneficial results, while adharmic action results in negativity. Therefore one should ensure that one’s karma or action is good.

### **Pollution**

Pollution or *pradūshana* of any sort is abhorred: it is a punishable offence [“Punishment...should be awarded to those who throw dust and muddy water on the roads...A person who throws inside the city the carcass of animals...must be punished” (Kautilya, *Arthashastra*, 2.145)]. Environmental pollution (*vikriti*) was identified several millennia ago. From pollution two types of diseases occur in human beings. The first is related to the body and the other to the mind, and both are inter-related. Cool, warm and air are the three virtues of the body. When they are balanced in the body it is free from disease” (*Mahabharata, Rajadharmanushasana parva*, 16.811).

The great medical scientist Charaka was prescient when he said, “Due to pollution of weather, several types of diseases will come up and they will ruin the country. Therefore, collect the medicinal plants before the beginning of terrible diseases and change in the nature of the earth” (*Charaka Samhitā, Vimānasthānam*, 3.2).

### **Water**

Water is sacred because all life depends on it: it is a medium of purification and a source of energy. “The waters in the sky (rain), the water of rivers, and water in the well whose source is the ocean, may all these sacred waters protect me” (*Rig Veda*, 7.49.2).

The rivers are regarded as Goddesses, and a dip in the sacred waters destroys one’s sins. Interestingly, the river waters also contain medicinal properties that cure several ailments. Thus river banks and their source in mountains were once the abode of ancient rishis. The sacred texts condemn activities which are detrimental to the quality of the environment. The rivers, especially, are taboo for any degrading or despoiling activities (*Charaka Samhitā, Sutrasthanam*, 27. 213-215; *Manusmriti*, 4.56).

### **Animals**

Among the most important aspects of Indian tradition is karma and rebirth, associating all species with birth, death and rebirth. The Supreme Being Himself is incarnated in several forms: “This form is the source and indestructible seed of multifarious incarnations within the universe, And from the particle and portion of

this form, different living entities, like demi-gods, animals, human beings and others are created” (*Śrimad Bhāgavatam*, 1.3:5).

Among the various incarnations of Lord Vishnu, the Preserver, the first four - fish, tortoise, boar and man-lion – are animals, and clearly indicate a knowledge of evolution. As Rama he was closely associated with monkeys and as Krishna with cows. As the Buddha, he was against all forms of killing animals. Several Hindu deities have animals as their vehicles, while some like the elephant-headed Ganesha are divine in themselves.

People are advised to treat all species alike:

“One should look upon deer, camels, monkeys, donkey, reptiles, birds and flies as though they were one’s own children; What is that which distinguishes these from those” (*Śrimad Bhagavatam*, 7.14.9).

India’s greatest contribution to world thought is the concept of ahimsa or non-violence. Killing animals has been prohibited since the Vedas:

“No person should kill animals who are helpful to all; By serving them one should obtain heaven.” (*Yajur Veda*, 13.47).

Ahimsa is non-violence in thought, words and action. All creation is sacred, and no harm may be inflicted on another species. The concept of ahimsa first appears in the Upanishads. All life forms, human or non-human, are of equal value and have the same rights of existence. “He who injures innocent beings with a desire to give himself pleasure never finds happiness neither in life nor in death” (*Manusmriti*, 5.45), (*Śrimad Bhāgavatam*, 1.7.38). In the sixth century BCE, this idea was taken to the people in the common language by two great preachers: Mahavira, the Jain, and the Buddha.

“Those who are wise and humble treat equally the Brahmin, cow, elephant, dog and dog-eater” (*Bhagavad Gīta*, 5.19).

“Born of Thee, on Thee move mortal creatures,  
Thou bearest them – the biped and the quadruped;  
Therewith, O Earth, are the races of men, for whom  
The sun, as he rises, spreads his rays,  
The light that is immortal” (*Atharva Veda*, 12.1.15)

Rishi Markhandeya says in the *Mahābhārata* that “all creatures act according to the laws of their specific species as laid down by the creator. Therefore, none should act unrighteously (*adharma*) thinking, it I who is powerful.” (*Mahābhārata*, *Vana parva*, 25.16).

Ahimsa is equally applicable in our treatment of the environment.

## Trees

Tree worship is an ancient and national phenomenon in India. It is probably the oldest form of worship. The sanctity of the sacred tree is attributed to either the place or the temple. The association of a single tree with a sacred *sthala* or *sthan* is reflected in the *vriksha chaitya* and *sthala vriksha* of literature and society. The

trees that were sanctified reveal the socio-economic-health concerns of ancient peoples. Some trees were sanctified for their economic role, some for their produce, some for providing homes for animals and birds, and others for their medicinal and air-purifying qualities. For example, the sacred tree of Mylapore in Chennai is the Alexandrian laurel which was used to build catamarans and the ships which traded with South-east Asia. The most sacred tree is the pipal which is revered first on the Indus-Sarasvati seals. Later, the Buddha received enlightenment beneath it while Siva, as Dakshinamurti, sits beneath it. The worship of each sacred tree – over 80 of them - reveal the people's knowledge of their environment and its protection. The reverence for the sacred tree pervades all religions. For example, we have found that the *Ber* (Indian jujube) is the sacred tree in *gurdwaras* because Guru Nanak received his enlightenment beneath it. Similarly, the Night Jasmine is a popular tree in many Sufi dargahs. Even today, Muslims in India, Pakistan and Afghanistan tie strings and cradles on trees as prayers for progeny, not unlike similar strings and cradles that we see in the *sthala vrikshas* of our temples.

### Forests and Sacred Groves

In the Indian tradition, forests were the abode of sages and had to be preserved. In fact, much of Vedic literature was written in forests and an entire genre – the *Āranyakas* – are named after the forests. Sacred groves within forests are dedicated to the local deity, or Mother Earth, and visited by the faithful during annual festivals. The awe-inspiring mountains are the abodes of the Gods and attract pilgrims in search of *moksha* - Liberation (of the soul). Every aspect of the environment is sacred, forests and groves, trees and plants, animals, rivers, water bodies, mountains, gardens, towns and precincts and seeds. They are still preserved and venerated all over India. Every village has a sacred grove presided over by a local deity; every temple has a sacred garden of flowers and herbs; several trees are venerated as sacred; rivers and lakes are sacred; mountains are the dwelling place of the gods; and entire towns are regarded as sacred. There is a sound ecological reason behind the selection of each (More information available in [www.cpreecenvis.nic.in](http://www.cpreecenvis.nic.in)).

Where sacred groves have shrunk, a sacred tree is left to commemorate the lost forest. Sacred trees form an important part of the ecological heritage of India. Every temple and most towns and villages are associated with a tree, some sacred to the deity, others sacred to the place. Often, towns and cities are even named after the sacred tree for example *Thillai* (mangrove), *Tirunellikka* (gooseberry), *Tiruvalangadu* (banyan), *Mangkadu* (mango), *Tirupanaiyur* (palm), *Tiruvidaimaruthur* (arjun), *Jambukeswaram* (black plum), and so on.

The most important cultural heritage that has protected the environment in India has been the reverence for sacred groves, dedicated to local deities and/or ancestral spirits. Thousands of these groves have been documented as storehouses of remarkable biodiversity, repositories of unique and rare plants and home to myriad birds, reptiles and other animal species. Sacred groves probably represent the single most important ecological tradition of ancient Indian culture. Sacred groves in India may belong to village communities, state forest and revenue departments, temples, communities such as tribals and gram panchayats and even private individuals, like



the *kāvus* of Kerala. However, many are sacred forests, either part of a larger forest or an exclusive whole.

Sacred groves are remnant forest patches preserved in the name of tradition or culture as observed in various societies across the world. A diverse range of ecosystems is preserved in the form of the sacred grove conservation tradition, along with its regional and local identities as represented in name, practices and management. Sacred groves probably date back to Palaeolithic times, to pre-agricultural hunter-gatherer societies that lived in forests (Gadgil and Vartak, 1973). In our times, an undisturbed patch of vegetation left in the outskirts of the villages in the plain or a part of forested area dedicated to the local folk deities or ancestral spirits that are protected by the local people through social traditions and taboos' incorporating spiritual and ecological values is called a sacred grove (Kosambi, 1962).

Sacred groves may be distinguished from the worship of certain 'keystone' plant and animal species that are both ecologically and socially significant. Sacred groves are the property of the gods of the villages in which they are situated, and the trees ought not to be cut without having approval from the headman of the village, whose office is hereditary, and who is also the priest (*pujari*) of the temple of the village deity (Malhotra et.al., 2001). All forms of vegetation in the sacred groves are supposed to be under the protection of the reigning deity of that grove, and the removal of even a small twig is taboo (Ramakrishnan et.al., 1998). The taboos, rituals and beliefs associated with the groves, supported by mystic folklore, have been the prime motivating factors for preserving the sacred groves in a pristine condition. People believe that any damage to the grove, to the fauna residing in it or felling of any tree may invite the wrath of the local deity, causing diseases and failure of agricultural crops. Even taking a dry twig is forbidden. Therefore, many people will not even take dead wood out of the sacred groves.

Sacred groves are a part of local folklore and religion. Every Indian village has – or had – a grove, a protected area associated with local folk deities of obscure origin. Sacred groves now play a vital role in the conservation and preservation of species diversity and local biodiversity. Sacred groves are the last remnants of the native vegetation of each particular region. They probably indicate the heroic efforts made by local communities to protect and preserve their natural forest tracts against the onslaught of the clearing of forests for cultivation and settlement.

Wherever sacred groves have existed in India, indigenous traditional societies have spiritual relationships with the physical environment that sustained them.

Sacred groves are the home of the local flora and fauna and represent a mini-biosphere reserve, making them an essential part of the conservation process. Due to local belief systems, human interference in the sacred groves has been restricted and thereby there is reduction of harvesting of natural resources. The consequence of such restriction has been that the groves have evolved as important reservoirs of biological diversity. Many sacred groves constitute pristine vegetation and are particularly rich in climax vegetation and associate groups of organisms, like flora and fauna. A number of studies have emphasized that many sacred groves are climax forests, and probably are the only remnant of near-natural vegetation in many parts

of India. Such islands of climax vegetation, amidst a degraded landscape can be seen in many parts of India (Tiwari et.al., 1998).

Sacred groves serve as a seed source (through dispersal by birds) through which ecological restoration can be achieved. For example, the sacred groves of Manipur contain ecologically valuable species like *Albizia lebbek* and *Ficus glomerata*, which conserve a high amount of minerals in their leaves. Sacred groves are an important refuge for rare, endangered and threatened medicinal plants. For example, *Kunstleria keralensis*, a climbing legume reported from a sacred grove in southern Kerala, is found only in that grove. A rare species of cinnamon, *Cinnamomum quilonensis*, is found only in some of the *kavus* (sacred groves) of Alapuzha district in Kerala (Unnikrishnan, 1995). A new species of frog, *Philautus sanctisilvaticus*, has recently been reported from the Amarkantak sacred grove, Madhya Pradesh (Das and Chanda, 1997). Many animal species, including birds that are otherwise threatened or becoming rare, find a safe refuge in many a sacred grove. The *orans* in Rajasthan, managed by the Bishnoi community, provide protection to the *khejri* or acacia tree, Indian gazelle, blackbuck and migratory Demoiselle crane. The *khejari* (*Prosopis cineraria*) species found in the *orans* of Rajasthan are linked with species diversity of the *orans* and religious value of the local community. Ficus, a keystone species in the conservation of many birds, bees, honeybees, insects and mammals, is also common in many groves (Terborgh 1986). Over 500 Indian flying foxes roost in a huge banyan tree in Puliangulam in Madurai Keelarajakularaman and Sri Vaikundam in Tamilnadu (Marimuthu, 1988).

The importance of sacred groves in nature conservation has been increased manifold in recent time especially after the declaration of the Convention on Biological Diversity (CBD). Community based conservation initiatives are one of the prime agendas for CBD for which the sacred grove tradition can be a role model. The importance of forests in socio-ecological life as well as livelihood security has been recognized by indigenous communities from time immemorial, who designated them as sacred forests or groves, protected by local customs, folk lore and social and religious taboos. However, the gap between traditional knowledge and scientific understanding of the environmental and ecological importance of the groves still remains wide (Rajasri et.al., 2010).

Sacred groves are also associated with perennial water bodies like streams, ponds, lakes, wells, etc. and serve as a valuable resource of water supply in the dry season. One of the important ecological roles of these groves is to provide a dependable source of water for the organisms living in and around the groves (Pushpangadan et.al., 1998). In addition, transpiration from the sacred groves increases atmospheric humidity and reduces the temperature in the immediate vicinity, producing a more favourable microclimate for many organisms. Surface water runoff is reduced to a greater extent by adopting suitable soil and water conservation measures and tree planting activities. Soil erosion is prevented because of the trees' capacity to retain water and bind the soil. The soil itself has few nutrients to support the large biomass of the grove, and the root system developed on the surface layers is important

for supporting the biomass and for cycling of nutrients. Many microorganisms, invertebrates, fungi, and a vast array of species also live on these root systems (Khiewtam and Ramakrishnan, 1989)

The 20th century has seen tremendous pressures on natural resources. Today, the fundamental concept of sacred groves - traditional belief systems – is regarded as superstition. Only a few people of the older generation know the taboos related to sacred groves. Traditional rituals are still performed in accordance with local beliefs in the larger groves, but exist no longer in the smaller ones. The erection of temples, developmental activities such as highways, roads, power lines or reclaiming of land for agriculture have also taken their toll on many sacred groves. Many have been destroyed by big dams. The groves have been urbanized by the local communities and various government departments, as well as by migrants. Many sacred groves have been destroyed by commercial forestry operations. As a result, the violation of cultural norms and taboos no longer carries heavy consequences, and the sacred groves are degraded or destroyed. Human activities such as dead wood collection, biomass gathering, lopping of tender branches and green leaves for goats, creation of footpaths, cattle grazing, mining of sand and clay, brick-making and collection of wild fruits, vegetables and collection of plant parts for medicine affect the ecology of the sacred groves. In addition, invasion of exotic weeds is a serious problem in the ecology of some sacred groves.

Sacred groves are a part of India's cultural and ecological heritage must be preserved for posterity. Sacred groves contain a wealth of natural resources and serve as a source of survival for local communities. Local people have conserved sacred groves out of religious sentiment. Man and nature have co-existed without disturbing the environment in the past. Traditional practices must be strengthened with appropriate scientific inputs for conservation. They are not protected by the Forest Act (unless they are situated within a forest) or any other law. Their chances of survival look bleak. The only hope is that those traditional communities who have protected them over millennia will continue to protect them.

## **CONCLUSION**

There is a strong symbiotic relationship between the biophysical ecosystem and socio-economic institutions, with strong cultural relations binding them. Culture and environment have been regarded as complementary, yet dynamic. The various cultural connections are expressed through myths and religious practices that celebrate plants and animals, forests, rivers, mountains and precincts that are so essential for existence. The concept of the sacred in nature has protected much of India's biological diversity in a fast-changing world. India has a long tradition of conserving nature by giving it a spiritual dimension.

The C P R Environmental Education Centre (CPREEC) has over the last 20 years documented the Ecological Heritage of India: Sacred Animals; Sacred Gardens; Sacred Groves; Sacred Mountains; Sacred Rivers; Sacred Water bodies; Sacred Plants; and Sacred Sites. Now we have added one more – Sacred Seeds. We are also trying to document the cultural practices by which the various aspects of the environment were protected by the common people and supported by religious traditions.

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## ***Special Addresses***



# Culture, Heritage and Biodiversity Register

**Dr. K P Laladhas, N Preetha and Dr. Oommen V Oommen**

*Kerala State Biodiversity Board, Pallimukku, Thiruvananthapuram-695024*

## INTRODUCTION

India is a country rich in tradition of culture with several unique and diverse cultural landscapes such as sacred groves, forests, rivers, mountains and water bodies. The interrelationship of humans with nature has been described from several traditional societies and landscapes all over the world (Boojh and Ramakrishnan, 1983). Human interaction with nature over prolonged time has resulted in the evolution of the landscape to the present form. The maintenance of cultural diversity and their knowledge increases the capacity of human beings to adapt to change ( Maffi 1998). Different cultures interact with nature in different ways and forge different relationships with them. A cultural landscape is the combined work of nature and humankind, expressed by a long and intimate relationship between people and their natural environment (Pannell, 2006). It is the heritage of many eras of natural evolution and of many generations of human effort (Fowler, 1999). Cultural heritage includes

- 1) tangible culture (buildings, monuments, landscapes, books, works of art and artifacts),
- 2) intangible culture (folklore, traditions, language, and knowledge)
- 3) natural heritage (culturally-significant landscapes, and biodiversity)

Cultural diversity guarantees sustainability because it binds universal developmental goals to plausible and specific moral visions. Biological diversity provides an enabling environment for it ( UNESCO, UNEP, 2002). The key issue here is that change has to come from within rather than imposed from outside (Ramakrishnan et al 2004). Being dependent upon nature around them not only for deriving intangible benefits, but tangible benefits that impinge upon their livelihood needs, traditional societies always had a sense of collective rather than individual ownership of natural resources around them. Such a value system has in the past ensured sustainable management of natural resources, ( Ramakrishnan, 2012).

## **INTERNATIONAL INITIATIVES FOR CONSERVING CULTURE AND HERITAGE**

The interactions between people and the natural environment have been recognized as cultural landscapes since 1992. They demonstrate the relationship between people, nature and ecosystem, which shapes culture. The UNESCO World Heritage Convention, 1972 works for conserving cultural and natural heritage of outstanding universal value. Although, every landscape is associated with some inherent cultural value, one which has an outstanding universal value in terms of the interaction between people and their environment is recognized as “World Heritage Cultural Landscapes.” The protection of traditional cultural landscapes is therefore helpful in maintaining biological diversity. The UNESCO World Heritage Convention defines intangible cultural heritage as: ‘the practices, representations, expressions, knowledge, skills that communities, groups and, in some cases, individuals recognize as part of their cultural heritage. (whc.unesco.org)

UNESCO’s World Heritage Convention recognizes three categories of cultural landscapes,

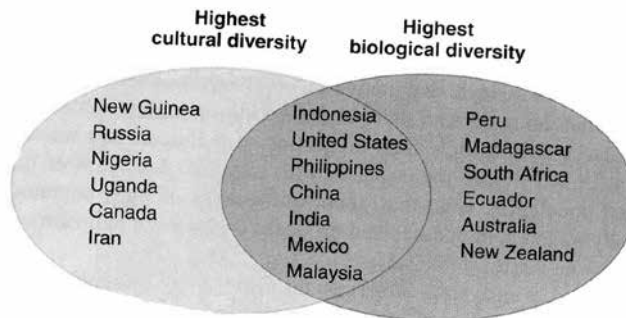
- (i) ‘clearly defined landscapes’, designed and created intentionally by humans, such as garden and parklands;
- (ii) ‘organically evolved landscapes’
- (iii) ‘associative landscapes’, by virtue of religious, artistic or cultural associations.

UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage provides legal safeguard to practices, representations, expressions, knowledge and skills that communities, groups and, in some cases, individuals recognize as part of their cultural heritage. This includes oral traditions and expressions, performing arts, social practices, rituals, festive events, knowledge and practice about nature and the universe, and traditional craftsmanship. The recognition of cultural landscapes on World Heritage list provides an incentive for identification of sites for inclusion under the world heritage status. This has contributed positively to the conservation and management of cultural landscapes through appropriate recognition and protection at the international level.

## **CULTURE, HERITAGE AND BIOLOGICAL DIVERSITY**

Cultural landscapes form the basis for biodiversity conservation and promote sustainable development of these landscapes. Cultural diversity, due to its intricate linkage with biological diversity promotes sustainable management of natural resources. Thus there is a significant overlap between the world’s areas of high biological richness and areas of high cultural diversity. The rich cultural diversity of India comprises of multitude of religions, castes and creeds. There are about 68 million people belonging to 227 ethnic groups and 573 tribal communities derived from six racial stocks in the country. In India 30 sites are recognized as world heritage sites. In 2012, the UNESCO World Heritage Committee declared specified areas comprising 39 serial sites of the Western Ghats as World Heritage sites of outstanding universal value. Western Ghats is unique as one of the eight hottest hotspots of Biodiversity as 54% of tree species; 65% of amphibian species; 62% of

reptile species and 53% of fish species are endemic. The nominated sites include 39 hotspots, including 14 important bird areas and 3 Alliance for Zero Extinction sites and a number of forest reserve areas of high conservation value with Kerala having 19 sites. Interestingly the Western Ghats could be considered as hot spots for ethnic diversity also, who have shared the landscape with biological diversity sustainably.



### KERALA- THE LAND OF CULTURE AND HERITAGE

In Kerala, ritualistic festivals begin from the Malayalam month of Vrihchikam continue through the harvest seasons until the pre- monsoon showers. Colours used are natural products: burnt husk of paddy - black colour, powdered turmeric - yellow and powdered leaves and *mylanchi* (henna) for green. These hues are mixed to obtain more combinations. The outline is drawn with powdered rice, to get white colour.

A range of cultural celebrations and festivals spread all the year round is indicative of the rich cultural heritage of Kerala. Each locality is replete with their own myths and legends most of which are associated with nature. These communal-centric concerns towards natural resources around are reinforced through myths, rituals and ceremonies. Most of these are expressed and perpetuated through folk dance, music and arts. It is through indigenous knowledge, communicated through local dialects, that this link between cultural diversity and biological diversity is maintained. Indigenous people have developed lifestyles and cultures which are tied to nature. Cultural and traditional values prevent overexploitation of resources and sustain the systems for future generations. Symbiotic relationship between habitats and cultures, is shown in taboo in cutting trees in sacred groves. Many of these sacred natural sites have survived for generations . Folklores such as folk tales, folk songs, folk arts as sculpture, pottery play an important role in knowledge transfer. But so far there has been very limited concerted effort to document the cultural heritage and landscapes and their biodiversity link at LSG level and the Peoples Biodiversity register being developed by Kerala State Biodiversity Board is a step in this direction.

### CULTURE AND NATURAL HERITAGE IN PEOPLES BIODIVERSITY REGISTER

The major mandate of National Biodiversity Authority is documentation of knowledge of the local people on the status, uses and management of biological resources in the PBRs and also the cultural heritage of the area. PBR envisages the creation of



database of biological resources, cultural heritage of locality and local knowledge on uses of resources. The Bio-diversity Management Committees (at local level) are entrusted with the documentation of bio-diversity .

**Table 1**  
**Diversity of Traditional Knowledge in PBR**

<b>Cultural diversity</b>	<b>Folklores</b>	<b>Areas of cultural significance</b>
Sacred groves	Fumigants/ Chewing plants	Weeds
Agricultural crops	Wild plants	Wild animals
Medicinal plants	Wild water plants	Wild aquatic animals
Timber	Pests of crops	Fishes
Wild relatives of culti- vars	Landscape	Soil
Fodder crops	Ornamental plants	Domesticated Animals

The key issues related to Culture and Heritage which PBR addresses are:

- What is Cultural heritage (Myths and Legends) associated with the locality?
- Link between Cultural Heritage and Biodiversity?
- Why conserve it?
- Who owns the traditional knowledge?
- How to conserve it?
- Threats to cultural and biological diversity?

### **Components of PBR**

The PBR gives account of areas having natural vegetation of cultural significance in the locality, such as sacred groves, water bodies etc. and similar areas associated with cultural and religious beliefs, knowledge and practices concerning nature and traditional medicine. The major mandate of PBR is documentation of biodiversity and associated knowledge, ways to accrue benefits to community, quantification and sustainable management of resources. Traditional knowledge and local ecological knowledge accumulated within a society and transferred through cultural modes of transmission, such as folklores and riddles are also mentioned in PBR. Expressions of traditional culture such as local festivals and mythology, folklores and riddles connected with harvesting and agriculture, local arts and crafts, sacred groves, cultural diversity, local viads and primary health care, age old systems of biodiversity conservation, local land races, agro diversity, and native breeds of animals, traditional knowledge holders of locality are some of the components of PBR.

The intangible cultural heritage is manifested in the following 5 domains as elucidated by UNESCO

- (a) oral traditions and expressions;
- (b) performing arts;
- (c) social practices, rituals and festive events;

- (d) knowledge and practices concerning nature and the universe;
- (e) traditional craftsmanship.

All these manifestations of cultural heritage find expression in PBR in one way or another.

### ***Sacred groves***

Sacredness is viewing nature and natural resources around, obviously with attached 'intangible' psychological values; very often these values being converted into 'tangible' benefits that enable natural resources to be managed in a sustainable manner (Ramakrishnan, 2001; Ramakrishnan et al., 2004). Sacred groves (Kavu or Sarpakavu) are green spots, rich in a variety of flora and fauna. Home to many rare and unique plants and trees of Kerala, these sacred groves are self sustaining mini ecosystems. Sacred grove represents the effort to recognize and conserve biodiversity traditionally which has been chronicled in PBR. The age old system of every village having a temple, a tank and associated sacred grove where people were prohibited from felling trees and even removing a twig shows the value attached to natural resources by local people in sharp contrast to the unsustainable mode of lifestyle of urban people. Snake worship is carried out by many communities. The canopy (pandal) where the serpent dance takes place is adorned with palm leaves, lotus, banyan leaf, betel leaf, ripe arecanut and branches of coconut flowers. A serpent *kavu* or abode of snakes was an indispensable adjunct to each well-to-do family of Kerala (Chandran and Gadgil, 1993). The serpent worship is an important feature of SGs in the State.

Declaration of Biodiversity Heritage Sites (BHS) is the mandate of State biodiversity Boards. Under Section 37 of Biological Diversity Act, 2002 (BDA) the State Government in consultation with local bodies may notify in the official gazette, areas of biodiversity importance as Biodiversity Heritage Sites. The BHSs are endowed with richness of wild as well as domesticated species or intra-specific categories, high endemism, presence of rare and threatened species, keystone species, species of evolutionary significance, wild relatives / ancestors of domestic / cultivated species or their varieties. These areas are also represented by fossil beds and have significant cultural, ethical or aesthetic values. As a preliminary step towards the identification of BHS, KSBB investigated ideal biodiversity rich sites for the declaration and five sites came into the consideration of the Board. Kalasamala, a sacred grove located in Thrissur district harbors critically endangered plant, *Syzigium travancoricum* is one among the five sites identified by the Board. Cultural landscapes linking nature and culture determine the local identity as well as cultural identity of the area. They can become an effective tool to conserve biodiversity as they are embedded in local traditions and belief systems

### ***Ethnic diversity***

The Western Ghats could be considered as hot spots for ethnic diversity. Majority of them inhabit the western slope of the Western Ghats (1) the Koraga (Kasaragode) ; Cholanaickan (Nilambur, Malappuram); Kurumbar (Attappady, Palakkad); Kadar of erstwhile Cochin area; Kattunayakan (Wayanad, Malappuram).

### ***Myths and Legends***

Local myths and legends, practices, religious customs, festivals, legends, oral traditions, arts, traditional craftsmanship, social practices find mention in PBR. Thus PBR from Tirunelli describes important festivals among some communities as Thira. The festival is celebrated in the paddy field and shows the link with paddy in Wayand. After fasting for a long period they put the dress for Thira and there is a belief that if the fast is broken some disaster will occur. Thira is celebrated to solve all the problems of the locality. It is believed that by doing so all disasters are removed and life will become happy.

The worship of Mariyamma Devi by Adiya Community who has migrated from Kudugu and Naduneekkal a ritual to bring prosperity are other customs prevalent in Wayanad. Members of Kattunaikkar community also known as Thenkurumar collect forest resources as honey and stay in the forests and are worshippers of Vishnu known as Perumashi. The digitalization process of PBR which is underway is expected to provide more such insight in a readily available format to hitherto unknown legends of different locality.

### **Bio cultural Heritage in PBR**

The agriculture calendar is linked with socio-cultural festivals and ceremonies. Agricultural, soil, land preparation, sowing and planting of propagules, manuring, irrigation, intercultural operation, intercropping and harvesting etc form main themes in the folk-poems mentioned in PBR. There are many folklores relating to importance of quality seeds in agriculture, use of organic manure time and method of sowing and planting, soil and land preparation, the quality of local land races etc in PBR. Farmers conserve several domestic plant species and varieties adapted to diverse environmental conditions and cultural needs. The tribal people of Wayanad still follow the traditional system of cultivation and cultivate several traditional varieties of rice based on soil composition, soil texture and water availability. A wide range of local landraces and farmers varieties of rice are available showing variability for different characters such as duration (long, medium and short), grain size (big, medium and slender), season (Nancha and Puncha cultivation), landscape (lowland, upland and Marshy land). Based on duration Njavara, Thonnuram thondi, Urunkaima are the popular drought resistant and short duration varieties of rice while Mullan puncha is flood tolerant and of long duration. The local community's have practised their own techniques for varietal selection and suggests that for Thaichool cultivation for the next season, seed source has to be changed otherwise yield is less. Regarding agricultural practises they practise cultivation of Thaichondan vella rice by sowing at wider intervals as it grows luxuriantly. They have developed their own system of usage of food products and use Vella Puncha rice for making snacks while Vella kuruva is good and tasty for rice. Cultural landscapes can provide the basis for the crops with greater resilience to adverse climatic conditions and the PBR throws light on the local land races and wild relatives of agricultural crops of Kerala.

## **IDENTIFIED THREATS TO CULTURAL AND BIOLOGICAL DIVERSITY**

The major threats to cultural diversity and biological diversity includes rejection of traditions by younger generations, lack of respect for indigenous knowledge, migration and urbanization, Cultural and biological diversity face common threats due to globalization, loss of habitats, degradation of fresh water habitats and wetlands, monocultures leading to dietary deficiency, loss of traditional knowledge, unauthorized commercial exploitation and challenges posed by new technologies. Traditional societies have used biological resources in a sustainable way and created a cultural landscape around them. Loss of cultural diversity is accompanied by loss of linguistic diversity, indigenous knowledge and ultimately biodiversity. The knowledge of indigenous peoples about the sustainable use of resources must be the foundation of environmental education.

Since indigenous people are often the custodians and stewards of biological diversity, the maintenance of cultural diversity is an important factor in the conservation of biological diversity. The challenge before the scientific community lies in being able to put meanings into, what may just seem to be mere belief systems, and link it with the decision-making process in the contemporary context of nature-culture linkages and interactions. ( Ramakrishnan, 2012). Folklores such as folk tales, folk songs, folk arts as sculpture, pottery play an important role in transfer of a dying knowledge to future generation. The project PBR as text book and Panchayat as Classroom initiated by KSBB in the schools of Kerala is a step in this direction. Further, the digitalization of PBR which is underway will also enable in compiling and interpreting the enormous amount of generated data.

## **CONCLUSION**

Cultural diversity is being eroded at an unprecedented rate and with it, traditional knowledge of how to use and conserve biodiversity. To safeguard the cultural and natural heritage and ensure respect for it is our responsibility. PBR serves to document the cultural and natural landscapes and heritage of locality and this is the first step towards formulating conservation plans. It aims to sensitize the public about the cultural legacy of Kerala. Such an exercise at local level will instill a sense of social responsibility towards preserving cultural and natural heritage. In short PBR serves to protect and conserve our living, built, and natural heritage by suggesting necessary actions and measures; encourage capacity building of indigenous community by training programs in protecting natural and cultural heritage; documents the diversity of domestic plant and animal varieties developed and conserved by various communities. PBR also seeks to identify those communities which have been making efforts for protection and conservation in respect of sacred groves, ponds, lakes, grasslands, wetlands, coastal and marine areas and watersheds. The local community has lived in harmony with nature and has sculptured the landscape around them, creating a vibrant cultural landscape around them following sustainable natural resource management practices. PBR exercises is an attempt to learn from the past, adapt the best practices available with them, and builds upon it for the future and understand the interrelationship between cultural heritage and biodiversity.

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# Guidelines for Scientific Water Management in Ancient India as Revealed from Kautilya's Arthashastra

**Joisea James and Dr. E J James\***

*\*Vice Chancellor, Karunya University, Coimbatore*

## INTRODUCTION

The Arthashastra is an ancient treatise on statecraft attributed to Kautilya (also known as Chanakya or Vishnugupta ), who was the mentor of Emperor Chandragupta Maurya of India (321-297 BC). It contains 15 *adhikaranas* or books (Shamasastri, 1967). Arthashastra maintains that the wealth of a nation is both the territory of a state and its inhabitants who may follow a variety of occupations, and the government has a crucial role to play in maintaining the material well being of the nation and its people (In Sanskrit, *Artha* means wealth or material well being and *sastra* means science or knowledge). As such, it can be considered a precursor to Machiavelli's 'The Prince'. The scope of Arthashastra is, however, far wider than statecraft, and it offers an outline of the entire legal and bureaucratic framework for administering a kingdom, with a wealth of descriptive cultural details on topics such as mineralogy, mining and metals, agriculture, animal husbandry and medicine. Of the 15 books, Book 2 describes the duties of various executive officers of the state and gives a full picture of state activities in agriculture, mining, leisure activities and so on. Although he wrote in a period of absolute rule by emperors, Kautilya also focuses on issues of welfare (for instance, redistribution of wealth during a famine) and the collective ethics that hold a society together.

An analysis of ancient Indian literature shows that it contains valuable references to hydrology. The important concepts of modern hydrology are found scattered in various verses of Vedas, Puranas, Meghmala, ancient Buddhist texts like Vrahat Sanhita and Mayurachitraka, Arthashastra and various other ancient Indian works.

In many parts of the world, the water management, and not water scarcity, was the problem. Water has been harvested in India since time immemorial. Evidence of irrigation with water harvesting systems and a regular class of officers to superintend the rivers, measure the land and inspect the sluices by which water was let out from the main canals, can be found in Kautilya's Arthashastra and this information finds corroboration in other ancient Indian texts, inscriptions, local traditions and archaeological remains. Since Kautilya viewed agriculture as an important source

of state revenue, he gave considerable importance to the management of water resources since agriculture mostly depended on water. Palaeobotanical research conducted in Rajasthan highlighted the huge variations in the rainfall pattern in ancient times. There was a sudden and steep rise in rainfall in the third millennium BC which reached its peak around 2500 BC. But by the end of the millennium, the rainfall had decreased as rapidly as it had increased and by about 1800 to 1500 BC it had come down considerably. The period around 400 BC was probably one of the driest periods of all (Kulke and Rothermund, 1986). This fact might have prompted Kautilya to resort to better and stringent water management practices to facilitate agriculture. He took care to collect the hydrological data in various places and plan the agricultural activities accordingly and we see in Arthashastra the instructions to install rain gauges, the methods of forecasting the rainfall and the wise use of water for agricultural purposes. Water resources were developed and structures to store water and water harvesting systems for irrigation were constructed. A well organised water pricing system was also prevalent. Various aspects of water law also find its reflections in the Arthashastra. An efficient administrative set up to manage all these was also advocated by Kautilya. Surprisingly, all these features of scientific water management we find in Arthashastra are in accordance with the principles of modern hydrology.

#### **BEGINNINGS OF HYDROLOGIC DATA COLLECTION**

The Arthashastra indicates that people knew about rainfall regimes, soil types and irrigation techniques in specific micro-ecological contexts. It classifies different parts of the country between the Himalayas and the ocean into various kinds of regions, like forest regions (*aranya*), village areas (*gramya*), mountainous areas (*parvata*), wet or humid areas (*audaka*), dry lands (*bhauma*), plains (*sama*) and uneven lands (*visawa*). The average annual rainfall in various parts of the country was also furnished by Kautilya. In regions where the cultivation is dependent entirely on rainfall, land is classified as suitable for dry crops if the rainfall is about 16 *dronas* (1 *drona* = 1.5 or 2 inches) a year and for wet crops if the rainfall is one and a half times of that, ie, about 37.5 inches a year. Among regions where canal irrigation is practised, Asmaka (Deccan) has a rainfall of 13.5 *dronas* and Avanti, 23 *dronas*. In Konkan and snowy regions rain is unlimited in all seasons. Arthashastra also says about the ideal distribution of the rainfall for a good crop; a good rainy season is one when one third of the annual rainfall occurs at the beginning (*Sravana*-July/August) and at the end of the season (*Kartika*-October/November) and two thirds in the middle (*Parushtapada*-August/September and *Asvayuja*-September/October). Kautilya gave importance to agricultural planning so as to manage excess or deficit rainfall. He says, "According to the rainfall (more or less) the superintendent of agriculture shall sow the seeds which require either more or less water". Arthashastra also give clues to forecast the rainfall like observing the position, movement and cloudiness of Jupiter, the rise, setting and movement of Venus and changes in the appearance of the Sun. It also states that even and beneficial rainfall is three clouds raining almost continuously for seven days, eighty clouds raining intermittently, and sixty clouds raining alternating with sunshine. A good harvest is certain with this kind of rainfall.

Kautilya's attention to detail is reflected by his instructions to install raingauges. He states, "In front of the storehouse, he (director of stores) should place a basin with a mouth of one *aratni* in width as a raingauge" (one *aratni* (cubit) = 18 inches = 45cm). It had a volume of 511 in<sup>3</sup> (8373cm<sup>3</sup>) and a surface area of 254.3 sq.inches(1640.64cm<sup>2</sup>) (Biswas, 1970). These were perhaps the first raingauges of the world (Shamasastri, 1967) and were known as *varshaman*. It had the same principle as that followed by modern hydrology except that weight measure of *drona*, *pala* etc were adopted instead of modern linear measurement of rainfall.

Varahamihira in Vrahat Sanhita describes a device which can also be considered as the forerunner of the raingauge and he gives details of measuring rainfall from it . In verse 2 of chapter 23, he states that constructing a circular bowl measuring one cubit, one should be able to tell the amount of rainfall (Vrahat Sanhita, 23.2). For the calculation of rainfall he adopts the weight measures of *pala*, *drona* and *adhaka* (1 *adhaka*=7 lbs. approximately, 4 *adhaka* = 1 *drona* = 200 *pala* ). For calculation, rainwater received in the bowl during the actual falling should be measured. The distribution of rainfall according to time is discussed in the verses 6-9. These verses specify the amount of rainfall in various lunar months. Parasara knew the contrivance of primitive raingauge and method of measuring the quantity of rainfall received. Panini in his Ashtadhyayi writes of rain equivalent to the depression created by the hoof of a cow, and rain equivalent to fill the furrow created by an indigenous plough. The former one was the measure of the lowest rainfall (NIH, 1990).

#### ADMINISTRATIVE MACHINERY

Kangle notes that "the kind of state control over the economy Arthasastra presupposes is not possible without an efficient administration. We, therefore, find in it a description of an elaborate administrative machinery" (Kangle, 1965). Book 2 of Arthasastra is titled *adhyakshaprachara*- 'Duties of Heads of Departments'. The Arthasastra states that the Chief Superintendent of Crown Lands shall be conversant with the science of cultivation, water management and the proper care of plants. It also lays down certain responsibilities to the Chief Superintendent. He should employ experts to cultivate the crown lands profitably and should supervise the seed collection, land preparation, seed preparation and sowing, putting manure and protection, harvesting and threshing. The Chief Superintendent shall be responsible for collecting the water cess from the farmers for the areas under his charge.

It was his duty to construct wells and water works where water is scarce. Kautilya says that he should build irrigation systems with natural water sources or with water brought from elsewhere. He should also help others who build these water works with land, roads, trees and implements and should also render help to build parks and holy places. An agreement to build irrigation works was an agreement for a joint undertaking. If one does not cooperate in the joint building of an irrigation work, he should help with his labourers and bullocks and should share the expenses but will not receive any benefit from it. There were guards for rivers and the revenue from river guards is termed '*nadipala*'. The government helped in the construction of irrigation works in a newly settled village. Poor people were evacuated from the banks of rivers as a precaution against floods. Persons carried away by floods were rescued using gourds, skin bags, tree trunks, canoes, boats and thick ropes.



## DEVELOPMENT OF WATER RESOURCES

The Arthashastra advocates that one of the primary ways of making land more valuable for agriculture was to make proper facilities for irrigation. Land provided with irrigation facilities was valued more than rain fed land. The state initiated and sponsored irrigation projects. Irrigation was widely practised in flower gardens, fruit orchards and vegetable gardens. Rainfed agricultural areas which received 16 *dronas* of annual rainfall were termed *jangala* (dry) and those with 24 *dronas* of rainfall, *anupa* (wet). The construction of embankments to collect rainwater was a popular irrigation device. Both natural resources like rivers, springs and lakes and manmade systems like tanks, reservoirs and wells were tapped for irrigation. Irrigation works were built both in dry areas and those with abundant water. Kautilya was confident that in dry areas the most practical way of getting water supply was to dig wells which had underground feeders. The term 'anudake kupasetubandhotsan sthapayet' in Arthashastra refer to the importance of wells as the mainstay of irrigation in the anudaka (dry) areas. Kautilya stipulates that there shall be a water well for every ten houses. Canals were dug from a reservoir or river for the purpose of irrigation. Both government and private irrigation works were there. The king was advised to build storage reservoirs and to keep them in good condition. The ownership of the fish, ducks and green vegetables in the irrigation works should go to the king. The most important natural resource, land, was primarily in the public sector, with the state holding all virgin land, forests and water resources. However, an embankment, a water tank or a reservoir associated with arable land could also be privately owned. The most important economic activity was agriculture and another, building of water works and reservoirs as the source of crops. Availability of water was important and it was better to acquire a smaller tract of land with flowing water than a larger drier one. It was necessary to build storage reservoirs because the water stored after a good rainfall could be made continuously available for irrigation. Dams built to store water from a flowing source such as a river are preferable to those built to store water brought by canals dug for that purpose. Among reservoirs built by damming rivers, the one which irrigates a larger area is better. It also says that a forest watered by a river is self-sustaining and provides shelter in times of calamities.

The village community had a major role to play in water management at that time. During the period of Chandragupta Maurya, dams, lakes and irrigation systems were constructed as seen from the historical records and archaeological findings. Officers were appointed specifically to take care of the river systems, ascertain the land area and to inspect the sluice gates of canals. Chandragupta Maurya constructed the famous lake-Sudarshan Lake- at the foot of Girnar mountains. Later, canals were executed during the time of his grandson, Ashoka the great. The dam collapsed due to a very heavy rainfall in 150 AD. The repair works were carried out during the reign of King Mahakshatrapa Rudradaman in 151 AD. Junagadh (Gujerat) inscription of 151 AD provides a complete history of the reservoir and its destruction due to cyclone. The dam after restoration again collapsed in 455 AD during King Skanda Gupta's period following which repairs were carried out. The Junagadh inscription confirms that water from the lake was used for irrigation through canals and people knew how to construct dams, lakes and irrigation systems even in the fourth century

BC (Agarwal and Narain, 1997). The inscription also mentions that the lake was created by *setubandana* or embankment across the river Palasini and Suvarnasikata and other streams. Kautilya also uses the term *setu* for embankments.

## **WATER LAW**

A study of Arthashastra clearly brings to light the rudiments of water law prevalent at that time. In a chapter dealing with legal aspects, Kautilya mentions about various aspects of water law. He states that waterworks such as reservoirs, embankments and tanks can be privately owned and the owner shall be free either to sell or mortgage them. If they had not been in use for a period of five years the ownership of tanks shall lapse, except in cases of distress. Anyone leasing, hiring, sharing or accepting a waterwork as a pledge with the right to use them, shall keep them in good condition. Owners may give water to others by dredging channels, or building similar structures, in return for a share of the produce cultivated in the fields. In the absence of the owner, either charitable individuals or the people of a village acting together, shall maintain water works.

An organised water pricing system which is an important part of water management was developed during the time of Kautilya, as evidenced by the following lines of Arthashastra, “those who cultivate irrigating by manual labour (*hastapravartimam*) shall pay one fifth of the produce as water cess; by carrying water on shoulders (*skandhapravartimam*), one fourth of the produce; by water lifts (*srotoyantpravartimam*), one third of the produce; and by raising water from rivers, lakes, tanks and wells (*nadisarasatatakupadhatam*), one third or one fourth of the produce (Shamasastri, 1967 ).

For building or improving irrigation facilities some exemptions from payment of water cess were granted. For new tanks and embankments five years exemption was given, and for renovating ruined or abandoned waterworks, four years exemption and for clearing waterworks overgrown with weeds, three years exemption. The Arthashastra further advocates that no one irrigating his field from a reservoir or tank shall cause danger to the ploughed or sown field of another. The water from a lower tank shall not submerge a field fed from a higher tank built earlier. A higher tank shall not prevent the filling up of a lower tank, except when the latter has not been in use for three years. No one shall let water out of dams out of turn and no one shall obstruct the use of water by others through negligence. No one shall obstruct a customary water course in use or make a customary water course unusable by diverting the water. No one shall build a dam or a well on land belonging to someone else, or sell or mortgage, directly or indirectly, a bund or embankment built and long used as a charitable public undertaking except when it is in ruins or has been abandoned. When Kautilya elaborates on punishments, he states: “in case of damage to the ploughing or seeds in another’s field by the use of reservoir channels or a field under water, they shall pay compensation in accordance with the damage. In case of damage to gardens, parks and embankments, the fine shall be double the damage. If a higher tank prevents the filling up of a lower one, in use for at least three years, the punishment shall be the lowest fine for violence and the emptying of the higher tank. For failure to maintain an irrigation facility the fine will be double

the loss caused by the failure. The Arthashastra also elaborates on the details of the fine one has to pay as compensation. For one letting out water from the dams out of turn, the fine shall be six *panas*, and the same for one obstructing the flow of water of others when it is their right. If a person himself or through others mortgages or sells a charitable and existing water work, the moderate fine for violence shall be imposed, the highest on witnesses for not preventing it, except when it is in ruins and abandoned. If one breaks a dam full of water, the punishment shall be drowning in the same place. If the dam is without water, the highest fine will be imposed and if the dam is abandoned or in ruins, moderate fine.

The Arthashastra also calls for some regulations to be followed in the construction of houses. If the house has no adequate rain water drainage, he should pay a fine of 12 *panas*, and if the house causes damage to the well of another house by letting water collect without proper drainage the fine will be same. A fine of 54 *panas* is to be imposed if the house has a fresh water course too near a neighbour's house. Kautilya also focuses on hygiene; he says that if one uses a water reservoir as a urinal, he should pay a fine of one *pana* and if he uses it as a latrine, a fine of two *panas* (Rangarajan, 1992 ). Kautilya observes that the roads on reservoir embankments shall be 27 feet wide.

## CONCLUSIONS

Kautilya in his Arthashastra gave considerable importance to water management , since irrigated agriculture was one of the main sources of revenue to the state. A critical study of Arthashastra brings to light the water law, water pricing and responsibilities of the Irrigation Department prevailing at that time in India. The treatise also gives a vivid picture of the water management practices of ancient India.

It is evident from this work that the people of ancient India have been familiar with the rainfall distribution, soil classification and appropriate irrigation practices for different agro-climatic regions. The rainfall data for certain locations of the empire are furnished and depending on the rainfall, the empire is divided into wet lands and dry lands. The earliest mention of a raingauge (*varshaman*) is found in this work. It gives the details and dimensions of the raingauge and the locations where it has to be installed. Certain principles have been prevalent at that time to classify the land according to land capability and land irrigability. Apart from the traditional sources, man-made structures like tanks, reservoirs and wells were used for irrigation. One of Chandragupta Maurya's notable achievements was the construction of a great irrigation lake called Sudarshan near Junagadh (Gujerat).

The Arthashastra brings out certain salient features of the water law of the period. The upstream and downstream water rights were well defined. For example, a tank built downstream of an earlier existing tank should not flood the fields irrigated by the upper tank. A tank constructed upstream should not deprive the downstream users. The law stipulates not only fines but also emptying of tanks for cases of violation. Exemption from tax was given to those involved in the construction and renovation activities of irrigation works. Fines were imposed on those who let out water from dams out of turn, and on those who obstructed a customary water course.

The responsibilities of the Head of Irrigation Department, according to Arthashastra, included construction of irrigation systems and aiding others involved in such activities. In waterless regions, the government superintendents were in charge of constructing wells and other water works.

The Arthashastra clearly talks about a water cess over and above the normal land revenue levied by the state on users of irrigation facilities. Even those using their own private water works had to pay some water cess. The ownership of fish, ducks and green vegetables in the irrigation works should go to the king. It is interesting to note that the ancient Indians had practiced scientific water management. Their concepts pertaining to water law and water pricing have relevance even in the modern times.

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# History, Traditional Knowledge Systems and Development of Meteorology in India

**Dr. Y E A Raj**

*Deputy Director General of Meteorology & Head, Regional Meteorological Centre, Chennai*

*e-mail: yearaj@gmail.com*

## INTRODUCTION

Meteorology is basically an atmospheric science dealing with several weather phenomenon that human kind encounters every day. Rainfall, wind, humidity and temperature are some of the meteorological parameters that are intrinsically related to life on earth. Monsoons, cyclones and thunderstorms are some of the other meteorological phenomena which exercise profound influence on the human kind. Meteorology as a science is basically multi disciplinary with several branches which are related to other major sciences such as Physics, Mathematics, Statistics, Chemistry, Instrumentation, etc.

In this brief paper we present how meteorology as a science has evolved over India. The publication “100 years of weather service 1875-1975” published by India Meteorological Department (IMD) in its centenary year of 1975 has been the major source of reference for this note up to the year 1975. For the period since 1975 we have referred large number of IMD publications, national website of IMD viz. www.imd.gov.in and several other websites maintained by the sub-offices of IMD.

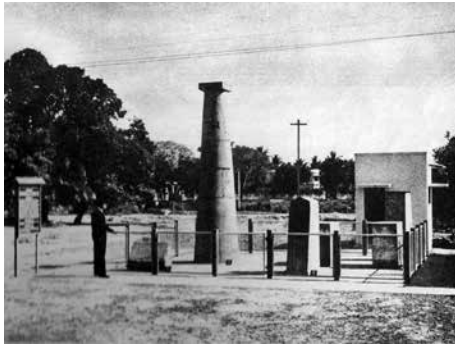
## METEOROLOGY IN THE VEDIC AGE AND UP TO 18TH CENTURY

One of the oldest treaties of India, Rig Veda has several descriptions of deities associated with weather. These are Varuna (Light rain), Marut (wind associated with stormy weather), Parjanya (Onset of monsoon rains) and Indra (Lightning). The two great epics of India, Ramayana and Mahabharatha adduce several references to weather related incidences including description of rainy season, i.e. monsoon. There have been references to Sun as the source of all weather related activities which are very much correct and appropriate. Sanskrit Literature during the period 5<sup>th</sup> century B.C. to 7<sup>th</sup> century AD had frequent references to rain. Manu-Smriti written in the 2<sup>nd</sup> Century AD contains a sloka meaning ‘From the Sun rain is born, from rain food and from food living creatures’. Kalidasa described monsoon clouds in his 1<sup>st</sup> Century AD epic ‘Meghdoot’.

During 15-18<sup>th</sup> centuries several European travelers to India have recorded their impressions on Indian weather and climate. During 1402-03 floods in Cauvery submerged vast tracts of Thanjavur district of Tamil Nadu. In 1630-32 severe famine occurred in Deccan and Gujarat. In 1650 severe drought prevailed in the entire India. These events are available in the historic literature.

**BEGINNING OF THE PERIOD OF SCIENTIFIC METEOROLOGY IN INDIA**

The earliest instrument based astronomical observations were taken at Madras (Now Chennai) in the year 1786 at Egmore. In 1792 an astronomical observatory was established at a garden house in Nungambakkam (The present day campus



**Astronomical Observatory at Madras (1792)-  
The first scientific observatory in India.  
Now preserved as a monument**



**Monument at Madras – Recent Image**

of Regional Meteorological centre (RMC) , Chennai spread over 10 acres) by the East India Company for promoting the knowledge of Astronomy, Geography and Navigation in India. The granite pillar which carried the original transit instruments

is now preserved as a heritage monument. Tamil and Telugu inscriptions were carved on the pillar in order that “posterity may be informed a thousand years hence of the period when the mathematical sciences were first planted by British liberality in Asia”. The first astronomer who was Mr.J.Goldingham also started a meteorological register in 1793/96. The Madras observatory continued in the same location but in 1899 the astronomical observatory including meteorological registers were shifted to Kodaikanal.

*Table of the Medium, Greatest, & Least Heights, with the Baromet. diff. of the Thermometer, at Madras, in 1793.*

<i>Month.</i>	<i>Thermometer, Celsius &amp; Fahrenheit at the circulation of Air.</i>			
	<i>Medium</i>	<i>Greatest</i>	<i>Least</i>	<i>Bar. Diff.</i>
<i>September</i>	71.4	79.2	76.0	13.2
<i>October</i>	71.0	79.0	75.2	12.8
<i>November</i>	70.6	78.5	69.0	11.5
<i>December</i>	71.6	72.0	73.2	8.8
<i>Medium</i>	70.7	76.4	73.0	13.6

**An oldest Meteorological record of Madras Observatory – 1793**

In 1823 the East India Company started another observatory at Colaba,

Bombay (now Mumbai). The third observatory at Trivandrum (now Thiruvananthapuram) which was established in 1836, with Mr.J.Caldecott as its Director, owed its origin to the generosity of Maharajah of Travancore. Several other observatories were established, the list includes, Calcutta, Simla, Ootacamand, etc.



Trivandrum Observatory in 1852

To further streamline meteorological observations, Asiatic Society of Bengal appointed a Meteorological Committee in the year 1857. But the Mutiny revolution against British rule in 1867 resulted in the suspension of meteorological services in several stations. However the newly established British Government showed much interest in scientific observations including meteorological observations. The Asiatic Society pursued with the British Government for establishing more meteorological observatories and in 1874, 77 observatories were in operation in the then British India.

#### ESTABLISHMENT OF IMD IN 1875

In the year 1864 a very severe cyclonic storm struck Calcutta city causing 80,000 human deaths. In the same year another cyclone struck near Masulipatnam causing nearly 40,000 deaths. Pressure was exerted on the British Government for effecting improvements in the meteorological observational organisation to provide cyclone warning services. The Government of India set up IMD in the year 1875, appointing Mr.H.F.Blenford as the first Imperial Meteorological Reporter of the Government of India. He assumed the post on 15<sup>th</sup> January 1875 (15-th January is now observed as the Foundation Day of IMD). Later on the headquarters moved to Simla wherefrom Mr.Blenford functioned. In 1899 the post of Head of IMD was changed from Imperial Reporter to Director General of Observatories which in 1970s was redesignated as Director General of Meteorology.



Surface weather chart dated 1.8.1900 (Indian Daily Weather Report)

After the establishment of IMD, meteorological observatories already existing were brought under its ambit and new observatories opened. Pilot Balloon Observatories (PBO) were established at Simla in 1905 and at Agra in 1914. Sir Gilbert Walker remained as DGO for 21 years before retiring in December 1924. In 1928 the Headquarters of IMD shifted from Simla to Pune.

The commencement of World War-I in 1914 adversely affected IMD's operations and progress. However the development of aviation in India after the war, gave a fillip to meteorological services over India. In 1931 an agricultural meteorology division was established in Pune. The observatory strength under IMD during 1931-32 was nearly 300 including several part time observatories.

The Second World War which commenced in the year 1939 accelerated development and enlargement of IMD. A large no. of PBOs were established and current weather and surface observatories opened. During the war period the headquarters of IMD was shifted to Delhi in a sprawling 30 acre campus in Lodi Colony for administrative reasons and has continued in the same campus since then. Since 1942 IMD expanded rapidly in the context of war requirements. New recruitment on a large scale was carried out and training facilities established. As many as 1304 personnel got enrolled into IMD during the war period. Dr.Charles Normand retired as DGO on 9.9.1944 after 37 years of service to IMD. Dr.S.K.Banerjee who took over from him was the first Indian appointed to the post of DGO.

In 1945 IMD underwent decentralisation which included establishment of several Regional Meteorological Centres, including one at Madras with Dr.S.R.Savur assuming the post of Regional Director on 1<sup>st</sup> April 1945. With India gaining independence, asset segregation of meteorological holdings took place between India and Pakistan. Pakistan established its own meteorological services named as Pakistan Meteorological Service. When World Meteorological Organisation was established in the year 1950 on 23<sup>rd</sup> March, India became a founder member.

The IMD further expanded its reach after Independence using the five year plans. IMD maintains as of now nearly 200 surface observatories, nearly 300 part time observatories, 62 PBO and 39 Upper air observatories and a host of other observatories and instruments which are too numerous to mention here.

### **DEVELOPMENT OF SATELLITE AND RADAR METEOROLOGY AND METEOROLOGICAL INSTRUMENTATION**

The launching of the first meteorological satellite TIROS-I on 1.4.1960 by USA was an important milestone in the history of world meteorology. Subsequently more satellites were launched some of them with meteorological components. IMD was able to receive cloud pictures from satellites launched by foreign countries with suitable bilateral agreements. The availability of satellite pictures provided considerable fillip to IMD especially in the field of cyclone detection and tracking. In 1982 the INSAT series of Geo-stationary satellites was launched by India. The INSAT satellite with meteorological sensors provided continuous monitoring of weather from Indian region which essentially means watching



**The S-Band Doppler Weather Radar installed at Hyderabad in 2010**



weather over the earth from the sky. As of now, the Kalpana weather satellite beams cloud images over Indian region in different types of wavelengths almost continuously. Besides cloud imageries, several other products are also derived such as water vapour, sea surface temperature and upper winds. Satellite Meteorology itself has developed into a separate area of science.



AWS installed by IMD at Madhavaram, Chennai

In the early 1970s IMD started establishing Cyclone Detection Radars (CDR) along the coastal belt of India to detect and track tropical cyclones (TCs) which form and move over the North Indian Ocean (NIO). The S-Band CDR at Visakhapatnam was installed in the year 1970. In 2002 Chennai CDR was upgraded into a Doppler Weather Radar which aside from tracking cyclonic storms also provides several other products and monitors the weather continuously. The upper air observations are taken at 39 observatories most of them manned by IMD by releasing into the atmosphere an instrument called radio-sonde carried aloft by a hydrogen inflated balloon. Upper winds are also computed based on the observations transmitted back to the ground. Recently IMD has upgraded some of the observatories into those taking observations with GPS-sonde which are very sophisticated and accurate. In the last 5-6 years IMD has installed large no. of Automatic Weather Stations and rain gauges all over India. 105 AWS and 219 ARGs have been installed in the southern states up till now.

### **CYCLONE RESEARCH AND CYCLONE WARNING**

Tropical Cyclones are one of the most conspicuous systems which form and move over NIO and a good percentage of them have struck Indian coasts. On an average 4-5 TCs form over NIO every year and out of these 3-4 cross the coast of either India or adjacent countries. IMD has meticulously recorded the TC tracks over NIO since 1891 and the Atlas on *'Tracks of cyclone and depressions of Indian Seas'* was printed first in the 1960s and then 1970s. In 2008 the tracks as available in cyclone atlas were digitised and a software named *'Cyclone e-Atlas IMD'* was developed at RMC Chennai. Subsequently the e-Atlas was made into a web based application completely free of cost for the registered user. The cyclone warning procedures followed by IMD are very systematic and got evolved over several decades. At present a 4-stage warning system is followed.

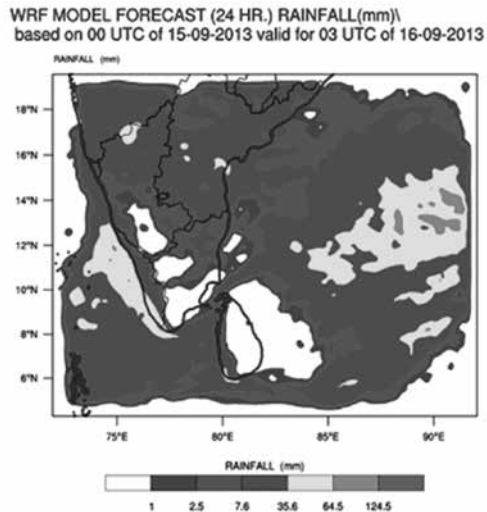
### **MONSOON METEOROLOGY**

India is endowed with two monsoons. The south west monsoon which affects India during June to September provides nearly 75% of its annual rainfall of nearly 115 cm. There is also a small scale north east monsoon which affects the south eastern peninsular India during the period October to December, Tamil Nadu being the major beneficiary of this monsoon. These two monsoons present several fascinating research problems for the Indian meteorologists. The SW monsoon has been studied

extensively in India and abroad. Perhaps this is one of the most intensively studied of monsoons of the world. In recent years fairly large number of studies have been conducted on the NE monsoon also with Chennai remaining as the focal centre for Indian NE monsoon studies. Monsoon experiments such as the International Indian Ocean Expedition (IIOE) in 1963-64, MONOX in 1977 & 79 have been conducted by IMD.

### ADVANCEMENT IN NWP

Up to 1970s the weather forecasts issued by IMD were by and large based on interpretation of weather charts, extrapolation of weather based on synoptic and statistical inputs. Forecasting weather by solving non-linear equations, which govern the motion of the atmosphere, is called Numerical Weather Prediction (NWP). NWP calls for considerable amount of computing power and needs high power computers and also processing of vast quantum of weather data at all levels of atmosphere at different time intervals. In 1988 the *National Centre for Medium Range Weather Forecasting* was established at Delhi where the country's first super computer was installed. This institution was a dedicated NWP centre especially for medium range weather forecasting. In recent years several Regional and Meteorological Centres of IMD have been installed with high performance computing systems, for e.g. in the southern region at Chennai, Bangalore and Hyderabad. The NWP models presently run at IMD New Delhi provide weather forecasts 7 days in advance, that by NCMRWF 10 days in advance that at Regional Centres 3 days in advance. The NWP models have made the weather forecasts more accurate and reliable. Formation of low pressure systems, their movement, intensification, re-curvedure of cyclonic storms – all can be accurately predicted based on NWP models.



**High Performance Computing system and rainfall forecast derived using the system  
– at RMC Chennai**

## **DEVELOPMENT IN OTHER BRANCHES OF METEOROLOGY**

Aviation, Agriculture, Hydrology are some of the several other areas where meteorology plays an important role. Being a subject which is multi-disciplinary in nature meteorology has several components in wide spectra of scientific subjects. Agricultural meteorology has seen considerable development both as a scientific subject and as an application oriented topic. Nearly 130 agricultural establishments in India have now agricultural meteorology divisions under the IMD scheme of providing Integrated Agromet advisories to the farmers. Similarly aviation meteorology as a science is taught in several aviation schools and defence establishments. In recent years climate change as a science has been taken up for study by several universities and institutes, which need in-depth knowledge in meteorology.

## **TEACHING AND RESEARCH IN TROPICAL METEOROLOGY – PAST AND PRESENT**

As expected teaching of meteorology was in the domain of IMD for a long time. IMD recruited its own personnel and imparted different levels of training, such as Elementary, Intermediate and Advance. Such courses of training were generally imparted in the Training School of IMD, Pune which is now a WMO recognised Meteorological Training Institute (MTI). Training related to meteorological instrumentation was imparted at IMD, New Delhi. Besides these routine courses, specialised training in different areas of meteorology was also imparted by respective divisions for e.g. Agromet, Satmet, Radarmet, etc. Standard text books, compendiums prepared by WMO besides lecture notes prepared by IMD faculty served as training material. In due course Meteorology as a subject got introduced by universities at graduate and post graduate levels. Andhra and Cochin Universities have offered post graduate level courses in Meteorology for the last 2-6 decades and have produced several internationally renowned meteorologists. Since then meteorological schools were established at renowned institutes such as Indian Institute of Science, Bangalore, IITs Delhi and Kanpur, PRL Ahmedabad, etc. Indian meteorologists have authored several text books in different topics of meteorology. Besides this numerous research reports, meteorological monographs and forecasting manuals have been published by meteorologists of IMD ( Please refer Annexure 2 for a selective list of books )

Research work in meteorology has been carried out in IMD addressing its specific needs of forecasting and service delivery. Besides papers on operational meteorology, meteorologists of IMD have published numerous research papers in various topics of meteorology. The Indian meteorological journal *Mausam* published by IMD is in its 64-th year of publication and has brought out so far more than 63 volumes, 250 issues and has published nearly 2000 research papers. Now there are several other Indian journals exclusively devoted to atmospheric sciences. Papers published by Indian Atmospheric Scientists have appeared in several International journals also. To provide a fillip to meteorological research an Institute of Tropical Meteorology was established at Pune in 1962 which now functions as Indian Institute of Tropical Meteorology as an autonomous Institute. It is now a premier research institution of meteorology with international recognition.

## **PRESENT STATUS OF IMD'S SERVICES**

The advent of internet in the mid 1990s in India and its subsequent spread have provided considerable fillip to IMD especially in disseminating its products and forecasts. It has now become possible to get across images, bulletins, tables and full publications through internet in an effortless manner. The IMD website [www.imd.gov.in](http://www.imd.gov.in) is a treasure of information and has been rated as one of the best amongst similar websites. It contains vast information on the various branches of meteorology. Several National Meteorological Services of other countries also provide weather forecasts for the Indian region and have made them available through the www. The meteorological data collected by IMD for nearly 140 years have been archived at its National Data Centre at IMD, Pune. Substantial amount of data are freely available through the IMD's national website.

## **IMS'S ROLE IN POPULARISING METEOROLOGY**

The Indian Meteorological Society (IMS) established in the year 1956 is a scientific society dedicated to the cause of popularising meteorology and has opened a large number of chapters at different centres to achieve this objective. IMS and its chapters have conducted several seminars and symposia in meteorology on Indian monsoons. Since 1992 IMS has been holding what is named as the TROPMET seminars every year or once in two years which also include international symposia called INTROMET held nearly once in five years. These seminars have become excellent fora for the professional meteorologists, students interested in meteorology, researchers pursuing research in meteorology and allied subjects to present their work and also to listen to acknowledged experts in meteorology. Seminars in meteorology and allied topics have been organised by several other institutions also including IITM, Pune, Cochin University, Andhra University Vsakhapatnam, SV University, Tirupathi NCMRWF and several other institutes.

## **CONCLUDING REMARKS**

Knowledge on meteorology and related topics existed in India for a longtime. Instrumental measurements of meteorological elements began in India in 1792 and the subject has substantially developed since then. India may only be a developing country in economical terms but it stands amongst developed countries in the status of knowledge on meteorology and in providing weather services to the users. For a long period meteorology in India was synonymous with IMD, but in the recent 2-3 decades the subject has come on its own with several other institutions offering courses and with easy access to meteorological literature through www. With its multi disciplinary nature meteorology as a scientific subject has the potential to appeal to wide spectra of students and learners and will continue its growth further in the years to come.

## **REFERENCES**

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- [www.imd.gov.in](http://www.imd.gov.in), History of Meteorology in India.

### Annexure 1

#### Development of meteorology in India: Chronology of some important events

1792	- Madras Astronomical Observatory established at Nungambakkam
1793	- Weather observations commenced at Madras
1823	- Met observatory established at Colaba, Bombay
1829	- Met. Observatory set up at Calcutta
1836	- Met. Observatory established at Trivandrum
1841	- Simla recorded met observations
1864	- Asiatic Society of Bengal requested Indian Government for improving its meteorological system
1875	- Establishment of India Meteorological Department with Calcutta as its headquarters
1878	- Publication of Indian daily weather report
1890-1900	- HQ of IMD shifted to Simla
1905	- Pilot balloon observatory established at Simla
1918	- Pilot Balloon observatory established at Agra
1928	- HQ of IMD shifted from Simla to Pune
1939	- Commencement of Second World war, Accelerated development of meteorological services.
1943	- Upper Air observatory using radar started functioning from Jodhpur.
1944	- IMD HQ shifted to New Delhi
1945	- Establishment of Regional Meteorological Centres, including RMC Chennai
1950	- India becomes the founder member of WMO
1956	- Indian Meteorological Society formed.
1960-65	- Satellite weather imageries from Polar orbiting satellites were available to IMD.
1962	- Establishment of Institute of Tropical Meteorology at Pune.
1963-64	- International Indian Ocean Expedition (IIOE) conducted
1971	- ITM made autonomous and renamed IITM, Pune.
1970	- S-Band analogue Cyclone Detection Radar commissioned at Visakhapatnam.
1977-79	- Monex (Monsoon experiments) conducted.
1982	- INSAT Satellite launched, India received weather imageries from its own satellite.
1988	- National Centre for Medium Range Weather Forecasting (NCMRWF) established at New Delhi equipped with Super computer
1999-2002	- Websites opened by the various offices of IMD, dissemination of Weather bulletins through the national website of IMD: <a href="http://www.imd.gov.in">www.imd.gov.in</a>
2002	- IMD's first S-band Doppler Weather Radar commissioned at Chennai
2007	- Installation of Automatic Weather Stations and raingauge stations by IMD commenced all over India.

**Annexure 2**  
**Text books published in Meteorology in India – Selective list**

Sl. No.	Author	Year	Title & Publisher	No.of pages
1	Asnani.G.C.	2005	Tropical Meteorology Vol. 1-3	2241
2	Attri S.D., Rathore L.S., Sivakumar M.V.K., Das, K.S.K.	2011	Challenges and op- portunities in Agrome- teorology Stringer	597
3	Das.H.P.	2012	Agrometeorology B.S. Publications, Hy- derabad	373
4	Das P.K.	1986	Monsoons, WMO	155
5	Das P.K.	2006	The Monsoons, National Book Trust	254
6	Kelkar R.R.	2006	Satellite Meteorology B.S. Publications	251
7	Kelkar R.R.	2008	Monsoon Prediction B.S.Publications	
8	Kelkar R.R.	2010	Climate Change, A holistic view, B.S.Publications	208
9	Mavi H.S.	2004	Agrometeorology	447
10	Pandarinath N.	2006	A course in Dynamic Meteorology B.S.Publications	364
11	Pandarinath N.	2012	Aviation Meteorology B.S.Publications	903
12	Raghavan S.	2003	Radar Meteorology Springer	549
13	Rao Y.P.	1976	South West Monsoon, Met. Monograph, IMD	364



***Subtheme I:  
Culture, Heritage and Agriculture***





# Culture, Heritage and Agriculture

**Dr. C Bhaskaran and Dr. G S Sreedaya**

*Department of Agri. Extension, College of Agriculture, Vellayani, Thiruvananthapuram*

## INTRODUCTION

A culture is a way of life of a group of people--the behaviors, beliefs, values and symbols that they accept, generally without thinking about them, and that are passed along by communication and imitation from one generation to the next. The word is of Latin origin, *cultura*, meaning a reverent relationship (cult) with the earth (Ur). Heritage is the environment, objects and places that we inherit from the past and pass on to future generations to use, learn from and be inspired by. Together these frame our understanding of the past and influence the decisions we make about what is worth keeping. Agriculture is the science, art or occupation concerned with cultivating land, raising crops, and feeding, breeding, and raising animals, birds, fish etc. An attempt is made here to describe the relationships among culture heritage and agriculture.

## NATURE AND CULTURE

Charaga, a well-known physician of 10<sup>th</sup> century India answering a scholar who asked him the names of useless plants in the area where Charaga lived, said in reply, "Go and ask the people of this area and give me the list of useless plants mentioned by them". After two days the scholar returned and told Charaga, "Master, I have got my answer. There is no plant that is useless". This story exemplifies the attitude of earlier civilization to biological wealth.

## ORIGIN OF AGRICULTURE

In a Balinese legend, Lord Vishnu, male God of fertility and water came to provide better food for the people who had only sugarcane juice as food. Vishnu made Mother Earth give birth to rice and then fought Indra, Lord of the Heavens to force him to teach man to grow rice. Thus it is believed that rice, as a source of life and wealth and a gift from the Gods was born from the union of the divine creative forces represented in Earth and Water.

Agriculture is not of recent origin, but has a long history dating back to Neolithic age of 7500-6500 B.C. It changed the life style of early man from nomadic hunter of wild berries and roots to cultivator of land. Man first settled down before cultivating plants. Population pressure and scarcity of resources are the two important factors which might have forced man to settle down. This in turn forced him for permanent settlement preceded by domestication of plants and animals. It gradually developed from cultivating wild varieties to resistant varieties and village settlements to towns and cities.

This substituting of farming and stock raising for hunting and gathering as the main mode of food production which happened in many different parts of the world set in motion a whole series of adaptive processes which completely altered the ecology of planet and culture of the world. Settled life permitted division of labour and gradual appearance of different enterprises. It seems that all these transition first occurred in the middle east region of the world, which must thus be considered as the cradle of agriculture and settled life.

Another important transformation was the shift from slash and burn agriculture / shifting agriculture which allowed using a plot for a short period of time and moving to another due to the depletion of nutrients. But the domestication of cattle lead to the production of manure which lead to the repeated use of the same land. Also some of the technological innovation like heavy irrigation system which necessitated heavy physical work forced the enslaved poor to work hard. But many cultures based on this kind of agriculture collapsed due to social and ecological reasons.

The point to be noted is the conservation of nature in olden days. They believed that the sky is protected by trees and if the forest disappear the sky will collapse and nature and man will perish together. The sacred groves are the typical examples of the value the primitive people had given the mother nature. The traditional beliefs and cultural values are more powerful agents for environmental conservation than legally designated areas such as national park or nature reserves. But industrialization, urbanization and super market age have changed the vision of the modern society and pushed away from the natural environment.

### **CULTURE, HERITAGE AND AGRICULTURE - RETROSPECTION**

Experience over the years from many parts of the world has illustrated the ultimate dependence of all cultures on what constitutes the very basis of human existence: Agriculture. In the anthropological sense, cultures are as old as mankind. But with agriculture came the first settled communities – the basis of modern civilization. Equally interesting from the point of view of development is the intimate relationship between the natural physical environment, in which a certain type of agriculture has developed, and the way of life, ethical values and social structures of the people. These traditional influences have fashioned our cultural identities. Modern politics and modern strategies for development have to do with how to handle individual and collective reactions to change. Development projects now take the factor of culture as a strategy to account since experience has shown that development projects often fail if this factor is ignored. Many studies have pointed out that the ecological wisdom of local people is fast disappearing which requires to be reckoned if agriculture development is to be inclusive and sustainable.

Agriculture is the source of livelihood for the vast majority of the world's population, many of whom try to make a living under difficult conditions. Increasing their capacity for self-fulfillment by respecting and understanding their culture would have a beneficial effect on their situation.

### **CULTURE, HERITAGE AND AGRICULTURE - PROGRESSION**

An obvious way to describe agriculture's cultural heritage more specifically is to take on the agricultural sector's own perspective. This enables the classification of the different kinds of cultural monuments in the agricultural landscape into the following categories:

- Farm dwellings
- Farm buildings (for production and storage)
- Technical and other installations, such as roads, bridges, terraces, canals, dykes etc
- Kitchen gardens, orchards, avenues, farmyard trees and pollards
- Infield and outfield farmland, including cropland and pastures
- Various archaeological cultural remnants, both with or without connection to farming history. The former include old housing sites, field edges, stone heaps and fossil traces of farming activities found in the soil
- Land tenure, property structures and land consolidation history embodied in the landscape
- Land use structures and farming methods embodied in the landscape
- Ethnic and social structures embodied in the landscape

In addition, there is also an immaterial cultural heritage, which exists as traditional knowledge in the rural population. This includes knowledge associated with historical farming methods and of the supplementary activities. Such knowledge often dealt with resources, methods of resource utilization and sustainability. This tradition also includes handicrafts and the domestic industry, which were vital additional activities on all farms throughout the history of agriculture. In addition, there is extensive knowledge of historical events, beliefs and traditions associated with the landscape. These resources can be used as a source of historical information or can be directly experienced.

### **CULTURAL HERITAGE MANAGEMENT AND SUSTAINABILITY**

An important aspect of integrating cultural heritage management with the concept of sustainability is that this enables the development of an increased awareness of environmental issues and human responsibility in relation to these. Environmental policies should be based on a holistic approach to the environment; including a natural and a cultural dimension, as well as the interaction between the two. It is important to realise that the rural population itself, as land owners and stewards, is the main bearer of our cultural heritage, and thus represents the foundation for practical cultural heritage management. Agriculture is an important bearer of this heritage. The awareness for its role as a steward for our natural resources is

an important part of the traditional attitudes within the sector, and therewith also an important part of its immaterial cultural heritage. A long-term perspective on resource management, taking future generations into consideration, is a major element of this heritage. Other elements include skills related to the management of cultural environments and added value creation in connection with the material and the immaterial cultural heritage and these skills are a necessary prerequisite for achieving sustainability. It is in this context the following different forms of agriculture have to be evaluated for the sustainability.

1. Primitive agriculture
2. Transitional agriculture
3. Nature farming
4. Permaculture
5. Organic Agriculture
6. Sero tillage agriculture
7. Sero budget farming
8. Modern agriculture

#### **AGRICULTURE HERITAGE IN INDIA**

Agriculture in India is benefited from the wisdom and teachings of great saints. The wisdom gained and practices adopted have been passed down through generations. The traditional farmers have developed the nature friendly farming systems and practices such as mixed farming, mixed cropping, crop rotation etc. The great epics of ancient India such as Rigveda, Kautilya's 'Arthashastra'; Panini's 'Astadhyayi'; Patanjali's 'Mahabhasya'; Varahamihira's 'Brahat Samhita'; Amarsimha's 'Amarkosha' and Encyclopaedic works of Manasollasa convey the depth of knowledge possessed by the older generations of the farmers (agriculture animal husbandry) of India. Classification of historical age into stone age(which is further divided into Paleolithic, Mesolithic and Neolithic Period), bronze age and iron age is based on the agricultural implements used in these respective periods. Indus Valley civilization, also called the Harappan civilization comprising both Mohenjo-daro and Harappan in the river bed of Indus developed and established mainly through agriculture which faded out after 1750 BC probably due to decreasing fertility of the soil on account of the increasing salinity, caused by the expansion of the neighboring desert or kind of depression in the land, which caused floods. Also prediction regarding the outset of rain, flood and other natural vagaries were made and cultivation was done only in accordance with the Krishi-Panchang.

Physically, India may be divided more or less into three main regions viz. (1) the mountainous borders of Himalayas in the north and of the Vindhya in the south with the linings of Ghats in the south-eastern and south-western coasts and the traverse range or Aravalli hills; (2) the Deccan plateau or table land; and (3) the plains or lowlands, a rich Indo-Gangetic alluvium overflowed by the rivers-the Ganges, Jamuna and Brahmaputra. Although primordial mountains remained inaccessible for human settlement, the foothills have been increasingly brought under cultivation and

settlement and the upland valleys striking the Himalayas include some of the most fertile of Indian lowland formations. The whole Indo-Gangetic alluvium consists of rich fertile *soil* and has contributed materially to the growth of civilization. Also it is an astonishing fact that all the scientific soil and water management techniques were prevalent in ancient period as evident from ITK/Folk songs, agricultural proverbs, sayings etc which have been studied extensively. These studies also paved way for heuristic research in agriculture.

### **KERALA AS AN AGRICULTURAL HERITAGE SITE**

In order to safeguard and support the world's agricultural heritage systems, in 2002 FAO started an initiative for the dynamic conservation of Globally Important Agricultural Heritage Systems (GIAHS). The GIAHS initiative promotes public understanding, awareness, national and international recognition of Agricultural Heritage Systems. Looking to safeguard the social, cultural, economic and environmental goods and services, these provide to family farmers, small holders, indigenous peoples and local communities, the initiative fosters an integrated approach combining sustainable agriculture and rural development.

Kerala has a strong case to get the benefit of this initiative and assistance in the dynamic conservation of its agricultural heritage system. The Kuttanad, Kole, Pokkali and Kaipad lands as well as the integrated homestead based farming systems prevalent in Kerala can be sustained only by such measures in the light of fastly globalizing and business agriculture in the state. Massive campaigns involving all the stakeholders are the need of the hour in this regard to preserve the unique agricultural heritage of Kerala.

### **THE CULTURAL DIMENSIONS OF ENVIRONMENTAL DECISION-MAKING**

It is high time to think about the cultural dimensions of environmental decision-making due to the following reasons

- (1) The very purpose of culture is to harmonise the activities of a population with the particular opportunities and constraints presented by their environment. The "war on culture" that began in the colonial era and persisted through present-day neo-colonialism may soon be dismissed as a self-destructive period that left in its wake many sterile, damaged, and homogenous environments. A period of rebuilding culture may be our best hope for proper stewardship.
- (2) A policy of sustainability must be maintained by local people. Local culture is more significant for environmental sustainability than written laws and distant bureaucrats. Empowering local people to develop cultures appropriate to where they live, and co-management schemes between local and national actors, could both improve environments and reduce conflict.
- (3) The global geography of mismatched cultural and political boundaries foments enormous conflicts over environments and resources. The chief tragedy of Africa is the outcome of the 1884 Berlin Conference which either placed international boundaries across cultural boundaries or combined many cultures into one state. Most African governments are now dominated by one ethnic group or another, leading to resentment and conflict over the distribution of resources, including

- territory. Cultural conflict accounts for 80% of Africa's genocides and wars. It is thus vital to include culture in this analysis of environmental conflict.
- (4) Cultures produce local knowledge. The earth is not a uniform ball of wax and treating it as such imperils life and creates conflict. Local knowledge of soil, climate, and resources critical to maintaining a distinct cultural landscape is transmitted in various ways between generations. Local knowledge and technical-scientific knowledge should both be included in environmental decision-making. In many cases, Western science is a European cultural product that has sought to impose laboratory conditions on distant environments with many ill effects and through an ill-considered technocentrism (e.g. the Green Revolution).
  - (5) Colonialism and neo-colonialism have contributed heavily to environmental degradation. For example, clearing tropical rainforests for European husbandry and row-crops has resulted in soil loss, eroded environments and the invasion of alien species ("biological imperialism"). Reconstructing damaged environments requires cultural reconstruction and therefore intercultural cooperation.
  - (6) Any fully integrated environmental management system must take cultural impacts into account. Past failure to account for differences in culture has led to failed projects, cultural genocide, violent competition for scarce resources and instability between various cultural groups. Large scale water projects have been notorious for this oversight (e.g. damming India's Narmada River Valley, conflict over the Lesotho Highlands Water Project etc).
  - (7) Cultural landscapes are also environmental treasures that add to the wealth and resources of a country. Cultural diversity is an environmental stimulus that educates and entertains people. Furthermore, maintaining diverse cultural landscapes is a precondition for the biological diversity required for sustainable systems and should therefore be a principle of environmental decision-making.

#### **ENVIRONMENT: THE POLICY – PRACTICE PARADOX**

The Government of Kerala have over the years formulated more than 25 policies pertaining to various aspects of environmental conservation. The Kerala State Environment Policy (2009) is yet to be implemented fully. Subsequently, the Organic Agriculture Policy and the Conservation of Wetlands and Paddy Lands Act were also promulgated in 2010. The Agricultural Development Policy of the Government of Kerala (2013) is now on the anvil.

A closer scrutiny of these Policies, Acts, Regulations etc. reveal that while the formulation of these is meticulously attempted, only half hearted efforts are noticed in their implementation giving rise to the Policy – Practice Paradox. To cite an example, the Organic Agriculture Policy (2010) of the GOK stipulated that within five years the entire field crops in Kerala will be brought under organic cultivation and within the next five years, entire agriculture in the State including plantation crops will also be brought under the organic umbrella to make Kerala "Totally Organic Agriculture State" by 2020. Practitioners in the field of agriculture including the farmers know for sure that it is not only a distant dream but a pipe dream. This chasm between policy and practice is a major blow on the fragile environment of

Kerala. Conscientisation programs with multi-stakeholder participation keeping the state in the vanguard is a sure way to ensure that there is a perfect match between policy and practice concerning environment. The State's leadership should take the mantle of a "Tri-Sector Athlete" engaging and collaborating the public, private and social sectors in the pursuit of enabling environment with development.

### **CONCLUSION**

Agriculture is the source of livelihood for the vast majority of worlds' population many of whom try to make a living under difficult conditions. It is a fact that evolution always does not lead to constant improvement as people we call "primitive" are much more developed when it comes to knowing how to use the environment without over exploiting or destroying it with pollutants. Any type of development should acknowledge the cultural dimensions, enrich cultural identities, broaden participation in cultural life and should promote cultural cooperation of all stakeholders.

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# Cultural Traditions in Seed Resource Management

**Dr. S Jeyaraman and Dr. S Marimuthu**

*Institute of Agriculture, Kudumiyanmalai – 622 104, Pudukkottai district, Tamil Nadu.*

*Email: sjtnau@gmail.com*

## INTRODUCTION

Traditional knowledge is not so-called because of its antiquity. It is a living body of knowledge that is developed, sustained and passed on from generation to generation within a community, often forming part of its cultural or spiritual identity. As such, it is not easily protected by the current intellectual property system, which typically grants protection for a limited period to inventions and original works by named individuals or companies. Its living nature also means that “traditional” knowledge is not easy to define. The knowledge and innovation that its peoples have developed to use and conserve these resources is based on indigenous practices developed and tested over generations. This paper examines the importance of cultural traditions in seed resource management and its role in enhancing sustainability in agriculture while natural resources.

## TRADITIONAL SEED MANAGEMENT PRACTICES

A detailed description of the indigenous technologies being followed by farmers in dry tracts of India for storing grains and seeds were collected and presented below:

**1. Pungam leaves in paddy seed storage:** In this age old practice, fresh pungam (*Pongamia glabra*) leaves were placed as layers in between the gunny bags arranged one above other in store rooms. These leaves acted as a repellent against Angoumois grain moth (*Sitotroga cerealella*) and rice weevils (*Sitophilus oryzae*). The strong odour released from pungam leaves avoided the pest attack. Some farmers placed these pungam leaves directly in the gunny bags and stored the grains (Karthikeyan, et al., 2009).

**2. Neem seed kernel extract dip jute gunny bags:** Farmers preferred jute gunny bag in the short term storage of grains used as seed materials for future sowing. The practice of treating the jute gunny bags with neem (*Azadirachta indica*) seed kernel extract (NSKE) was followed among the farmers. The practice involved the preparation of NSKE and then treating the jute gunny bags with NSKE solution before storage. About 10 kg of NSKE was powdered well and soaked in 100 litres of water for nearly 24 hrs,

the extract was filtered, Jute gunny bags to be used in storage were then dipped in the NSKE solution for 30 min and shade dried. Later, these NSKE treated jute gunny bags were used in storing seed materials of paddy, pulses and oilseeds. Farmers believed that the strong odour of neem would repel the storage pests. Another advantage revealed by the farmers was that seeds stored in jute gunny bags would be the better performers in terms of germination and quality (Karthikeyan, et al., 2009).

**3. Ragi storage with neem and thumbai leaves:** Farmers used neem (*Azadirachta indica*) leaves and thumbai leaves in the storage of ragi (*Eleusine coracana*). The strong odour of these leaves keep the storage pests like lesser grain borers (*Rhyzopertha dominica*), saw toothed beetle (*Oryzaephilus surinamensis*) and flat grain beetle (*Cryptolestes minutes*) away. Neem leaves and thumbai being organic repellants were also safe to use.

**4. Ash seed treatment in sorghum:** Ash was mixed with the sorghum (*Sorghum bicolor*) seeds at the ratio of 1:4. After the ash treatment, sorghum seeds were tied airtight in the jute gunny bags. Farmers using this technology stored the sorghum grains for 6 months without any storage pest problems.

**5. Storage of grains using camphor:** Both cereals and pulses attracted a wide range of storage pests. Hence, farmers indigenously practiced simple method in grain storage. In this practice, about 1 gm of camphor piece per 5 kg of grains was placed as such in the jute gunny bags. This practice of placing camphor inside the grain storage bag repelled the storage pests due to the strong odour emanated from camphor. A short-term storage of grains up to 3 months was possible with this traditional storage method and after that the grains were to be sun-dried and then kept with fresh camphor pieces for subsequent storage.

**6. Ginger grass oil treatment:** Srivastava *et al.* (1988) reported that 0.2% (v/w) ginger grass oil on redgram prevented oviposition and F1 emergence of *Callosobruchus chinensis* (L.) for a period of 45 days after initial release of adults. Paranagama *et al.* (2003a) reported that grain damage was lower in *Cymbopogon citratus* Stapf and *Cymbopogon nardus* Rendle treated rice than in the control. *C. citratus* and *C. nardus* showed deleterious effects on oviposition and F1 adult emergence of cowpea bruchid, *Callosobruchus maculatus* compared to the control during no-choice tests (Paranagama, *et al.* 2003b).

**7. Sun drying of seeds:** The grains to be stored are first sun dried by the tribes and this kills most pests. Lale (1998) reported decreased oviposition and increased adult mortality of *Callosobruchus maculatus* in grains stored after exposure to sun. Lale and Vidal (2000) recorded 100% mortality of the eggs and first instar larvae of *C. maculatus* and first instar larvae of *Callosobruchus subinnotatus* (Pic) exposed to sunlight for 2 hours in *Vigna subterranean* (L.). Exposure of *C. maculatus* and *C. subinnotatus* adults to solar heat decreases the oviposition, retards egg development and reduces survival rate of immature stages. Thus *Thombai* relies on the insect deterrent action of plants and the sterilizing effect of UV in solar radiation. *Thombai* could be successfully used in granaries where long term storage is required, even up to a period of more than two years. The same structure can be repeatedly used for storage and only roof replacement is required.

**8. Seed treatment with Cowdung:** Hakbijl (2002) reported the use of ash from burnt cow dung as an insecticide against *Sitophilus granaries* and *Cryptolestes ferrugineus* (Stephens) larvae. Ashes kill insects by desiccation or by filling the intergranular spaces, restricting insect movement and emergence.

**9. Leaves powder for seed storage:** The leaves of plants used as inner lining of Palmyra leaf bin are known to have insect deterrent action. *Psidium guajava*, *Vitex negundo* leaves admixed with freshly harvested paddy, field infested with *Sitotroga cerealella* (Oliver), significantly reduced the number of emerging F1 adults during four months of storage (Dakshinamurthy, 1988). The LD50 for *P. guajava* leaf powder admixed with rice assessed for *Sitophilus oryzae* and *S. granarius* at seven days was 2.25% and 2.28% (w/w) leaf powder, which prevented the production of F1 adults of both species (Sharaby, 1989). Morallo-Rejesus *et al.* (1990) showed that leaves of *V. negundo* caused 80% mortality in adult *Callosobruchus chinensis* within 48 hours and prevented egg laying in mung bean.

**10. Seed treatment to prevent diseases:** Varahamihira recommended pelleting of seed with flours of rice, blackgram and sesame and fumigating them with turmeric powder to ensure good germination. Surapala listed several botanicals such as seed treatment materials for shrubs and trees. Even today cowdung, suggested by Kautilya in the 4<sup>th</sup> century BC, is used for treating cotton and some other seeds by a large number of farmers. Farmers strongly believe that problem of mould in the grains can be easily overcome by proper drying in the sun. For this, the farmers follow the lunar calendar and the grains are dried in the sun during the day of new moon light. This method is very effective in practice, and does not require chemicals for the control of storage pests. Women were the main actors responsible for handling storage grain (Ghale, 1998).

The seeds of grains are to be exposed to mist and heat for seven nights. This practice is followed in wheat to prevent smut diseases. Soaking of seed in water to activate fungal mycelia and drying the seed under hot sun to kill the fungal; the setts of sugarcane are plastered at the cut end with the mixture of honey, clarified butter, the fat of hogs, and cow dung. Honey is widely antimicrobial property. Ghee could seal off the cut ends prevent loss of moisture and cow dung facilitated biocontrol of potential pathogens; cotton seeds with cow-dung; and water pits at the root of trees are to be burnt and manured with the bones and dung of cows on proper occasions. The sprouts of seeds, when grown, are to be manured with a fresh haul of minute fishes and irrigated with the milk of snuhi (*Euphorbia antiquorum*). Where there is the smoke caused by burning the essence of cotton seeds and the slough of a snake, there snakes will not stay.

*Moringa* seeds inhibit the growth of bacteria and fungi. *Tulasi* is a water purifier with antibacterial and insecticidal properties. Copper or brass pots are what Indian women use to carry and store water; and unlike plastic, they do not breed bacteria. The technologies women have used for water purification are based on locally available natural products and locally and commonly available knowledge (Shiva 1988).

### Agriculture and Tamil Literature

**Seeds and sowing:** Seed was selected from those earheads that first matured. The selected seed was stored for sowing only and never used as food grain. Seeds were

sown with adequate spacing (Natrinal). Seed germination happens with adequate moisture (Nanmanikadigai, 67). About 2000 years ago, Parasara recommended (i) proper drying of seed (ii) freedom from the seeds of weeds (iii) visual seed uniformity (iv) storing seeds in strong bags, and (v) storing seed where white ants would not have access and at a location where seed would not come in contact with substrates that would allow moulds to grow such as cowshed wastes, damp spots, or left over foods. Sage Parasara had stated that Uttarashadha, Uttarabhardrapada, Uttarapahalguni, Mula, Jeyshtha, Anuratha, Magha, Rohini, Mrigashirsha (Mriga), Rohini, Hasta, and Revathi are the good nakshatras for sowing. Two days should be avoided for sowing and transplanting; Tuesday, which portends threat from rats and Saturday, which foretells threat from locusts and insects. Sowing should not be done on 'empty' days (such as the fourth, ninth, and the fourteenth day of the lunar fortnight of a month) especially if the moon is weak. Seeds of grains should be planted at a distance of hand (approximately 1½ ft =45 cm) when the sun is in Cancer. In Leo the distance should be half of it. In Virgo it should be four fingers, (3-4 inches =7.6 –10.2 cm). Kautilya in Artha Sastra indicated that decision to sow seeds of specific crops should be taken on the basis of known rainfall patterns. He recommended that rice be sown first and mungbean and black gram later. Kashyapa's The Procedure of Sowing involves ploughing, levelling, furrowing, or digging pits. The procedure is said to depend on the characteristics of land, availability of water, sunshine, and also on additional wisdom.

**Seed and sowing:** Ancient scholars showed awareness of the importance of good seed; i.e selection of the apparently healthy seed from a ripening crop. Sowing of seed was considered a very important event. Prayers and rituals were associated with the sowing operation. Primitive bamboo drills were used for sowing seed. Adjusting the inter-plant and inter-row spacing was done on the basis of sowing time; late sowing meant more seeds per unit urea. A wooden plank was run over sown fields to ensure uniform seed germination. The art of sowing rice in small areas; i.e. in nurseries and transplanting of the seedlings is not a recent practice. It was first perfected in the deltas of Godavari and Krishna rivers in 100 AD. It was the most important agricultural operation during the Sangam age (AD 300 - 600).

**Practices using inorganic and organic materials:** It was Someshwara Deva (c. 1126 AD), a Chaluyka king who suggested treatment of seed with ash, besides other materials to ensure good germination. Use of ash however was suggested as far back as 120 BC by Varro a Roman encyclopedist, and was known to Tamils. Butter milk makes the seeds sprout earlier than the normal time. The use of common salt solution mentioned by Dara Shikoh (Razia Akbar, 2000) for soaking fig cuttings prior to planting. Apparently salt was used to disinfect cuttings. Nuskha Dar Fanni-Falahat (Razia Akbar, 2000) has many recommendations to protect plant species from insects, fruit-drop, fruit cracking heat and cold. Use of dung garlic, and pine oil should protect the cuttings from damage by some insects and pathogens. Burning of garlic was recommended for 'expelling caterpillars' by the Roman author Palladius. Resin application to roots has been recommended for preventing cracking of pomegranate is found in ancient literature. Application of excreta of sheep, pig and donkey and human urine can at best keep the apple tree well nourished which in turn perhaps keeps insect and diseases damage animals. Mustard paste or suspension is known to

posses antifungal, acaricidal, nematicidal, and insecticidal properties. The sprouting mustard seeds around the packed betel leaves would release a volatile antifungal gas. Covering melon fruits with earthen pots is practiced by the small farmers to protect melons from excessive heat or cold.

According to Varahamihira, sesamum is sown and ploughed back when it blooms in order to mix it with the soil. The general practice of sowing seeds, according to Varahamihira, involved soaking them in milk for ten days, taking out daily with hand, smearing with ghee, rolling many times in cow dung and fumigating with the flesh of deer or hog. Then the seeds were sown in a soil which was already treated with sesame crushed together with flesh and hog's marrow. They grew and bloomed when sprinkled with milk and water. Hard seeds like tamarind sprouted when sprinkled with a mixture of the flour of rice, black gram and sesamum and wheat particles together with stale meat, and fumigated with turmeric powder, repeatedly. Cotton seed was treated with red lac juice in a special manner to get red tinged cotton. It was also treated with cow dung paste to facilitate sowing and control of seed borne diseases. The seedlings for transplanting at a distant place were smeared from root up to the stem with a mixture of ghee, Usira or Khas (*Vetiveria zizanioides*), sesamum, honey, Vidanga (*Emblica ribes*), milk and cow-dung. Varahamihira has recorded two methods of grafting. They are (1) inserting the cutting of a plant into the root of another, cut off from its trunk, and (2) inserting the cutting of a tree into the stem of another. The junction of the two in both the cases was covered with a coating of mud and cow dung. Grafting was advocated for jackfruit, ashoka, plantain, rose apple, lemon, pomegranate, grape, jasmine, etc. Further, he recommended February-March for grafting those plants which have not developed branching; December - January for those which have developed branching and August - September for those which have developed large branches. The grafted trees were to be watered both in the morning and evening every day in summer, on alternate days in the cold season and whenever the soil becomes dry in the rainy season.

**Growth promoters:** In respect of diseases, Varahamihira says the tree catches disease from cold weather, strong winds and hot sun. In such cases a paste made of vidanga, ghee and silt must be applied to the affected parts. Water and milk should be sprinkled on such trees. When there is a premature fruit drop, the tree should be watered with milk that has been cooled after being boiled with horse gram, black gram, green gram, sesamum and barley. After this treatment, the trees will produce abundant flowers and fruits. A mixture of powdered dung of goats and sheep, sesamum powder, wheat articles, beef and water, kept for seven nights should be sprinkled for increasing flowers and fruits of trees, creepers and shrubs. In the Sangam age, the dung of cow and sheep and green leaves were used to increase the yield of crops. Krishi Parashara has prescribed the method of preparing manure from cattle dung and dry leaves. Sesame, cow dung, barley powder, fish and water when mixed in fixed proportions formed as effective manure.

**Seed collection and preservation (Sage Parasara):** *The origin of plentiful yield is the seed.* A good quality of seed is stated to be the first step towards the success in farming. Seeds of several trees specified for plantation are also to be procured and preserved. All sorts of seeds should be procured in Magha (February) or Phalguna (March) and should then be dried well in the sun without putting those directly on

the ground. To procure healthy seeds of panicles are located in the field, cut from the standing crop, and collected in a pouch. A mixture of different kinds of seeds causes great loss. Uniform seeds produce excellent results.

**Fumigation:** Diseases of cucurbits were controlled thought smoking by burning the bones of cow and dog mixed with the excreta of cat. For the control of insect pests several ancient recommendations available are as follows: Insects infesting trees could be removed by smoking a mixture of white mustard, black pepper, asafoetida, vidanga (*Embelia ribes*), vaca (*Zingiber zerumber*), and water mixed with beef horn of buffalo flesh of pigeonpea and the powder of bhillata (*Semecarpus anacardium*). Sprinkling water mixed oil cake could control insects infesting creepers. Dusting cow dung ash and brick-dust could destroy leaf-eating insects. Trees were watered with cold water for days to remove insects from the roots and branches. A wound caused by insects was healed if sprinkled with milk after being anointer with mixture of vidanga, sesame, cow's urine, ghee (clarified butter), and mustard.

Few of the ancient plant protection practices existing in Rajasthan are: (i) use of foliar and soil applications of oil (sesame) to trees from frost and termites; (ii) Sprinkling of curd (91 g) mixed with asafoetida (112 g) on trees to prevent powdery mildew; and (iii) use of asafoetida (*Exbelia ribes*) mixed with curd every 10 days to protect canker (or anthracnose of orange). Kautilya (c. 300 BC) mentioned the use of cow dung for dressings seeds pasting cut ends of vegetative propagating units such as sugarcane setts, dressing wounds sprinkling diluted suspension on plants and applying to soil.

### **Traditional Storage structure**

Storage and upkeep of agricultural products are very important post harvest activities. Considerable amount of food grains is being spoiled after harvest due to lack of sufficient storage and processing facilities (Singh and Satapathy, 2003). The selection of a traditional storage system by an ethnic group is often related to climate, but local natural resources and customs also influence the choice of the storage methods (Hall, 1970). Different traditional method of storage structures are discussed below.

**1.Thombai (Bamboo bin):** is a chief storage structure made from *Bambusa arundinacea* (Retzius) Roxburg (Bamboo) splits which are closely intertwined in such a way that a bamboo skeletal structure is formed with a narrow opening at the top. This structure is placed over a foundation of boulders and covered over on all sides by clay and allowed to dry. The interior of the structure is lime washed while the exterior is fortified with cow dung. When the structure is fully dried the grain to be stored is put in to the interior (figure 1). The clay provides an impervious coating which will not allow even small insect pests. The ginger grass used in the top cover has insect deterrent action which prevents insects from settling down on the structure.

**2. Mankattai (Mud house):** is the variant of *Thombai*, and it is normally kept indoors. Here, there is no bamboo skeleton and the walls are made of mud bricks and plastered over with a primary layer of mud. There is no spire, and the top is covered over with wooden planks after storing the grains inside. The whole structure along with the wooden planks is plastered over with clay and cow dung, allowed to

dry and then it is lime-washed (figure 2). The size of the *Mankattai* is determined by the farmer based on his need. Mostly it is used to store larger quantities of the same commodity.

**3. Kulukkai (Earthen bin):** is another popular storage structure for storing lesser quantities of grains (< 200 Kg). The structure has a unique shape with a smaller base and a broader top with a constricted mouth for pouring in grains (figure 3). The base of the structure is trenched in the soil, normally inside a protected house and there is a basal vent for removing the stored grains closed by coconut shell (*Cocos nusiifera* L.). When grains are stored for longer periods, the door or vent is sealed with clay.

**4. Addukkupaanaai (Earthen pot-pile):** is a small-scale storage system. A variant of the earthen bin is the earthen pot-pile (figure 4). Usually three pots are arranged one over another, the smallest being at the top, covered over by an earthen lid fastened by thick cloth. The pots fit exactly one over another in such a way that, there is no gap left. The lips are sealed with clay and cow dung to further ensure perfect alignment.

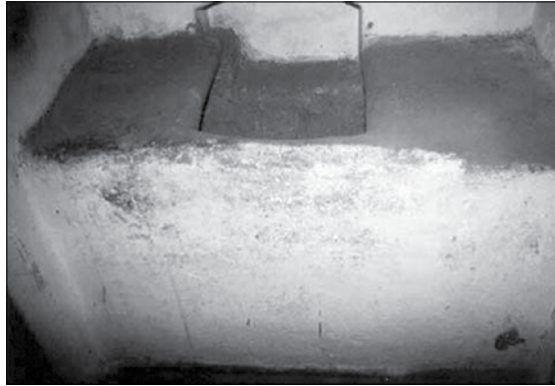
**5. Pathayam (Wooden bin):** is a wooden structure with a cubic capacity ranging from 2,000 to 10,000 litres. It is made up of wooden planks joined together by carpentry work (figure 5). The wooden planks are arranged in such a way that there is no gap left between any two planks since a third plank lies over the two planks along their junction. The only opening at the top is quite narrow (about 30 x 30 cm) (figure 5a) with a strong door which snugly fits into the opening. *Pathayam* is topped up with leaves of locally available plants like *Azadirachta indica*, *Pongamia pinnata*, *Annona squamosa* and *Eucalyptus globulus* which have proven insecticidal activity against stored product pests.

**6. Thallpai (Straw bin):** is an unusual storage structure made up of paddy straw for storing seed grains. This storage maintains the seed grains viable for about two years. Paddy straw is specially prepared for making this structure (figure 6). The ethnic groups using *Thallpai* (straw bin) live in hilly areas where the rainfall is high and the humidity, excessive. The straw bin protects the grains from moisture for the next season.

**7. Vattappetti (Palmyra leaf bin):** is normally used for short term storage of grains and exclusively designed to suit storage needs of an individual household (figure 7). The normal size (2.5-3 m height, 1 m width, 2 m length, capacity > 500 kg) is mainly used as maize storage. Seasoned Palmyra leaf (*Borassus flabellifer* L.) is carefully woven to form a type of cylindrical basket. In Palmyra leaf bin, the architecture is such that the Palmyra leaves are closely superimposed preventing the entry of insects. The dried leaves used for making this storage system are seasoned to make them hard enough to resist the bite of mandibulate insects and insect larvae that may hatch out from the eggs laid on the external surface. The ruggedness of the leaf sheath is usually not lost even after a period of one year in indoor storage. Usually double weaving is done to make the storage system more durable. The storage system is provided with a top cover made up of the same material and in traditional storage practices, leaves of plants like *Psidium guajava* L., *Vitex negundo* L., *Azadirachta indica*, and *Pongamia pinnata* are used as the optional inner lining of the palm leaf bin.



**Fig. 1.** *Thombai* (Bamboo bin), 3 m height, 1 m radius, capacity > 500 kg.



**Figure 2.** *Mankattai* (Mud house), 1.5 m height, 1.5 m width, 2 m length, capacity > 500 kg.

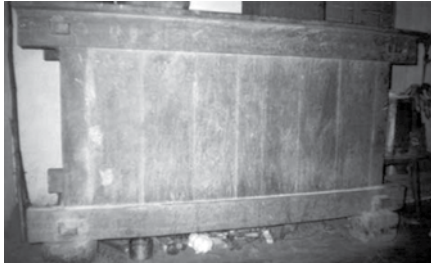


**Figure 3.** *Kulukikai* (Earthen bin), 2 m height, 0.5 m radius capacity: bottom pot 30 kg; middle pot 20 kg;

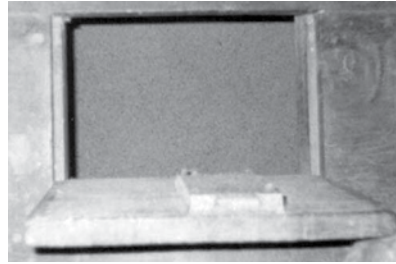


**Figure 4.** *Addukkupaanaai* (Earthen pot-pile), top pot 15 kg.





**Figure 5.** *Pathayam* (Wooden bin), 1.5 m height, 1.5 width, 2 m length, capacity > 500 kg.



**Figure 5a.** Door of *Pathayam* (Wooden bin)



**Figure 6.** *Thallpai* (Straw bin), capacity: 100 kg.

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# **Kuttanad-Global Agricultural Heritage: Promoting Uniqueness**

## **Dr. K G Padmakumar**

*Professor (Aquaculture) & Associate Director of Research (Rtd), Kerala Agricultural University,  
Regional Agricultural Research Station, Kumarakom  
E-mail: kgpadman@gmail.com*

### **INTRODUCTION**

United Nations, Food and Agriculture Organization (FAO) has recognized the adventurous farming community of Kuttanad, Kerala for their ingenious and traditional farming practice at below mean sea level situations by declaring Kuttanad as a Globally Important Agricultural Heritage System (GIAHS). The traditional farming practices developed and practiced for long by adventurous farmers that ensured conservation of its rich biodiversity endowments is considered as most relevant in the period of global warming and sea level rise owing to its climate resilience and adaptive significance. These ingenious agricultural systems developed by virtue of its profound relationship with nature reflect the evolution of human history and the diversity of its knowledge systems. This recognition for Kuttanad guarantees local and international efforts for the conservation of not only its rice history but also its rich biodiversity and genetic resources.

Worldwide, agricultural systems are created, shaped and maintained by generations of indigenous farmers. Diverse natural resources, and locally adapted management practices, local knowledge and experiences are the foundations for this development. These transformations result in outstanding landscapes like the one in Kuttanad. Undoubtedly, the sustenance of the agricultural biodiversity and indigenous knowledge systems ensures resilience to such ecosystems. Above all, such systems sustain multiple goods and services, food and livelihood security for the thousands of farmers especially the poor and marginalized.

Kuttanad is famous for its rich agricultural heritage and endemic biodiversity. The traditional rice varieties grown here were harboring several dominant genes for biotic and abiotic stresses. Unlike farmers in other regions who survived and evolved exclusively on traditional knowledge systems, the adventurous rural farmers in these places developed farming through their ingenuity and urge for resolving the boggling issues of food and nutritional insecurity. Almost all of today's landraces, claimed to have been evolved by our scientists were naturally the products of

careful and continuous selection by our forefathers, whose contributions remains unacknowledged and recognized.

## **THE BACKGROUND**

It is also well identified that our food production is under serious stress due to rapid globalization, privatization and increasing population pressure and environment degradation. Modern agriculture has also left us in a situation of biodiversity destruction and livelihood loss. The local food security has been dependant on its rich biodiversity, where growing several varieties of rice and animal husbandry and endemic biodiversity ensured livelihood security. The poor and the marginalized are the worst affected in this process. More than the ingenuity of management systems of farming under below mean level, the agricultural and biological diversity and a hoard of indigenous knowledge make Kuttanad farming system distinctive. Ironically, the declaration as global heritage site comes under a period when our wetland systems are exposed to greater risks from a variety of human Interferences. Pollution, habitat loss and environmental issues etc have driven the system in to great distress. The several packages promulgated to tide over the crisis has little effect due to the lack of initiatives and coordination..

## **KUTTANAD- HISTORY OF RECLAMATIONS FOR FARMING**

Kuttanad the low-lying area with backwaters canals and stream networks in the western coastal lowlands in South-central Kerala is an ill-defined area with common physical features and cultivation practices. It has unique features with its below sea level rice cultivation, the only one of such a system in India. The system is considered unique as it contributes remarkably well to the conservation of biodiversity and ecosystem services including several livelihood services for local communities. Physiographically, a major portion of the area forms flood planes on the upper reaches of the lake Vembanad, where rivers Achencoil, Pampa, Manimala and Meenachil originating from the eastern hills of Western Ghats confluence in to the Vembanad backwaters. The fertile land has been ideally suited for rice cultivation from the very early days as a major portion of this area has been lying below mean sea level. Private farmers undertook reclamation of the shallow regions of the lake with assistance from the state and over time, Kuttanad was developed in to a rice bowl, due to powerful landed interests and urge for rice farming.

Reclamation of land from the lake was a highly capital intensive activity that demanded mobilizing physical labor and development of large capital intensive agriculture. It is natural that this region also became a fertile ground for agricultural worker mobilizations, witnessing intense class conflicts and the nucleus of Kerala's political history. Next to agriculture, fisheries have been an important occupation for the local population. The backwaters that are connected to the Arabian sea, which brings in tidal influence and seasonal salinity in to the system also served as an extensive nursery for coastal fish and shellfish stocks. However, the developmental interventions principally oriented towards making it into rice centric economy has had long-standing effects on the fishery wealth of the region. The unique below sea level farming was developed and master minded by the adventurous farmers of Kuttanad during the past 150-200 years ago was woven to the cultural fabric and in consonance with the diverse biodiversity endowments.

Rice cultivation has been the foremost land use in Kuttanad. The rice culture developed by our forefathers were totally in consonance with the topography and merging with the climatic rhythm of the land. The traditional wetland use system was shaped in such way that it favored a crop of paddy at the most opportune time and during rest of the season the paddy lands served as flood plains and cushions for the rivers in spate. This also helped enrichment of the soils through silt-laden waters. The system promoted flourishing of diverse and unique aquatic wealth notably the endemic fish and shellfish species. The paddy lands or popularly called 'polders' and the dykes criss crossed with meandering network of canal systems were suitably planted with coconut and other intercrops. The agro ecosystem of Kuttanad thus comprised principally 'kayals', reclaimed paddy lands, polder dykes, 'tharas' reclaimed garden lands, and open waterways as an interwoven network. It also encompassed a unique biodiversity endowments viz., the myriad of rice varieties developed by the peasants over centuries, a large number of food and medicinal plants, livestock breeds, fish and aquatic bio-diversity apart from the migratory fauna that make it a repository of water fowl habitat. However,

The evolution of paddy cultivation in Kuttanad was correlated to the technological advancement and changes in the regulatory frame work existed during the 19th and 20th centuries. In the earlier times, reclamation was done mainly from the shallow part of the Vembanad lake or from the periphery of river systems. These reclamations constituted small areas of paddy fields called "Padsekhamams". Bailing out of water from those fields was done manually using water wheels named "Chakram". The period between 1865 and 1890 is usually considered as the first phase of kayal cultivation. Gradually the manual method used for bailing out of water gave way to steam engines. The introduction of kerosene engines for dewatering resulted in the reclamation of wider areas of the lake for cultivation. It made the farmers to think of venturing into the deeper parts of the lake.

### **Innovative knowledge systems**

Paddy fields remain completely water logged for a considerable period of the year from the onset of monsoon to post monsoon. Acidity of the soil in the dry period confines the rice cultivation season from October to January which is called punja. The surfacing of acidity is controlled by letting in water and flooding and at the same time the fields are natural rearing locations for fishes and the field functioned as breeding grounds for fishes. Naturally it is well known that in tropical regions fish breeding happens in flooded ricelands. Hence the paddy cultivation in lowlands used to be undertaken always in consonance with the unique role of paddy lands as fish habitats. The trapped sediments maintained fertility of the paddy lands and the need for extra manuring was very much unnecessary. The fields were kept fallow essentially for acidity amelioration and also for neutralization of toxic salts such as iron, aluminum, manganese etc which are in high toxic concentration in the soils..

Weeds being the major impediment to rice farming, farmers in Kuttanad these places have developed an ingenious practice of 'stale seed bed' technique to control weed growth where in the weed seeds are allowed to germinate before sowing and as the initial flush of weeds are germinated, the fields are deep flooded and submerged

under water for a week or so, and then flora get totally decomposed. The decomposed weed plants also turns out as a rich source of soil nutrients. Similarly for removal of soil acidity, shallow underwater ploughing using wooden plough, unique to these region is adopted. This practice help to remove acidity and toxic salts accumulated in the top soil. During monsoon, the fields perform a very significant ecologic function as flood plains and flood cushions. Such fields are also render as sediment traps for humus rich silt brought by the rivers..

### **Social hierarchical structure**

Historically Kuttanad is a densely populated area and the traditional agrarian structure until mid-20<sup>th</sup> century was hierarchical and caste based; land being owned or possessed only by upper caste Hindus or Syrian Christians (Kannan,1979). Cultivation used to be done by tenants, the agricultural laborers who tilled land and harvested the crop being scheduled castes and communities. The characteristic feature of this system was that it was inherently coercive in nature perpetuated itself by trapping the poor and the weak in a vicious circle of poverty, debt and bondage.

### **Land reclamations for Rice farming**

Records of lake reclamation as *padasekharams*, polders are available from 1834 when the government of Travancore advanced loans for reclamation and by the dawn of the 20th century almost 2300 ha of Vembanad lake was reclaimed. The initiative for institutional reforms came from the monarchy and by 1850, as a consequences of this policy, a major share of the cultivated land and the whole of the wetland came under the state. This led to the emergence of a class of independent farmers who reclaimed the back waters of Kuttanad for rice cultivation through operations which required large capital.

### **Pioneering Kayal Reclamations**

The pioneer in Vembanad reclamation was one Eravi Kesava Panickar, belonging to the Chalayil family, one of the leading landed aristocrats in Kavalam (Kerala Gazetteers, 1975., Pillai and Panikkar, 1965). He was an unusual person who commanded great respect and influence. His very first effort bears an eloquent testimony to his innovating genius. It was a project to reclaim that portion of Vembanad, (Attumuttukayal) which was situated at the mouth of Chennankari River. He proceeded to erect a barrier across the river at its mouth with local materials and manual labor. He had to face the opposition of local people who filed a case against him for diverting the course of river. Sir Raja Rama Rao, the Dewan Peshkar, Travancore was deputed to conduct an enquiry and personally inspect the site. The farsighted Peshkar was more impressed with the potentialities of farming development, which this genius had opened up than as an offence of law. Fully alive to the problem of land shortage and food scarcity in the state, he saw in this novel adventure a new vista of possibilities. Contrary to all expectations, instead of reprimanding the offender, the Peshkar congratulated Mr. Panickar and blessed his adventure. Encouraged by the success of his first venture, Mr. Panicker set about other reclamation schemes also. The next block which he reclaimed was named after the Peshkar as 'Raja Ramapuram kaya'l. This is the beginning of the history of kayal reclamation in Kuttanad which



is the most important advance in the history of Kuttanad farming development. This example of early pioneers was followed by enterprising agriculturists, Shri. Kalathil Antony Mappalai and Chirayil Thomman Mappila, whereby, over 5500 acres were reclaimed by the beginning of the 20<sup>th</sup> century (Kerala Gazetteers, 1975).

The successful experiment of reclamation of land from the lake helped to convince the local public of the immense possibilities of *kayal* cultivation. Several other enterprising farmers in the later days further continued this marvelous feat. But second phase (1890 to 1903) of reclamation activities came to a halt because of the ban on *kayal* reclamation imposed by the then Madras Government in 1903 on expression of fear that Vemband reclamation would adversely affect the development of Cochin port. The ban on reclamation was further withdrawn in 1912 after protracted deliberations. The increasing pressure of population on land during the last century and the exhaustion of shallow backwaters for reclamation purposes compelled the people to venture in to the deeper waters of the Vembanad lake. These are known as the "New reclamations". The efforts for reclamation thereafter continued with great enthusiasm. The scarcity of food grain during 2<sup>nd</sup> World War and the 'Grow More Food' campaign gave momentum to adventures of the most outstanding figure in the history of Vembanad reclamation has been by Shri. Thomas Murikkan who reclaimed about 1980 acres in one stretch which was the most marvelous feat. The advent of electric motors by then made the reclamations relatively easier, cheaper and less risky as compared to the earlier periods. On the whole 20000 acres of Vemband lake had been brought under farming by 1945. He named these polders after the Queen Regent and her two sons as Rani, Chithira and Marthandom kayals. These were also the last tract of reclamations made which is also known as Q, S and T blocks. Thomas Murikkan did cultivation in a very large extent of reclaimed kayal and achieved great success and was crowned as "Krishi Rajan" (farmer king) by the then Prime Minister of India, Jawaharlal Nehru.

### **Crude and Indigenous technologies**

The initiative for reclamation of land for rice came from a few individual entrepreneurs with slender resources. The only aid at their command to conquer the invincible Vembanad consisted of crude indigenous implements and flimsy materials. It is a miraculous feat that they conducted the exciting operations of bunding, draining, ploughing and bund raising in the lake area with the help of bamboo, split coconut, excavated earth using country canoes. Strong wooden water wheels of about 12 feet diameter were used for baling out water. The state also encouraged the movement by simplifying the procedure for appropriating backwaters for reclamation purposes. The role of state was passive and shy in the beginning. Among the encouragements given were the exemption of reclaimed lands from taxes during the first five years after reclamation, and concessional rates of taxes during subsequent years, in addition to loans and subsidies for cultivation and pumping out water.

### **Interventions- Post Independence**

All the state interventions in Kuttanad after independence were oriented to turning it in to rice centric economy. In addition to early reclamation of land from marshes and the backwaters under private initiatives for as rice farming, for facilitating double

cropping in the region, two engineering structures were built -1) a spillway to drain off flood waters and 2) a barrage across the Vembanad lake at Thanneermukkom to prevent ingress of salinity to the vast paddy lands of Kuttanad. The salinity barrier was meant to limit the damage caused to rice by high spring tide in November and saline water intrusion in February-March. Although it was thought that the growing season for rice could be extended and cropping intensity increased, the unintended consequences of the spillway and the barrage were most catastrophic and counterproductive.

### **Green Revolution Period- after effects**

Kuttanad was selected as one of the regions in the country for Integrated Agricultural Development Program(IADP) during the green revolution period,. Massive use of fertilizers and pesticides became inevitable for this type of rice farming. Agro-ecological constraints in cattle rearing on large scale in Kuttanad also limited the availability of organic manure leading to dependence on chemical fertilizers for high productivity. The advent of HYV seeds which were more prone to pests and disease forced intensive use of fertilizers and pesticides. Inherent soil problems, vulnerability of crop to pest attacks in Kuttanad due to high humidity etc demanded massive use of pesticides for the high yielding rice technology. Farming in tune with the climatic rhythm of the land changed to convenience farming. Salinity exclusion barrage that warded salinity helped to time the cropping according to convenience. This has in turn led to gross indiscipline that followed no crop calendar. Excessive weed growth and environment induced pest and disease problems only helped to increase the cost of production of rice. Rice farming in such situations turned uneconomical and cropping intensity fell from 160% to 114 % (Padmakumar, 2006 ).

### **Shrinking backwaters - Declining Fisheries**

Kuttanad region with its extensive water bodies and connection with the seas has also been the source of livelihood for a substantial section of the society. Most of them belonged to the lower cast landless laborers and fishers who mostly depended on the Vembanad lake and water bodies for livelihood. Because of the massive reclamation and encroachments of kayal lands for agricultural and non-agricultural purposes, fishable area have declined drastically.

### **Socio- Political Processes**

The shift in worker mobilizations on community identities happened in 1930's when the Congress socialist party (CSP) which later joined the Communist party, began organizing workers in to Travancore Karshaka Thozhilali Union (TKTU) in 1940. The emergence of social reform movements for social dignity for the poor also fuelled this process. The movement flourished in the context of tenancy reform of 1930's. The rebellious labor mobilizations against the influential landlords who framed cases against labor leaders and wielding of economic weapons, denying work etc were all part of the political history (Kamalasanan,1993). The period of 1950's were most turbulent. Farmer vs labour conflicts and unions declaring regular strikes at critical period of crop such as harvesting etc were most common. There were also counter mobilization against militant trade union leaders and formation of Kuttanad Karshaka

Sanghom in 1932 and the Upper Kuttanad Karshaka Sanghom in 1958 developed as a defence and counter offensive mechanism (Narayanan,2003).

### **Rice Centrism Backfires**

Rice cultivation is the important agricultural process that identifies Kuttanad as “The Rice Bowl of Kerala”. With the several interventions, the traditional one crop per year has changed to two crops annually in at least some areas. For centuries, fishing has been an important occupation for the population of the area. There is both subsistence and commercial fisheries in the backwaters. Because of massive reclamation and encroachment of kayal lands for agricultural purposes, the availability of fishable area to fishers have become reduced and inland fish production has suffered immensely. The inland fisher’s interests and livelihoods seldom received attention in the developmental history of Kuttanad. Almost all the state interventions in Kuttanad later , were oriented towards turning Kuttanad in to rice centric economy. This led to a vicious cycle of cultivation by intensive use of fertilizers and pesticides that affected the ecosystem and biota. With backwater tourism gaining strength in Kuttanad during early 2000, the water bodies designated as *puramboke* in records were reclaimed legally and illegally . This has led to deep resentment and uprising of fisher folks in Kuttanad demanding permanent opening of the Thanneermukkom barrage.

### **Effects on Livelihood and Biodiversity**

Traditional diet of the people in Kuttanad were dependant on the rich biodiversity that included primarily rice, fish, coconut and cassava prawns, crabs, mussels, duck meat, milk, etc. Kerala is well known for the rich genetic diversity of the traditional rice varieties grown during various seasons. However, indigenous rice adapted to local environmental conditions are hardly cultivated now in Kuttanad and they have totally disappeared with the advent of high yielding varieties. Most popular high yielding and early duration varieties of rice include Karthika, Makom, Jyothy, Mattatriveni, Annapurna, Revathy, Remanika, Krishnanjana, Prathyaasa and medium duration varieties are Bhadra, Asha, Pavizham, Remya, Kanakom, Jaya, Sabari, Bharathy, Renjini, Pavithra, Panchami, Uma, Gouri. The most popular rice variety of the State is Uma (MO.16) developed by Rice Research Station, Moncompu followed by Jyothi, developed from Regional Agricultural Research Station, Pattambi (KAU,2011)

An inventory of biodiversity in 110 holdings in Kuttanad wetland covering Alappuzha and Kottaym district taken up by the Regional Agricultural Research Station, Kumarakom (RARS Annual report , 2012) revealed 210 species of plants under as agro biodiversity components comprising endemic germplasm of banana, medicinal plants, spices , tuber crops and minor fruit plants. There were 28 genotypes of indigenous mango and several genotypes of jack identified from this wetland as part of this study. In addition to above, 6 mango germplasm types that flower round the year bearing was also reported. A study on floristic composition of *pathiramanal* island in Vembenad lake (Pradeep and Padmakumar, 2003) indicated that a small area of 68 ha harbors a total of 118 species of indigenous vascular plants represented under 107 genera and 58 families. The observed high diversity in such a small area is indicative of the floral richness of Kuttanad. Famous local

breeds of Kuttanadan ducks, Chara and Chempalli, Kuttandan buffaloe, Vechur cow, Kuttanadfan konchu, *Macrobrachium rosenbergii*, Karimeen, *Etrophus suratensis* and Kakka, *Villorita cyprinoides* are biodiversity icons of this wetland. The Kuttanad wetlands are also an important bird area (Islam and Rahmani, 2004) that sustain a good number of migratory avian fauna comprising over 229 bird species belonging to 59 families. (Prashant and Sreekumar, 2010). A one day fish inventory, organized for the first time in the state in the river Meenachil, in Kuttanad in 2004 inventoried 48 species of fin fishes and over 14 species of shell fish species (Padmakumar, 2006). In later inventories over 65 fin fish species have been identified to exist (Atree, 2012). Some of the endangered fish species of the region reported are the endemic carp of Central Travancore, *Labeo dussumieri*, (Tooli/Pullan), the esteemed golden catfish, *Horobagrus brachysoma* (Manjakoori), river catfish, *Wallago attu* (Attuvaala), highland species, *Gonoproktopterus curmuca* (Kooral), the Travancore catfish *Clarias dussumieri* (nadan muzhi), *Macropodus cupanus* (Karinkana), *Parambassis dayi* (Nandan), the spotted murrel, *Channa diplograma*, *Tetradon travacoricus*, (Pufferfish), *Pristolepis marginata*, (Pannakarimeen), *Macrognathus guentheri*, *Panarakan*, Kuruvaparal, *Puntius sarana subnasutus* (Panarakan) etc. Some of these species have been captive bred (Padmakumar et al. 2004) and returned to abundance through artificial propagation and ranching interventions

The virtual exclusion of salinity and adoption of high input rice cultivation practices by indiscriminate use of pesticides led to near elimination and endangerment of several fish species. The disruption of the physical and biological continuity of the lake with the coastal waters also fuelled the decline of fish production to almost one tenth, upstream i.e., 507 to 584 tons per annum (Padmakumar et al., 2002). The chronic imbalances in the species spectrum of the lake and impoverishment of fauna from 150 species to 36 species upstream the barrage has also been documented (Padmakumar et al, 2002).

The physical obstruction by the barrage and its effect on the fishery of the endemic freshwater prawn, *Macrobrachium rosenbergii* has been catastrophic. The annual recruitment of *Kuttandan konchu* was totally disrupted in its home ground. The annual catch of these species during the pre-barrage days was as high as 429 tones which dwindled to less than 40 tones in the late eighties and further down to 27 tons on the southern stretches after a brief spell of recovery during the late 90's (Padmakumar et al., 2002)

The black clam, *Villorita cyprinoides* (Family, Corbiculidae) is an important biodiversity endowment of the Kuttanad wetland system. This species supported an artisanal fisheries provide livelihood to hundreds of poor fishers, mostly womenfolk. Over 90 percent of the natural lime produced in the country is also contributed by the shell fisheries from Vembenad. With deprivation of salinity and environmental decline, this species has been on rapid decline. *Vembenad 'vella kakka'* has been an important product of geographical acclaim. The estuary that accounts for an average annual production of 45,000 tons almost two-thirds of the total production of in the country. The optimum salinity for spawning of this species has been 10-12 ppt. Being a filter feeder, feeding predominantly on green algae, this species serve an important role in bioremediation of the lake by reducing eutrophication, (Teena and

Padmakumar, 2012). Most unfortunately the species is severely on the decline due to cutting of salinity to facilitate rice farming in Kuttanad.

Another major ecological consequence of these interventions has been the near extinction of the estuarine mangroves that fringe the shores of these backwater system that provide breeding grounds for a variety of fish species. Mangroves, were once abundant in all the river mouths of Kerala and have become severely depleted owing to a variety of interferences. Being nursery and breeding grounds for the fish species such as pearlspot, the damage to indigenous fisheries has been colossal.

Pearlspot, *Etroplus suratensis*, considered as the heritage fish of Kuttanad is endemic to Kuttanad and Vembenad lake, considered as the homeground of this species. Though tolerant to lower salinities, it suffered rapid impoverishment due to habitat destruction. This is attributed *inter alia* to large scale reclamation of shallow wetlands and destruction of the fringing vegetation of mangroves, that served as favored nursery areas for pearlspots. Apart from this, their unique breeding and courting behavior, bi parental monogamy, etc also impose severe constraints in natural recruitment. Pearlspot being a visual breeder that essentially need transparency of water for breeding, the high turbidity imposed by discharge of organic wastes inflict serious damages to their recruitment.

### **Emergence of Integrated Farming models**

There is a strong view that the Green Revolution inspired technologies adopted in Kuttanads in tune with the national agenda have been inappropriate owing to its complete negation of natural agro-climatic situations. Several studies carried out show that by conserving biodiversity and development of Integrated farming combining rice and fish in the wetlands can be a better option in such context. The rice-fish farming model now popular in the region as *Oru Nellum Oru Meenum* (Padmakumar et al., 1985, 2005) developed and popularized in Kuttanad wetlands for example is a suggested alternative to monocropping of rice, as rice and fish are staples in the diet of the peoples. Judicial integration of rice and fish has been demonstrated to enhance average income of farmers by 40 percent with significant savings on rice production costs rendering rice farming more organic, attractive and remunerative.

### **Farming practice- tuned to topography**

It is increasingly evident that our heritage farms should also become natural habitats for wildlife by increasing plant diversity and by mimicking the native ecosystems. Biodiversity cannot be preserved effectively as isolated islands in a sea of chemically drenched monocultures. Rather, our farm areas must serve as corridors for species that thrive in natural areas, and as refuges in times of stress. Our traditional farmers knew full well that rice fields provide not only home to a wide range of aquatic organisms, but also offer opportunities for their enhancement and culture. Traditional paddy cultivation patterns adopted by them had profound respect for the natural functions of wetlands and their land uses rarely disrupted them. Over centuries, our peasants have evolved varieties and strategies for rice cultivation in consonance with the rigid environmental conditions be it Kuttanad or Pokkali. This globally acclaimed saline tolerant rice variety, *pokkali* evolved by farming community has thus been capable

of tolerating salinity up to 6-8 ppt. The development of unique *Pokkali* system of farming on the coastal stretches of Vembenad in rotation with shrimp farming is an excellent example of a system wherein, in one and the same field, a rice farmer and shrimp farmer operates cyclically at different periods of the year. Pokkali farming has acclaimed recognition recently as geographical indicator and heritage species. In the coastal stretches when rice is cultivated during the low saline phase and shrimps during the summer, the situation is altogether different in Kuttanad where paddy is raised traditionally after the cessation of monsoon.

### Global Heritage Status to Kuttanad

The key feature of the Global heritage system in Kuttanad is that it is linked to the most adventurous people living there. The farming community has, over the centuries understood, appreciated, and developed a farming practice in consonance with the rich biodiversity of plants and animals. The system developed with the ingenious knowledge of natural systems and biodiversity endowments. Hence our efforts shall be to safeguard and support ecologically viable heritage farming practices and identification of the unique ecological environment to support and enhance the wide variety agro biodiversity. The declaration demands promulgation and espousal of strategies that effectively address the concerns and apprehensions on the unsustainable processes being promoted in Kuttanad during the recent past, which forecloses the ecosystem services in the name of economic development. The declaration comes at a critical time on the predicted issues of climate change is feared to jeopardize our food security. Management of heritage farming therefore calls for development of an enabling environment that promote and enhance the traditional farming practices by conserving biodiversity and ecosystem service unique to the region. This also calls for massive education and sensitization of all the stake holders on the real ecosystem values, its unique history and adaptive values.

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***Subtheme II:  
Culture, Heritage and Biodiversity***





# Culture Heritage and Forestry in Kerala: Issues, Opportunities and Way forward

**Dr. Anil Kumar Bhardwaj, IFS**

*Additional PCCF(FMIS), Kerala Forest & Wildlife Department, Thiruvananthapuram*

## INTRODUCTION

Culture may be seen as the inherent human nature of relating within community and people, land and all life, and the awareness of these relations. Culture forms who we are in family, in society and so in the landscapes we form directly and indirectly. Culture defines a unique communality of a people that celebrate through familiar customs, practices, resource use, arts, institutions, history and achievements (FAO, 2009). Forests play a vital role in the life and culture of people around the world. The reverence and adoration of trees has a strong psychological and social foundation in most human cultures. The variety of cultural values and symbolic functions ascribed to forests are as numerous and diverse as the communities and cultures. Forests feature in all these aspects of culture: language, history, art, religion, medicine, politics and even social structure. Heritage is that which is *inherited* from past generations, maintained in the present, and bestowed for the benefit of future generations. Therefore when we talk about culture and heritage it is a process of past, present and future and is a dynamic phenomenon. Broadly heritage could be classified in two categories i.e. cultural heritage and natural heritage (IUCN 1972). While talking about forests and forest landscapes the main focus remains on natural heritage however in real sense cultural and natural heritage are inseparable and these are in fact the two sides of the same coin.

Forest heritage and culture are reflected in a range of traditions and values throughout the world. Sacred groves are one of these manifestations where specific forests sites are used as a means of communication linking with their ancestors. Traditional knowledge is another manifestation of heritage which has long been known to have implications for forest management, conservation of Bio diversity and identification of forest genetic resources. Traditional knowledge and practices have sustained the livelihoods, cultures and forest resources of local and indigenous communities for centuries and it has been historically very dynamic, respondent to changing environment, social, economic and political conditions in to ensure that the forest continue to provide tangible and non-tangible benefits to present and future

generations. Another window of natural heritage is through traditional knowledge and medicines which refer to health practices approaches knowledge and believes incorporating plant and animal based media, spiritual therapies to diagnose, treat and prevent illness or maintain well being (UNFF, 2010).

### **KERALA FORESTS – ECOLOGICAL HERITAGE AND CULTURE**

The Western Ghats is one of the 8 hottest hotspot areas of biodiversity in the world. This comprises on 5% of the geographical area of the country which harbors 27% of India's floral diversity. The area harbors 60 Important Bird Areas (IBA), 325 globally threatened species, many endemic species and sacred groves spread over six states (Krishnaswamy et.al, 2006). Sixty five (Forty four in Kerala) rivers which originates from Western Ghats are lifeline for the local people. Kerala with 1.2% of the total geographical area of the country support 27% of total biodiversity of India. State forms part of Southern Western Ghats which have unique assemblage of flora and fauna with highest level of endemism and rarity (Gadgil, 1996 and Daniel, 1997). 29% of the total geographical area of the state is under forests. Even though there has been significant conversion of areas into plantations in the past, about 75% of the forest area of the state is still under different types of natural forests and with varying ecological status (Table 1 & 2; KFD Data Base, 2013). State has a representative Protected Area (PA) Network consisting of 5 National Parks, 15 Wildlife Sanctuaries and one Community reserve and collectively this covers about 23.86% of the total forest area. State has two Tiger Reserves and two Biosphere Reserves. Large extent of the forest area also forms part of project elephant. From Human dimensions point of view there are 723 tribal settlements with the population about inside the forest areas. Historically long associations of tribals and forests have undergone many ups and downs in the light of changing policies and management scenarios and socio political environment.

**Table 1**  
Classification of forest areas in Kerala

Sl No.	Forest type	Area Sq.km (% of Total)
1	Tropical Wet Evergreen and Semi Evergreen	3877.4413
2	Tropical Moist Deciduous	3615.9840
3	Tropical Dry Deciduous	391.3636
4	Montane Sub-tropical Temperate sholas	386.4210
5	Plantations	1477.3930
6	Grass Lands	501.0865
7	Others	1059.7860
	<b>Total</b>	<b>11309.4754</b>

**Table 2**  
Protected Areas (PAs) of Kerala

Sl No	Category of PAs/ Landscape	Area in Sq. km (% of Total)
1	National Parks (NPs)	356.155
2	Wildlife Sanctuaries (WLS)	2342.554
3	Community Reserves (CRs)	1.500
4	Tiger Reserves (TRs)	1568.67
5	Biosphere Reserves (BRs)	3283.40
6	Elephant Reserves (ERs)	10089.00
7	Total Area under PAs (NPs, WLS and CRs)	2698.709

*Kerala Forest and Wildlife Department data base*

## **HISTORY OF FOREST MANAGEMENT IN KERALA AND IMPACTS**

The span of forestry experience of Kerala is quite unique. Forest management has responded to the changes in external environment by varying the emphasis on expansion, production and conservation in different periods (KFRI, 1993). During 3000 BC, Assyrians and Babylonians were drawn to Kerala for Spices. The trade of spices became brisk in 5th century AD when Romans and Arabs started visiting Kerala. However most of this activity remained centered around coastal towns and settlements clustered around these areas and therefore thick forest which mostly lied along Eastern Boundary of the State in Ghats remained more or less undisturbed. This KFRI study reveals that first journey towards forests in hills started when rice, the most important cereal crops, was gradually extend in to the forested valleys with the help of a refined crop calendar and a labor intensive technology developed by Namboothiri Brahmins. The transformation of extensive forests landscape of Kerala during last two centuries has been remarkable. Forests where only small groups of tribal's threatened by killer diseases and crop raiding animals lived, survived without significant human modifications. Three-fourth of the land area of Kerala was under thick forest even up to 18<sup>th</sup> century till the emergence of British as unchallenged supreme power in India assumed direct rule of Malabar and gradually established controls over Travancore and Cochin through political alignments. These changes had significant impacts on forests of the region. European planters successfully initiated coffee and teak plantations as private sector. This also led to development of roads in the hills which accelerated the process of development. Economic integration with world markets let to curtailing of rights and controlling of activities of tribes in forests by European planters, foresters and peoples from plains. Expansion of commercial activity and trade in timber including strategic demands of timber for ship building timber and railways sweepers on one hand and the conservation ideas to protect the recourse as well as ecological consideration lead to policy of reservation of large forest tracks. Food scarcity during and after world war created emergency situation which allowed unplanned openings in the forests for agriculture. Political changes during same period such as India's independence, change over to democratic rules and realignment of state boundary gave a boost to migrations in to the forest areas which could not be regulated in future by administrative arrangements. Shifting cultivation was prevalent in the forests by tribals during this period. However it was gradually and systematically controlled. After independence, particularly during 1970s, the phase of expansion of exotic plantations accelerated (Table 3). Grass lands in high ranges were planted with eucalyptus by Forest Department for supply of raw material to industry. The development of markets for different produce, technology for plantation raising, processing of produce, improvement of transportation, growth and migration of population, war, food shortages and government policies for expanding agriculture and in supporting industrialisation by providing cheap raw materials in the post independence period have all influenced forest management. This was also the time of legislations in the form of Kerala Forest Act, 1961; followed by Kerala Private Forests (Vesting & Assignment) Act in 1971, adoption of Wildlife (Protection) Act in 1972 and then Forest Conservation Act 1980. After the coming of 1988 Forest Policy there had been a reversal of management style of forests from

production to conservation. World Bank assisted India Ecodevelopment Project in Periyar and Kerala Forestry Project provided platform to translate the principles of Forest Policy in some sort of action through community participation and livelihoods and focus on biodiversity conservation. The challenges to forestry can be said to be different in different periods. The earlier challenges were in regulating felling and in developing markets for the forest produce. In the second period the challenge was to cater to the new and increased demand for produce and land. In the third period the challenge is to meet the growing demands in an environmentally acceptable manner.

**Table 3**  
**Important mile stones in the History of Forest Management in Kerala**

3000 BC - 500 AD	Assyrians and Babylonians were drawn to Kerala for Spices. Romans and Arabs started visiting Kerala for brisk trade of spices in 5 <sup>th</sup> century
1792-1800	In 1792 Malabar came under British and till 1800 3/4 <sup>th</sup> of area of state was under forests and tribals more and less in harmony with forests
1800-45	Over exploitation of Malabar Forests for Teak and poor regeneration till 1841. In 1844 world's first Teak plantations of Nilambur established.
1882-87	Adoption of Madras Forest Act and reservation of forests. In 1887 Travancore Forest Act came into force and reservation of forests started
1891-99	Bourdillon appointed as first Conservator of Travancore in 1891. In 1894 first working plan of Nilambur division. Construction of Mulla Periyar dam in 1895 followed by declaration of Periyar Lake Reserve in 1899.
1934-50	Declaration of Periyar Game reserve and then Periyar Wildlife Sanctuary
1940	Influence of private industry on forestry
1956	Constitution of state of Kerala by merging Travancore, Cochin & Malabar
1961-73	Kerala Forest Act Passed in 1961 followed by Kerala Private Forests (Vesting & Assignment) Act in 1971 and in 1973 adoption of Wildlife (Protection) Act 1972.
1975-78	KFRI established in 1975 & Periyar became Project Tiger Area in 1978
1982	Social Forestry Programme started
1984	Silent Valley Constituted as National Park.
1996-98	India Ecodevelopment Project of Periyar & Kerala Forestry Project

### **COMMUNITY PARTICIPATION IN FOREST MANAGEMENT- MAJOR ACHIEVEMENTS**

1988 Forest Policy brought a major shift in the management of forest in India. This was the time when in the light of acute protection problem in Periyar Tiger Reserve, there was a growing concern for strengthening protection machinery to deal with poachers and ganja cultivators and also to elicit support of local people particularly tribals for the reserve by providing alternatives for reducing their biotic pressures on the forests. In line with mandate of Forest Policy of 1988 and subsequent resolution

of Government of India on Joint Forest Management in 1990, Project Tiger initiated a new scheme for Eco-development around Sanctuaries and National Parks including Tiger Reserves. This was the beginning of a new change where better relations were built with local communities through community welfare programmes on a very low profile. As the relations with the local people started improving, there were small successes in protection particularly of management of forest fires and the seed of new institutions in the form of EDCs to support alternate livelihoods to the local people was sown. In this back drop Periyar was picked up as one of the sites for World Bank supported India Eco-development Project in 1995 (Bhardwaj et. al, 2004). Already there was another World Bank assisted participatory biodiversity conservation initiative was being implemented under FREE project in Kalakkad-Mundanthurai Tiger Reserve of Tamil Nadu. During 1996 another project namely Kerala Forestry Project was also initiated in Kerala and this also had important component of community participation for biodiversity conservation both in PA and non- PA areas of the state.

### **MAJOR OUTCOME OF PARTICIPATORY PROGRAMMES OF FOREST DEPARTMENT**

As on today there are 407 Van Samrakshana Samities (VSS) and 198 Ecodevelopment committees (EDCs) working under the umbrella of 34 Forest Development Agencies (FDAs) and one Foundation (Periyar Tiger Conservation Foundation) in the state as a part of participatory management programme of the forests (KFD, 2009). All these programmes have lead to significant positive changes with respect to biodiversity conservation and strengthening of local livelihoods. These initiatives have also been able to integrate and support directly or indirectly the local culture and traditions through various activities. There has been significant decline in terms of resource use from forest areas. Studies indicate that in Periyar due to change in livelihood patterns supported by ecodevelopment programme the firewood pressures on the tiger reserve have reduced by about 57 percent. Illegal collection of cinnamon bark and poaching has completely stopped as the communities involved in these illegal activities are now being positively engaged in ecotourism and protection programmes of the reserve (Bhardwaj, 2008). Similar initiatives in Parambikulam Tiger Reserve and Eravikulam National Park have provided alternative livelihoods to the local dependent communities and transformed these areas as important ecotourism destination in the country. In non PA areas the fringe area communities are being engaged in sustainable collection, value addition and marketing of non timber forest products (NTFPs) through the institutions of FDA and Vanashree. As on today more than 60000 families are getting benefitted through these programmes (KFD 2009). The attitudes of local communities have undergone a significant change over the time and the level of their participation in conservation of forests has increased. Studies indicate the due to improved protection status and reduction of biotic pressures status of regeneration in many affected areas in the past has improved (Veeramani, 2002). There are indications of women empowerment and societal revival in areas like Periyar and Parambikulam. Local cultures and tradition have been skill fully integrated in ecotourism programmes in some areas so as to strengthen livelihoods of these people and they feel proud of their heritage. Traditional knowledge and skills

of communities have been used in collection and marketing of NTFP again to link it to their livelihoods. In nutshell the programme has provided an improved system of governance through decentralized decision making and stakeholder participation. Periyar and Parambikulam are emerging as new models of PA management in the country and the lessons from these have led to Policy level changes at National level.

### WESTERN GHATS AS WORLD HERITAGE SITE

Due to the ongoing positive initiatives, the Western Ghats which are older than the Himalayas and are described as one of the world's eight 'hottest hotspots' of biological diversity were inscribed in the UNESCO World Natural Heritage sites list in July 2012. ATREE was one of the organizations in 2006, that had supplied the science for identification and nomination of sites in the landscapes of Agasthyamalai, Periyar, Anamalai, Nilgiris, Upper Cauvery in Kodagu, Kudremukh, and Sahyadri. These were thirty-nine sites in seven sub-clusters of the Western Ghats. The proposal was made by the Ministry of Environment and Forests based on expert inputs from ATREE, Nature Conservation Foundation, Mysore and Wildlife Institute of India, Dehra Dun. As on today Western Ghats has been listed as world heritage sites by UNESCO and Kerala has 19 sites in 5 sub clusters in this list (Table 4).

**Table 4**  
**World Heritage sites of Kerala**

Sl. No.	Name of sub cluster	Name of site
1	Agasthyamalai Sub-Cluster	<ul style="list-style-type: none"> <li>• Shendurney Wildlife Sanctuary</li> <li>• Neyyar Wildlife Sanctuary</li> <li>• Peppara Wildlife Sanctuary</li> <li>• Kulathupuzha and</li> <li>• Palode Ranges</li> </ul>
2	Periyar Sub Cluster	<ul style="list-style-type: none"> <li>• Periyar Tiger Reserve</li> <li>• Ranni</li> <li>• Konni &amp;</li> <li>• Achencoil Divisions</li> </ul>
3	Anamalai Sub Cluster	<ul style="list-style-type: none"> <li>• Eravikulam National Park</li> <li>• Mankulam Division</li> <li>• Chinnar Wildlife Sanctuary,</li> <li>• Mannavan Shola and</li> <li>• Karian Shola</li> </ul>
4	Nilgiris Sub Cluster	<ul style="list-style-type: none"> <li>• Silent Valley N.P.,</li> <li>• New Amarambalam R.F,</li> <li>• Kalikavu Range &amp;</li> <li>• Attappady R.F</li> </ul>
5	Thalacauvery Sub Cluster	<ul style="list-style-type: none"> <li>• Aralam Wildlife Sanctuary</li> </ul>

### MAJOR ISSUES AND OPPORTUNITIES

There have been significant positive trends for protection and management of forests and biodiversity atleast in some pockets of Kerala through ongoing community focused approach of management. However there are many issues as well which need

immediate attention. Increasing Human wildlife conflict is the most serious challenge which leads to heavy damages to crops and private property as well as to lives of people in some of the forest areas. Department tries to give some compensations to the victims and support for erecting barriers to restrict the entry of wild animals to private areas but the problem still remains acute. At landscape level there are serious issues of connectivity and corridors due to developmental pressures. In some areas the invasive species are increasing. The menace of forest fires is another concern. To deal with many of these issues there is inadequate trained man power as well as backing of sound research base. Above all for replication conservation-development initiatives over large landscapes and outside traditional boundaries of forests there is need of better integration and coordination of other development departments, agencies, research institutions, NGOs and civil society organizations.

Even though there are many issues we have many opportunities too. Initiative of Kerala in linking communities for conservation of this natural heritage of biodiversity and culture is being seen as a new model. Already there is a proposal to designate Periyar as a learning centre for participatory biodiversity initiatives under the ongoing World Bank assisted “Biodiversity Conservation and Livelihood Project (BCRLIP)” initiative so that different staff and other target groups implementing similar programmes in their states can come over here and learn from Kerala initiatives. There is a larger policy support for ongoing initiatives in the wake of climate change. Western Ghats have been recently declared as eco-sensitive zone by Government of India which also opens new issues and provides many opportunities. In general there is a larger national and global support for these initiatives to protect our natural heritage by linking local communities and cultures. In this fast changing environment some of the old cultures may perish or get merged into the dominant ones but still there is a possibility that some of these cultures adapt to the changing circumstances and maintain their identity. What is required is a careful hand holding of the traditional communities for empowerment so that they are able make choices of coming opportunities and continue to protect their natural heritage and take pride in their culture. This will need sound planning, replication of ongoing good practices through integrated approach, political will and sound support of scientific research and monitoring.

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# Some Aspects of Kerala's Cultural Heritage and Ecological Sustainability

**Dr. Rajan Gurukkal**

*Visiting Faculty, Indian Institute of Science, Bangalore and Former Vice Chancellor,  
MG University, Kottayam*

## INTRODUCTION

The paper seeks to review certain aspects of Kerala's socio-cultural heritage in the perspective of the science of ecological sustainability. Heritage is the cultural aggregate what survives across social formations, withstanding even great transformations of epochal dimension. We cannot review the cultural aggregate of all the social formations of Kerala in their chronological sequential order in a short paper like this. Such an exercise cannot satisfy the purpose of analyzing ecological sustainability of heritage either. Therefore, the method of approach adopted here is to try and historicise heritage aspects of the present in order to sort out the most archaic from them, which were compatible with the landscape ecosystem and elucidate them against contemporary socio-cultural aggregate. This would mean that we have to historicise the socio-economic and cultural traces in the life of the eco-system people, the tribal descend groups, in the forest. Subsistence and survival through hunting, gathering, sheep rearing/cattle keeping and shifting cultivation is characteristic to these people, who are incorporated by the dominant world and hence existing as the marginalised. Historicisation takes us back to the ancient past of human existence as adapted to the landscape ecosystems of Kerala. Therefore, a brief sketch of that life's socio-cultural aggregate and its transformation forms the first important part of the paper. The next part seeks to try and highlight what sustainability aspects of the socio-cultural aggregate survived as heritage across the travail of centuries through the formation – transformation continuum of social formations.

## THE TRIBAL HERITAGE

Tribal culture constitutes the most archaic stratum of Kerala's heritage and the most relevant aspect in the context of environmental sustainability. Historicising the tribal means of subsistence and modes of survival we reach out ancient social formations based on economies resulting from human adaptation to natural ecosystems. Clues in various sources particularly the Tamil heroic poems, give us ideas of the pattern of ancient human adaptation to ecosystems of the Tamil macro region that included

Kerala too. [Tamil Heroic Poems' as an expression refers to what is popularly known as the corpus of *Sangam* poems here. The corpus includes in its most archaic stratum some of the anthologies grouped under *Ettuttokai* and *Pattuppattu* roughly belonging to second century BC and third century AD. A detailed analysis of the structure, diction and context of the corpus is available in Kailasapathy (1968) and Rajan Gurukkal & Raghava Varier (1989). Various other sources consist of archaeological material of early Iron Age, mainly burial relics in the form of megaliths of first millennium BC down to the turn of the century, Tamil brahmi labels belonging to c. third century BC to fourth century AD, and foreign notices, mainly the Graeco-Roman accounts. The details of Archaeology of Iron Age in south India are available in Guru Raja Rao (1972), Leshnik (1974) and Sundara (1975). For studies in the cultural overlap and continuity between the periods of Megalithism and the early historic heroic society the readers may please see Srinivasan (1947) and Champakalakshmi (1975-6)]. The lateritic hill slopes and undulating midland terrains besides the small pockets of wetlands in the Ghats and foothills were the main ecosystems of human adaptation in ancient period, especially since the age of megaliths or early Iron Age. The wetlands grew paddy and sugarcane while the other parts cultivated a wide variety of millets and short-term dry crops. These were supplemented by cattle keeping. The extensive low lying wet-plains were largely inaccessible to cultivation though peoples from late Stone Age onwards seem to have subsisted on fishing and hunting in the water logged/saturated ecosystem. Though the technology of wet-rice agriculture was known, its extension to the inhospitable landscape through reclamation of heavily vegetated marshes and water logged expanses, a very hard task demanding massive labour, was impossible, for it was far beyond the reach of the familiar labour of clannish households.

The nature of human adaptation to the ecosystems of ancient Tamil macro region is best expressed in the *aitinai* concept of the Tamil heroic poetics, which characterises the region as a physiographical assemblage of five landscape eco-types, viz., *kurinji* or the forested hilly area, *mullai* or the pastoral tracts, *palai* or the parched area, *marutam* or the wet-rice fields and *naital* or the littoral inhabited by hunters, shifting cultivators, pastoralists, cattle-lifters, agriculturists and fisher-folk and salt makers respectively [Discussion of the various related aspects is seen in Siva Thampy (1974) and Rajan Gurukkal (1989)]. The concept helps us imagine the material processes of the ecologically determined human existence and coexistence possible in the region in ancient days. In the region the inhabitants were tribal descent groups such as *kuravar*, *vettuvar*, and *vetar* who subsisted on hunting/gathering and shifting cultivation; *itaiyar* who subsisted on agro-pastoralism; *maravar* who lived on predatory means; and *paratavar* who subsisted on fishing and salt manufacturing (Rajan Gurukkal, 1989). There were several clans of wet-rice agriculturists (*ulavar*), cultivators of dry land called *punam* or *enal (toluvar)*, carpenters (*taccar*), smiths (*kollar*) and a few others as such as bards (*panar*). What emerges is an assemblage of coexistence and interaction of various tribes following the means of subsistence determined by the landscape ecosystems (*tinai-s*) that they inhabited.

This predominantly tribal social formation with hunting/gathering/fishing, agro-pastoralism, wet-rice agriculture, salt manufacturing, crafts production and exchange

as its constituent economies of considerable overlap was based on the multiple levels of iron technology. Iron implements required for slash and burn agriculture, the means of subsistence in the forest ecosystems, were iron tipped digging sticks, thrust hoes and axes. Their negative impact on the forest ecosystem hardly had gone beyond the carrying capacity, not only due to the demographic factor but also due to the cultural factors that were capable of enhancing the bond with the forest ecosystem. Such were levels of subsistence technology and types of cultural practices in other ecosystems. Each eco-type (*tinai*) had a determinate role in shaping the culture of its inhabitants.

### **Ecosystem Symbolism**

The texts of the poems, their classificatory syntactics and cultural semantics in the poetics embody several characteristic signs drawn from specific ecosystems upon which the ancient Dravidians intimately depended for subsistence (Rajan Gurukkal, 2009a). They show the way signs and processes of semiosis express the way humans interact with their environment for existence. These characteristic signs spontaneously evolved out of the processes of peoples' subsistence/survival dependence on specific ecosystems, are indicative of the holistic view of the universe, emphasizing the unity of human beings with their natural environment. Each of the five terrains or eco-types conceived in the Tamil heroic poetics derives its name from a plant endemic to the ecosystem. The terrain of hilly backwoods derived its name from *kurinji*, a species of shrub (*strobilanthus*), which blooms once in twelve years. The plant is considered symbolic of forest-clad ecosystem with forested hills and slopes having streams and tiny waterfalls. Landscapes with hills, open terraces and high altitude grasslands were called *mullai* that is a species of tree (*perris brevipis*) symbolic of the ecosystem. The name *marutam* given to the terrain of the wet-rice ecosystem generally characterized by the alluvial tracts along the riverbanks is derived from a tree in the wetlands often called *nirmarutu* (*terminalia paniculata*) that is symbolic of the ecosystem. In the Tamil region, the term denotes well-irrigated agrarian tracts fit for the cultivation of sugarcane and paddy. *Naital* is a flowering plant, a kind of water lily (*nymphaea stellata*), endemic to water logged and marshy tracts and hence symbolic of the ecosystem. The seacoast alone is not the terrain recognized as *naital*, but also landscapes around natural water sources such as rivers and backwaters. *Palai* is the name of a tree, (*alstonia scholaris*) which is typical of the parched zones and therefore, considered symbolic of the ecosystem.

### **Eco-cultural Hegemony**

It is not just the landscape eco-type alone that the plant signs are symbolic of but the culture as a whole that subsumes the human relationship to ecological existence and ecological relationship to human existence, as the homologically inter-twined nexus. This ecosemiotic dimension of the larger cultural whole is evident in the poetics' prescriptive attribution of certain features as specific to every landscape-ecosystem. The attributions in the poetics consist of three aspects – of space and time (*mutal*), of subsistence activities, food, deity, flora, fauna, musical instruments and such other matters (*karu*), and of social behaviour (*uri*) involving the situations of love (*akam*) and combat (*puram*). In short, they encompassed the entire universe of

human life. The implicit processes are those of socio-economic and cultural reality carried forward to poetics and subsequently stipulated as prescriptions for literary and aesthetic practice.

The formation of ecological signs as a direct outcome of the inter-relationship between nature and processes of human subsistence/survival strategies, which is eminently durable and substantial, transcends its metonymic structure and enters a higher cognitive process of allegorical relations. Here the dyadic relation becomes triadic through metaphorical extensions to the regime of aesthetic practices, heralding a fertile field of ecosemiotics (Rajan Gurukkal, 2009a). Each eco-type metaphorically symbolized a specific emotion in the aesthetics of romanticism, as its overall ecological setting would spontaneously inspire. For instance, *kurinji* is symbolic of the libidinal passion of lovers enjoying undisturbed union as the ecological setting of the forest quite naturally evokes; the *mullai* is symbolic of patient waiting for the lover, a mood that the pastoral expanse conjures up; the *marutam* is symbolic of hatred coming out of distrust, a temperament that agrarian tracts excite; the *palai* is symbolic of frustration with which the dry land fills the mind; and the *naital* is symbolic of anxiety that the littoral fuels up. Tamil heroic poetics' classificatory syntactic, applied for dividing, sorting out and arranging the poems into anthologies of specific features of identity, profusely exemplifies it. The syntactics embodies the eco-semiotic sign system carrying features of nature into cultural semantics through linguistic and aesthetic practices.

The dual concept of *tinai* and *turai*, has given rise to several sign-combinations, each of which as a sub-category accommodating poems of specific thematic identity. There are eleven sub-categories of signs evolved out of the concept of the *tinai*. The number of sub-categories of the classificatory syntagm evolved out of the *turai* sign is almost six times larger than those of the *tinai* sign. A distinct homology between nature and contemporary Dravidian culture is well attested by these aesthetic prescriptions of the ancient Tamil heroic poetics. There is a trajectory discernible in the sign process, starting with the homologous formation of ecological signs out of ecosystems and their subsequent cultural signification in linguistic and aesthetic practices.

Studies show that everything in the socio-cultural regime revolved round eco-culture of this economy and everything was disposed of so as to establish its eco-cultural hegemony over other economies (Rajan Kurukkal (1989). Organized under spontaneously evolved self-sustaining kin units (*urs*) of production, the tribes maintained exchange relations (primarily of the goods for goods type) and shared-cultural practices, which eventually led to the making of *Tamilakam* as a region of linguistic homogeneity. Exchange of goods and services hardly involved the concept of exchange-value/price and the peoples seem to have had no notion of interest/profit. It is true that both transmarine and inland traders from far away places like Rome and Gangetic valley had entered into exchange relations with the region. Recent studies have shown that the long distance exchanges were also based on the principle of use-value rather than exchange-value (Rajan Kurukkal (1998).

An aspect to be significantly singled out in the context of the present-topic of discussion is that the landscape ecotypes of the dominant economy were all within the forest ecosystem. The pastoral tracts (*mullaittinai*) and tracts of shifting

cultivation (*kurinjittinai*) that jointly constituted the larger terrain (*vanpulam*) of the economy were grassy hill tops and vegetated slopes of the forests. The parched zone (*palaittinai*) that enlarged in summer and dwindled during monsoon and inhabited by predatory clans called *maravar*, was also a part of the forest. In short, excepting the terrain of wet-rice agriculture, primarily confined to small pockets of fertile river planes (*menpulam*) and the littoral, most of contemporary human habitats were in the forest. Several allusions in the Tamil heroic poems show that contemporary human settlements and forests existed as subsumed by each other. The *aintinai* concept differentiating the terrain in terms of five eco-types (*tinai-s*) involves no rigid contrast between forest and non-forest. It is clear that the *tinai* peoples seldom conceived forestland (*katu*) in contradistinction to human inhabited land (*natu*) (Rajan Gurukkal, 1995). The *katu* >< *natu* opposition as it existed in the landscape consciousness of the people in the agrarian social formation was not known to them.

The principal social mode of labour realization was familial/cooperative. A few crafts like metal working and pottery that come under the category of skilled labour, must have been full-time trades of specialists and hence hereditary. Iron, the most extensively used metal, had a central place particularly as the base of weapons whose significance in a predatory society is explicit. Moreover, the practice of burying iron objects along with the dead had pushed a great deal of iron out of circulation presupposing continuous iron working as a full-time occupation of hereditary specialization. The production of earthen pots, a characteristically brittle artefact, was obviously a continuous full-time activity, for their use was extensive both for the living as well as the dead. The number of such full-time artisans/crafts folk of hereditary occupations was relatively more in the headquarters of bigger chieftains of the *velir* and *ventar* levels. As the major redistributive pools of resources, the chiefly settlements could support more full-time crafts. Another full-time function of hereditary nature was that of warriors (*maravar*). Every settlement (*ur*) needed full-time warriors since the main mode of political appropriation of resources was predatory. In association with the chiefly households, three other full-time hereditary functionaries, viz., the *panar* (bards), *paraiyar* (who play a kind of raid drum called *para*) and *tutiyar* (who play a small drum called *tuti*) were there.

### **Tribal Polity**

The poems clearly show that the political level of the social formation was characterized by tribal chiefdoms with a pattern of distribution of power varying from the simple to the complex along the small and big descent groups (Rajan Gurukkal, 2002). The *kutimakkal* or domestic segments of a descent group and their *ko-man* or *perumakan* (chief) constituted the simplest structure that signified an organized settlement or *ur* bound by kinship. The basic constituent in the structure was *kuti* or family. The heroic poems unveil before us an active scenario of coexistence and interaction of unevenly evolved chiefdoms of three types, viz., the *Kilar*, *Velir* and *Ventar*. Most of the *Velir* and *Kilar* were chieftains of the forest. One of the *Ventar-s*, namely the Ceras of Kerala were chieftains of forest lands too.

Like the *Velir* chiefs, the *Kilar* chiefs were also hunter chiefs either of *vetar* or *kuravar* tribes. The poems mention them as the *ur-kilar* or *ur-mannar* who were

generally chiefs of small settlements, mostly in *vanpulam*, the forest land. Certain *kilar* are also mentioned to have held sway over agrarian tracts who were relatively more resourceful. However, they also had to maintain predatory control over other settlements to meet the redistributive needs. A few *kilar* seem to have functioned like bards of the well-to-do chiefs. Most of the *ur-kilar* and *ur-mannar* were subordinates of bigger chiefs and had the obligation of fighting for them.

Exchange relations must have enabled the *Ventar* to possess gold and other prestige items. However, accumulation of resources and their redistribution was the major activity of the *Ventar* like the *Velir*. Plunder was indispensable for them also since their redistributive network was much more elaborate and complex than what they could have afforded with their actual resources. They had a large body of dependants such as their kinsmen (*kilainar*), scholarly bards (*pulavar*), warrior chiefs (*maravar*, *hilar* and *inannar*), warrior men (*maravar*), bards (*panar* and *porunar*) magico-religious functionaries and so on. The poetic flower symbolism *vechi* (cattle raid), *karantai* (cattle recover)', *vanji* (chieftain's raid), *kanji* (chieftain's resistance of a raid), and *tumpai* (preparation for raid) not only show how institutionalized and common the plunder was, but also how ecosystem centred the institution was. It involved some notion of a hierarchy from *Ventar* to the *kutimakkal* with *kilar* or *mannar* intermediaries. The hierarchy did cut across kinship and distance the *Ventar* from *kutimakkal*. But they did drink and dine with the *maravar* during *untattu*, the pre-raid or post-raid feasting at the residences of the *Ventar*.

The preceding discussions of the features of the economic and political levels of the social formation clearly indicate that they were predominantly characterized by the tribal polity and forest cultures. This is further endorsed by the various rites and rituals and instituted practices of the times. So do the various beliefs and customs, costumes and ornaments that characterized the regime of culture. Institutions for the chiefly celebration through group drinking and dining of warriors after and before cattle raids (*untattu*), chieftains' public rice-feasts (*corruvilavu-s*) and female dance propitiating the battle goddess (*kuravaikkuttu*) are some of the examples to mention only a few. The primacy of forest culture and tribal way of life continued until the social formation got dissolved itself into a new one dominated by advanced wet-rice agriculture.

### **Transformations**

The dissolution of the tribes and forest social formation began to manifest itself in the form of a series of institutional and structural changes. Predatory marches of chiefs, their ravaging of settlements, redistribution of *ur*, the consequent migration and subsequent immigration and so on, were some of the ongoing events of transforming effect on the social formation that was generating various contradictions within due to built-in factors like kin labour and redistribution. The most striking contradiction was the continued articulation of conditions totally uncongenial to the development of plough agriculture, which was the most potential form among contemporary forms of production. Predatory marches of chieftains, their destruction of agrarian settlements as part of the scorched earth policy in raids, and the dominance of the ideology of war and booty redistribution provided an adverse circumstance for the

development of agriculture. As we have already seen, redistribution exerted pressure on production, but failed to translate itself as a motor of intensified production since there was no scope for it within the kinship based forms of production. Intensified labour mobilization for better production was beyond the working power of contemporary political apparatus that had little coercive ability. It was not possible for the social formation to persist on for a long time in a set up of complex redistribution, generating contradictions. Obviously the major bend in the process was that of the gradual dissolution of the social formation. The process involved the expansion of wet-rice fields, slow disintegration of tribes into domestic segments of hereditary arts and crafts, formation of agrarian villages as clusters of settlements (*ceri-s*), occupied by artisans, craftsmen and tillers, and owned and controlled by landed households. A corresponding manifestation was the receding of the forest from the mainstream life-world and the rise of agrarian landscape as its contrast.

Opening up of the river valleys and reclamation of marshes, water-logged tracts and wetlands, and dominance of wet-rice agriculture based on plough technology did turn out to be a traumatic transformation socio-economically too. The social relations began to be further structured during the sixth-seventh centuries with the steady expansion of plough agriculture across the wetland. Expansion of agrarian settlements through the creation of *brahmadeyas* often involved the superimposition of the superior rights of the Brahmanas over the communal holdings and the clan families of the locality. It must have been an intricate process of transformation of primitive agriculture and clan settlements into advanced agriculture and farmer settlements, respectively. The main features of the process were differentiation, stratification, and political formation leading to the development of the state-system and authority structures. These were simultaneous developments taking place as supplementary and complimentary to one another, resulting from the growth of paddy economy. Such developments were in their turn ensuring the further growth of the economy. With the expansion of the new relations of production and the spread of wet-rice agriculture that became characteristic to the period from sixth-seventh centuries, the social formation structured by the dominance of forest economies came to an end. In short, the disappearance of the social formation dominated by forest economies involved a series of transitions like the ones transition from kin-labour to non-kin labour, multiple functionaries to hereditary occupation groups, clans to castes, simple clannish settlements to structured agrarian villages, and chiefdom to monarchy (Rajan Gurukkal, 1999 & Rajan Gurukkal and Raghava Varier, 1999).

### **ECOLOGICAL IMPACT**

There have been a lot of ecological differences between the agro-climatic zones of Kerala and those of the rest of Tamilakam in terms of seasons, rain fall, landscape, soil structure, permeability and so on. Extensive forests, large catchments, numerous micro watersheds, many natural aquatic networks of rivers and streams mostly flowing towards the west and well drenched aquifers constituting wet plains, vast stretches of water logged/saturated depressions, thickly vegetated large marshes and isolated swamps surrounded by undulating lateritic mid-terrains merging with hillocks and low lying fluvio-marine land forms had made the landscape of Kerala a major ecological distinction. The most striking difference about the wet-rice



landscape eco-system is the excess of water in the case of Kerala and its scarcity in the case of regions elsewhere. In the wet-lands of the former the management of the excess water has been the central problem since the days of the very inception of agrarian settlements whereas in those of the latter, irrigation. It is true that the new social formation caused the dissolution of the forest social formation. The values and passions of nature carried forward from the social formation persisted as a significant heritage. There was compatibility between the wetland eco-system and wet-rice agrarian techno-economic culture. In spite of changes of fundamental nature in the landscape ecosystem, the wet-rice agrarian technology, material culture and demographic growth had not crossed the carrying capacity limits. This was true in the case of the advanced phase of the agrarian social formation too. The carrying capacity of the ecosystem began to be affected gradually with the inception of colonial economy, its machine technology growth, road communication expansion, railway and the factory system.

### **AGRARIAN HERITAGE**

The substance of *Krishhi Geeta*, an orally transmitted text, a comprehensive manual of agriculture/agricultural life of Kerala, subsequently written down in palm leaf and later printed is an excellent traditional text of inheritance (Raghava Varier and Rajan Gurukkal, 1993 & 1996; Rajan Gurukkal, 2009b). Mohan Kumar (2008) provides the full text and translation of *Krishhi Gita*. It is a historically and culturally contingent farmer's manual, a comprehensive account of the traditional prescriptions for agricultural practices, which had been a process of continuity and change, coming from the agrarian social formation as adaptation of and additions to ancient texts such as *Asvalayana Grihyasutra* and *Parasara Smriti*. It encompasses details such as preconditions of multiple crops by way of various agricultural activities, appropriate climatic setting, seed selection, field preparation, ideal season, irrigation requirements and so on in the case of each one of them. An analysis of it unveils the holistic nature, structure, composition, features and dynamic of the embedded knowledge component that constitutes the substratum of the text. A reappraisal of the contemporary relevance of the integrated form of the knowledge in sustainability science perspective renders a lot of insights about environment management in general and agro-biodiversity conservation in particular.

*Krishhi Gita* sheds light on the life-world of sowing, caring and harvesting. Agricultural prescriptions begin with description of soil types, crop variety, tilling, ploughing and cattle care with specific pieces of advice for soil preparation, seed selection, manures, classification of seasons, characterisation of monsoon, *njarruvela* based typology of rain fall, nature of down pour in each *njarruvela*, the agricultural activities ideal thereof, types, utility and futility of efforts in each, classification of water percolation natural to soil-types, nature of water percolation during different kinds of down pour, methods of precaution, strategies of water management and techniques of irrigation. It prescribes as to what sorts of people cannot afford to caring agriculture; what types of resourcefulness are essential for agriculturists and; what kind of soil is appropriate for which crop and what care is needed in each soil type. Similarly it enlists the main types of manures to be used for each crop, emphasizing the centrality of cow dung. The text contains amazing insights about the stages of crop-growth and about the

level of yield at each stage. It prescribes the seasons appropriate for each crop. There is a detailed characterization of the nature of monsoon, its phases, duration and types of rain-fall in each phase, the effects of their variation, the activities of farming appropriate during each type of rain-fall, the consequences of their variation. It also contains symptoms of the commencement as well as absence of rain and strategies to predict occurrence as well as failure of monsoon. Where to plough or till the soil, how, and consequences of its neglect are discussed emphasizing the importance of appropriate preparation of the field before sowing. As part of it the features of good cattle, an ideal bull, and an effective ox are also described. In short, it is a comprehensive package of prescriptions for agricultural ecosystem habitat starting from the necessities of life, required arts, crafts and goods, subsistence and survival occupations and specific details of agriculture. Proverbs and axioms constitute another source of agrarian heritage, which retains traditional agricultural practices and their embedded wisdom [Details are seen in DAMP(1934). Out of the total 363 proverbs 44 are related to climatic prediction, 31 to wisdom regarding seeds, 6 to agricultural implements, 37 to agricultural labour, 16 to manures, 34 to sowing and planting, 18 to irrigation, 42 to crops and harvest, 5 to pest control, 39 to cattle rearing, and the rest to miscellaneous aspects of human – nature situation]. Several place names also carry the wisdom relating to landscape eco-types, soil conditions, crop identity etc.

A holistic perception of the landscape ecosystem, the climate, soil conditions and insights of integration makes the heritage of traditional agriculture distinct. Traditional agriculture subsumed by eco-culture or rooted in nature is a comprehensive package of practices inherently sustainable. Adapted to eco-types and agro-climatic conditions, they are full of insights from sustainability point of view. This was true of every other aspect of the traditional village life of Kerala. The pre-modern dietary practices and clothing pattern of the region illustrate were distinct for their agro-biodiversity and sustainability values. Of the traditional survival strategies, healthcare based on methods of herbal medication, utterly eco-centric and sustainable, constitutes a predominant aspect of Kerala's heritage. Ecological sustainability of technology is explicit in traditional architecture (*vastuvidya*). Technology – Ecology compatibility of subsistence and survival strategies, which comprises the core of sustainability, is what the heritage provides us as the all time lesson for environment management.

### **CARRYING CAPACITY QUESTION**

As regards environment management, the most pertinent question that we should examine about the heritage is its lessons on social and ecological sustainability. It is not easy to be certain about sustainability, for the meanings, measures and parameters of carrying capacity assessment, the first pre-requisite to establish sustainability, are not quite precisely drawn as yet. We can think only tenuously about the carrying capacity question in the case of heritage by reviewing the past in terms of the 'supporting capacities consisting of survival resource capacity, techno-economic capacity and socio-cultural capacity.' These capacities are of two categories: generative and absorptive. The first refers to the generative and regenerative capacities of the techno-economically adapted ecosystem and the second to the techno-economically adapted capacity to absorb negative impacts of development. Though estimation

shall never be accurate for it means the near impossible task of balancing multiple variables in a very complex synergy of interconnections (Barbier, 1993; Barbier et.al., 1994))

It is in this perspective that we have discussed at length the eco-types and the pattern of human adaptation to them as regards the ancient social formation of Kerala in a previous section. Since the supporting capacities vary according to the nature of ecosystems and modes of human adaptation to them, which decide the nature of techno-economic and socio-cultural capacities, we have examined the technology levels of economies in different eco-types in terms of the generative and absorptive capacities. The generative and regenerative capacities of the techno-economic strategies evolved as part of modes of adaptation to eco-types and their techno-economic capacity to absorb negative impacts of natural appropriation for subsistence and survival are explicitly very high.

As centuries passed the forest social formation dominated by the agro-pastoral economy had dissolved itself into the wet-rice agrarian and advanced agrarian social formations human existential negative impact was relatively extensive. Nevertheless, the techno-economic adaptation to the changed environment was effective enough to enhance the generative and absorptive capacities. This could very well reduce the intensity of human existential impact on the ecosystem. Moreover, the socio-cultural supporting capacity in the form of institutions, structures, relations and practices was also high. However, with the onset of the colonial economy, the decline of the techno-economic absorptive capacity began, since the negative impact has been consistently and incrementally on the higher side. Even then, as several aspects of the heritage vouch for, the cultural capacity of absorption persisted on until the expansion of automation technology, industry and urbanism made institutions, structures, relations and practices incompatible to the ecosystem.

There is a steady impairment of generative, regenerative and absorptive capacities, in spite of giant leaps in technology today. Now, in the wake of techno-capital globalization, state-sponsored land grabbing through diversion of forest land, deforestation for private enterprises, reckless sand mining, intense exploitation of all contested natural resources including water directly affect both the people's life and environment. This disastrous process, wrapped up in the veil of 'development', an enchanting word of social consensus, involves deforestation, denial of forest rights, destruction of habitats, deprivation of livelihood, contamination of the drinking water source, acquisition of rural farm lands, disruption of culture, and annihilation of heritage. The life of the rich is in inescapable trap too with the unmanageable non-degradable and toxic waste pushing the civilisation into the insurmountable entropy. We are forced to seriously probe into the ontology of heritage in search of the epistemology of sustainability science for effective environment management.

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# Environment, Culture and Traditional Knowledge Management of North- East India

**Dr. P Madhusoodanan Pillai**

*Registrar, Central Agricultural University, Imphal, Manipur, India-795004*

*Email: pmpillai@gmail.com*

## INTRODUCTION

Community based natural resource management, in all its legitimacy is a primaevial practice that existed in several regions of the world and is now confined to certain pristine geographical areas with limited anthropogenic influences. This has received a major paradigm shift with the onset of participatory natural resource management in recent years, consequent on key policy changes, realizing its value for human welfare, development and sustenance. The Traditional Ecological Knowledge (TEK) of aboriginal people became the chief focus of attention during the past decade (Freeman & Carbyn 1998, Berker 1993). The ecological strengths of TEK and management of ecosystems have been illustrated by several researches in recent years (Baker 1993, Chambers 1983, Klee 1980). TEK and wisdom are highly sensitive to the changing relationships between people and their ecological resource bases (Gadgil et al.2000), but more important is Traditional Knowledge Management (TKM) which is fundamental in the sustenance, conservation and transmission of the cultural values and traditions of the people, especially of remote areas like the North-East India. Refinement of the traditional knowledge, its proper documentation and management has received petite attention. The studies dealing with the eco-cultural landscapes of Arunachal Pradesh and Sikkim by Rai (2007) tries to bring out the traditional knowledge systems of the North-Eastern Region (NER) of India, though it is confined to Arunachal and Sikkim. According to Ramakrishnan (1996) the human managed ecosystems of North-east India forms an integral landscape mosaic as traditional societies form an essential component of the ecosystem. The NER retains a unique spirit of harmony between nature and culture, martial arts and spiritualism coupled with the maintenance of biodiversity and cultural traditions. The people of Northeast have their knowledge and belief systems, life sustaining rites and rituals in consonance with the rhythm of work, season, nature and culture which is to be respected.

The North- east India is an unexplored area of the subcontinent with unique cultural traditions, rich natural resources, wild flora and fauna, historical temples and colorful

people, mainly of mongoloid origin who speak Tibeto-Burman languages. The biodiversity, geomorphology, cultural heritage and nature linked celebrations of the people are unique. The concepts of 'sacred groves' symbolizes nature linked religious rituals, a peculiar type of socio-ecological system for sustainable development, respecting the nature as the abode of god. The NER, unique due to its historical, archeological, ethnographic and religious precincts, terrain tribulations, snow clad mountains and giggling streams is a place of ethereal beauty and scenic grandeur. The traditional performances of NER depict a very powerful form of narration and communication which embrace ethnic traditions, narratives on religion, expression of global views, agricultural seasons and healing practices, alien to other parts of India. These performances reflect the art traditions, food habits and knowledge systems combining rhythmic movements, art craft, drama and the divine element which have not been properly comprehended or documented.

### **METHODOLOGY**

This analytical study for obtaining an insight in to the environment management practices, multicultural and multilingual cadences of the ethnic groups and bio-resources of the region was carried out using the primary data obtained during the last two years by structured discussions with local people, interviews with experts and rapid rural appraisal during the visits to certain pre-decided areas and tribal hamlets of the North-East. This has been satiated with the help of local activists and selected employees of the different campuses of the Central Agricultural University, with seven campuses in six northeastern states. The secondary data has been obtained from several sources like published materials like books, research and policy papers, reports, documents and websites of Government organizations, NGOs and others.

### **CONSERVATION IMPORTANCE OF NER**

#### **Location**

North-East Region of India lies between 21° 57' and 29°28'N latitude and 89°40'and 97°25'E Longitude and consists of the eight states viz., Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura, often called as seven sisters and a small brother, with an area of 262185 sq km constituting 7.9% of the total land area of the country. This region sharing international boundaries with China, Bangladesh Nepal, Bhutan and Myanmar, is contiguous with two biodiversity Hotspots, the Himalaya and Indo-Burma. Arunachal Pradesh, Sikkim and some parts of upper Assam belong to Eastern Himalayan Hotspot whereas Manipur, Meghalaya, Mizoram, Nagaland, Tripura and most of the lower Assam belong to Indo-Burma Hot

#### **Climate**

The NER has several agro-climatic zones, which is the key factor for its rich biodiversity and the unique flora and fauna that can be linked to the climatic oddities of the region. The main rainy season of the NER extends from March to October. It is interesting to note that the Khasi and Jaintia Hills of Meghalaya account for a rainfall of about 1080 cm, especially around Chirapunjee and Mawsynram, where the highest rainfall of the world is recorded. This region which receives fairly good rainfall throughout the year, is blessed with water resources like the Brahmaputra

and its tributaries. But drought conditions have been recently observed in the valley districts of the states like Manipur, adversely affecting the farmers whose main source of income is agriculture and agro-forestry.

### Topography

This landscape is connected to rest of India by the Siliguri corridor of west Bengal, often called the chicken neck, 33 km on eastern side and 212 km on western side. Mountains and hills cover most of Arunachal Pradesh, Mizoram, Nagaland, Meghalaya, Sikkim, Manipur and Tripura and the Plains of the region are confined mainly to the Brahmaputra valley and the Barack valley in Assam and the plains of Tripura. Manipur valley is about 10% of the total land area of the state. The hills covering 90% of the land area is habited by the Kuki and Naga tribes and the valley by the Meetis predominantly. This often results in ethnic communal clashes for the creation of a new state and district for the tribals, not agreed to by the Meetis.

### Biodiversity

The rich biodiversity of the NER is attributable to the conservation culture of the ethnic communities who exploited nature only for self sustenance. This has to be regarded as a standing monument to the reduced development pressure on the environment of the North-East Hill (NEH) Region due to the low density of population and legal protection provided by the Central Government for evading immigration. According to the Botanical Survey of India, 10% of total flowering plants of the country are endangered. Of the 1,500 species of endangered floras, 800 are reported from North East India. The region has at least 7,500 species of flowering plants, 700 orchids, 58 bamboos, 64 citrus, 28 conifers, 500 mosses, 700 ferns and 728 lichen species.

Over 50 species of economically valuable plants have their rich genetic diversity in this region (Zeven and Zhukovsky, 1975). Out of the estimated 800 species of food plants in India (Singh and Arora, 1978), about 300 occur in Eastern Himalayas alone (Rao, 1994).

**Table 1**  
**Species richness of the angiosperms North-east Region**

State	Species richness (flowering plants)
Arunachal Pradesh	± 5,000
Assam	± 4,500
Manipur	± 3,500
Meghalaya	± 3,010
Mizoram	± 2,500
Nagaland	± 2,250
Sikkim	± 2,200
Tripura	± 1,600
Total	± 24,560

North-east is the abode of orchids as demonstrated by the establishment of the National Research Centre (NRC) for Orchids at Pakyong, Sikkim by the Indian Council of Agricultural Research. Of the 700 species of orchids reported from the NER, 545 species belonging to 122 genera are from Arunachal Pradesh (Choudhury, 1998), 12 amongst them are endangered, and 16 vulnerable, 31 threatened. Out of 12 species of *Rhododendron*, 2 sub-species and 5 varieties are endemic to the NER of India; Arunachal Pradesh with 9 species and 1 sub-species has maximum endemism, followed by Manipur and Sikkim with 3 species and 1 sub-species, Mizoram with 2 species (Mao et.al, 2001). Of 60 species of canes reported from India (Basu, 1992), the NER harbours more than 26 species, 18 distributed in Arunachal Pradesh. North east is believed to be the heaven of bamboos due to its rich bamboo diversity. Out of the 150 species of bamboos found in India, 63 belonging to 22 genera are found in North-East India, about 25 of them are classified as rare.

### Faunal diversity

The NER is rich in faunal diversity with an estimated 3,624 species of insects, 50 molluscs, 236 fishes, 64 amphibians, 137 reptiles, 541 birds and 160 mammals that have so far been described. A perusal of the primate population reveals that, of the three families of primates that occur in India with 15 known species, nine occur in North East India. The Golden Langur (*Trichypithecus geei*), Stump-tailed Macaque (*Macaca arctoides*), Northern Pigtailed Macaque (*M.leonina*) and Slow Loris (*Nycticebus bengalensis*) are the endangered primates listed in schedule I of the Indian Wildlife (Protection) Act, 1972 and appendix I of the Convention on International Trade of Endangered Species (CITES). Coming to the carnivore population; out of the six largest cats of the world recorded from India, Arunachal Pradesh sustains four of them – the Tiger (*Panthera tigris*), Leopard (*Panthera pardus*), snow Leopard (*Uncia uncia*) and the clouded Leopard (*Neofelis nebulosa*). The endangered Red Panda is predominantly seen in the region. Besides, North East India forms the western end of the range for Malayan Sun Bear (*Helarctos malayanus*).

Appraisal of the ungulate population reveals that the foothill grasslands and broadleaf forests of North East harbor significant population of the Asian elephant, one horned rhinoceros and the hippopotamus. The great Indian Rhinoceros (*Rhinoceros unicornis*) is now restricted to Kaziranga, Pabitora and Orang in Assam. The one-horned Javan Rhinoceros (*Rhinoceros sondaicus*) and the Two-horned Sumatran Rhinoceros (*Didemnoceros sumatrensis*) are now extinct from the region. The brown-antlered Deer (*Cervus eldi eldi*) locally known as Sangai is endemic to Manipur. The Pygmy Hog (*Sus salvanius*) is now survived in North East India by a few isolated wild populations. The newly discovered Chinese Goral (*Naemorhedus goral*), Red Goral (*Naemorhedus baileyi*), the goat antelopes, takin (*Budorcas taxicolor*) and Serow (*Capricornis sumatrensis*) are found in Arunachal Pradesh

The Avian population records show that over 760 bird species have been reported from Arunachal Pradesh. The Elliot's Laughing Thrush (*Garrulax elliotii*) and Brown checked Laughing Thrush (*G. henrici*) are the two species recently added to the region's list from Arunachal Pradesh. White winged duck (*Asarcornis scutulata*) which has been reported from Arunachal Pradesh is identified as highly endangered



(Kaul, 2000). Greater Adjutant (*Leptotilos dubius*), a threatened bird has now been found in Assam. Spot-billed Pelican (*Pelicanus philippensis*), Black-necked Stork (**Ephippiorhynchus** asiaticus), Lesser Adjutant (*Leptotilos javanicus*) and Pale-capped pigeon (*Columba punicea*), and a few other threatened birds, are found in the North East Region. One of the rarest bustards in the world, the Bengal florican (*Houbaropsis bengalensis*) has the largest population in Manas National Park, Assam. Swamp Prinia (*Prinia cinerascens*) an endangered bird species, is reported from Pabitora Wildlife Sanctuary in Assam.

Coming to the lower vertebrates, 137 species of reptiles have been recorded from North East India. Recently in the year 2000, a species chlonian (*Amyda cartilaginea*), the Asiatic soft shell turtle, has been reported from Mizoram which is the first record of the same from India. The black soft shell turtle (*Aspideretes nigricans*) once considered extinct (IUCN, 2002) has been rediscovered recently from Assam Valley. Lizard diversity of the NER is very rich with 20 species from Assam and 18 species from other states of the Region. Out of the three Monitor Lizard species found in the region, *Varanus flavescens* is listed in Appendix I of CITES. The Tokay Gecko (*Gekko gekko*), the second largest gecko of the world, found in North East India, Nepal, Bangladesh etc formerly used in pet trade, is now pilfered extensively from the forests of Manipur, Tripura and Assam; single specimen fetching several lakhs of rupees in China and Myanmar due to its reported medicinal values, not established scientifically. Rampant poaching has endangered the species, in spite of legal protection. Fifty eight species of snakes have been recorded in Assam, 34 from Manipur and 92 from Arunachal Pradesh. Python reticulate, the largest snake of India, is found in North east India. Moreover 64 species of amphibians have also been recorded so far from the North East.

The fish fauna of the NER consists of 236 fresh water species found in Brahmaputra and its tributaries, myriads of rivulets and lentic water bodies.. Several species like *Chitala chitala*, *Lebio nandina*, *Puntius sarana*, *Lepidocephalus bordermorrei*, *Bengala elenga*, *Catla catla*, *Cirrhinus reba*, *Puntius cola*, *Puntius conconius*, *Mystus vittatus*, *Ompok pabda*, *Ompok pabo*, *Ompok bimaculatus*, *Alia coila*, *Clupisoma gerua* etc., are either endangered or vulnerable due to over fishing. Nine of fish species of the region viz. *Ompok pabda*, *O.pabo*, *Labeo dyochelus*, *Serniplotus semiplots*, *Olyra longicaudata*, *Psilorhynchus homaloptera*, *Noemacheilus elongates*, *Balitora brucci* and *Barbus dukai* are endemic to the region (Sarkar & Ponniah, 2006). The fresh water shrimp *Macrobrachium hendersoni* is fairly abundant in all the rivers and lakes of the region. Several other indigenous fish species are found in the Loktak Lake, the largest fresh water body of the NER, located in Manipur valley. The people of the NER, especially of Assam and Manipur are highly piscivorous. The unrestrained Festival fishing of NER results in non judicious exploitation, endangering several fish species, *Osteobrama belangeri*, the state fish of Manipur, is the classical example. Culture of major carps is extensively seen in Brahmaputra basin with abundant water resources. Pond culture is one of the important aquaculture practices in the valley districts of Manipur as most homesteads are having small water bodies, still insufficient to meet the growing demand for fish. The NER is rich in Invertebrate faunal diversity consisting of 3,624 species of insects and 50 molluscs and hundreds

of others. *Princeps polyctor ganesa*, which occurs in North East India, is one of the most beautiful butterflies of the country. *Erasmia pulchella* and *Nyctalemon patroclus* are very beautiful moths that occur in the region

### **Threats to biodiversity**

Though the cultural traditions and agriculture practices of the NER are by and large environment friendly, the growth of population and ever increasing demand for natural resources in recent years has started inflicting wounds in the eco-cultural equations of the region, and reasons for threats to biodiversity, mainly anthropogenic. As in other areas of the country, deforestation and environment degradation due to excessive timber extraction in the NER results in landslides and soil erosion. Coal and lime stone mining, quarrying of sand from rivers; extraction of petroleum and natural gas; environmental and socio-economic implications of mega hydro-electric projects; issues relating to conservation of Ramsar sites of north-east India like the Loktak lake, are the areas of severe concern. Environmental and socio-economic impact of plantation and cash crops; Impact of tourism, social conflicts and Jhuming (slash-and-burn) cultivation adversely affect the eco-physiology and geomorphology of the region, outshining all conservation attempts. 'Bun' cultivation of Meghalaya also causes excessive soil and water erosion. Encroachment of forestland is another serious threat to forest ecology and diversity. About 60% of the domestic herbivore population of the NER grazing in the forest lands and exceeding the carrying capacity is one of the major factors for degradation of forests around the core areas. Human-wild life conflict also remains persistent, unless the natural corridors of movement of animals are firmly secured and the agriculture crops properly protected. Forest fires are frequent and they impinge on about 20% of the total forest area, destroys the habitat, micro flora and fauna. Large scale smuggling of forest produce results in total elimination of some of the richest forests, for example, *Taxus baccata* is overexploited from Western Arunachal Pradesh (Chatterjee and Dey, 1997). Mono cropping of forest areas on long term basis like the 3,000 sq.km rubber plantation in Tripura, has replaced the original mixed vegetation. Large scale tea plantation in Arunachal Pradesh has not only replaced the virgin forest flora but also added enormous chemicals, fertilizers, pesticides, etc to the environment. Replacement of indigenous species with exotic HYV of rice and vegetables has led to significant reduction in genetic diversity of the species. Similar is the case in poultry, fish, livestock and fruit plants. Uncontrolled and non judicious infrastructure development and lack of environmental friendly policies has worsened the situation in recent years. The recent Road construction projects of Arunachal Pradesh has facilitated the extraction of valuable forest resources and encouraged settlements in ecologically fragile areas. Environmental Impact Assessment (EIA) has not been adequately incorporated in developmental proposals of the state. Coal mining, a lucrative business is an important cause of concern in Meghalaya, linking of the Brahmaputra with Ganga has raised many sensitive issues on its feasibility and construction of mega dams in Subansiri has generated controversies. The proposed Tipaimukh dam in Manipur is presently being debated. Migration of human population from the neighboring states or countries bequeath negligible regard for the local sentiments and values of sacred groves and forests of reverence. Loss of traditional faith due to multifarious factors

has been a cause of loss of the “*Umang lais*” (forest spirits) of Manipur and numerous sacred forests of Meghalaya. Dichotomy in forest administration is another important bottle neck. Most of the forest in Arunachal Pradesh, Manipur, Meghalaya and Nagaland are owned by private individuals, communities, and highly civilized clans who do not care much for conservation. As they have traditional ownership and user rights over such forest areas, forest acts and rules fail to ensure their protection, which has to be looked into. Framing of appropriate policies and legislations to effectively manage and protect the immaculate forests is the need of the hour.

### **Population**

The region has a high concentration of tribal population in Arunachal, Mizoram, Meghalaya and Nagaland. According to 2011 census the region has 3.8 % of the Indian population with 160 scheduled tribes, 94 scheduled castes with 440 ethnic groups speaking different languages and dialects. All ethnic groups are anthropological off shoots of Negroids, Mongoloids, Australo-Asiatic, Tibeto- Burmans and the equally important Caucasians with Assam having more than 20 major ethnic groups (Sharma and Sharma 2005). The states of Arunachal Pradesh, Meghalaya, Mizoram and Nagaland are mostly inhabited by a number of native tribes, each having its own distinct tradition of art, culture, dance, music and life style. The numerous fairs and festivals celebrated by these communities and their friendly nature are enticing, in spite of the ethnic clashes and the insurgency existing in certain areas. The Lamas, Lepchas and Bhutias are the original tribal communities in Sikkim, though immigrants from Nepal have diluted the tribal culture of this peaceful state.

### **Agriculture**

The “Jhum”, a type of shifting cultivation practice in the hill areas is the major threat to conservation efforts in forest areas, is often viewed as the fight of tribals for survival in a hostile environment. Lack of proper awareness is the prime reason for such environment hostile agriculture practices. The Apatani, the direct descendants of the first man - the Abotani - live in the Subansiri District of Arunachal Pradesh have developed a unique wet-rice cultivation system called the ‘Apatani’ cultural landscape system, a famous rural forestry management practice. According to Bower (1953) and Rai (2005) the Aji cultivation, which is paddy-cum- fish culture with millets on the bunds has been one of the most productive integrated farming systems of Arunachal, which is environment friendly. The terrace farming and Buddhist eco-cultural landscapes of Sikkim have their scenic excellence, when viewed in jungle background.

### **Festivals and Cultural traditions**

The festivals of the NER linked to nature epitomize the rich indigenous cultural traditions, dances and folk lore, associated with conservation of nature and agriculture, which is mainly organic. The **Hornbill festival**, named after the most admired bird of Nagaland is one of the most legendary festivals of Northeast India. It is celebrated from 1-7 December every year in Kisama Heritage village of Kohima District. This festival is preordained to attract tourists by show casing the cultural heritage of 16 tribes of Nagaland.

The Bihu carnival of Assam, the domicile of the Great Indian one horned Rhino symbolizes a particular epoch in the agricultural calendar of the region. It has three phases the ***Bohaag Bihu***, celebrated in April at the seeding time with plenty of singing and dancing; the ***Kaati Bihu*** at the completion of paddy transplanting in October, is a solemn occasion with lighting of lamps, believed to guide the soul to the heaven. The third festival ie the ***Maagh Bihu*** also known as Bhogai Bihu, celebrated during the harvest season in January is discernible by the bonfires, buffalo fights and pot breaking. These festivals are analogous to the celebrations that existed in Kerala, especially kuttanad, during the paddy planting and harvest seasons.

The Brahmaputra the major lifeline of the NER, has several festivals to venerate the significance of this river in the life and culture of the North east. The two day Brahmaputra Beach festival celebrated in January-February every year is endowed with culture and adventure sports and traditional Bihu dances, food crafts, cultural exhibitions paragliding, canoeing and beach volley ball. The Dehing Patkai festival named after the Dehing River at Patkai range in eastern Assam, celebrated in January comprises of adventure sports, hiking and wild life and trips to World war II cemeteries. It is to be noted that the river festivals to adore the natural resources are mainly seen during the post harvest season, invariably an occasion to rejoice.

The Torgya Monastery Festival celebrated during January at the Tawang Monastery is a three day festival of the Monpa tribe of Arunachal Pradesh. Sacred dances by the brightly costumed monks are supposed to ward off all evil spirits for bringing prosperity to the tribe by pleasing the nature God, every third year the celebration attains opulence and is called Dungyur Chenmo.

There are several harvest festivals in Meghalaya celebrated by the tribal people. The ***'Nongkrem Dance'*** festival at Smit, about 15 km from Shillong is a 5 day thanks giving harvest festival of the Khasi tribe, celebrated in November with traditional dance performed by young men and women which ends with "Pomblang" or goat sacrifice. ***'Wangala'*** another harvest festival of the Garo Hills of Meghalaya dedicated to the sun God of fertility endowed with community celebrations and is famous for the sound of 100 drums (nagaras). Hence it is also called 100 drums Wangala, to please the nature for giving a good harvest during that year.

***'Chapchar Kut'*** is an agriculture festival of Mizoram during the planting season, analogous to the Bihu of Assam. The famous bamboo dance called 'Cheraw' is performed as part of the festival during which arts, handicrafts flower shows etc can be found. ***'Kang Chingba'*** is the famous festival of Manipur celebrated in July to celebrate the journey of Lord Jagannath, his brother Balabhadra and sister Subhadra. Thousands of devotees pull the Chariots that carry them, similar to the 'Rath Yatra' of Puri. It is associated with the Govidajee temple of Imphal, followed by feasting and dancing coinciding with the completion of the transplanting of paddy, the food crop of Manipur. The ***'Kharchi puja'*** of Tripura is one of the most famous festivals of Tripura. It goes to the tribal legend of cleansing the mother earth for revival of natural wealth and worship of 14 Gods as prescribed by Lord Shiva, followed by animal sacrifice.

Sikkim, the land of Lamas, Lepchas and Bhutias is considered sacred by Sikkimese budhists and Mt Khangchedzonga of west Sikkim referred to as Demozong is the

abode of Sikkim deities. This region has a number of glacial lakes in the higher reaches, which are considered sacred lakes (Rai 2002). Mt Khangchedzonga, the alpine meadows and the rhododendron jungle up to the subtropical rain forest is the core of the sacred land of Sikkim. The important religious festivals of Sikkim are '**Bum Chu**' which exalts the sacredness of the Rathong Chu River and the 'Pang-Lhabsol' performed throughout Sikkim to propitiate the ruling deities of Khangchedzonga (Rai 2007).

## DISCUSSION

The NER, well known for its cultural and biological diversity has major forest types of consisting of tropical, subtropical, temperate and alpine with 4 biosphere reserves, 13 national parks and 43 sanctuaries under the protected area net work of 15,579 km<sup>2</sup>. The bio-resources of this region have to be conserved for the food security and wealth of the northeast in particular and the humanity in general. Forest management practices well integrated into the traditions and culture of the ethnic communities are obvious in Arunachal Pradesh and Sikkim. But food habits of ethnic groups of some states like Mizoram and Nagaland has paid heavily to the macro-faunistic diversity of the region. Management of traditional Knowledge in this region is dismal and several practices are fast disappearing. The indigenous knowledge systems have to be sustained and transported through generations so that they are not devoured by the elapse of time due to lack of proper conservation strategies. Planners and policy makers will have to think of a mechanism for the sustenance of the traditional knowledge systems of the region. Conservation of nature and natural resources are prominent in Arunachal Pradesh, especially, due to the increased dependence of the people on these resources for life sustenance. There are specific tribal rules and regulations for the use of forests for community purposes. The natural and cultural landscapes and the hill agriculture for sequential harvesting are the unique features of the NER. Unclassified state forests of the NER (29.88%) are under community control. Community participation in sustainable agriculture is an age old practice which has been recently refined by the use of more efficient and less labour intensive agricultural implements, used as part of the modernization of agriculture.

The traditions and life styles of the Lamas, Lepchas and Bhutias of Sikkim which are nature friendly and local resource based, is also under the grip of modern civilization, though their hamlets still stand apart. The revival of the sacred grove concept in every village, as a protected forest has imparted much to the sustenance and conservation of the resources for the progeny, the real owners of the nature. Manipur with highest literacy rate is farthest in development bench marks due to insurgency and ethnic clashes, adversely impinging on the economy and livelihood security of the state.

## CONCLUSION

There is an ever increasing awareness about the use of traditional ecological knowledge for sustenance of life systems and biodiversity. Conservation and propagation of eco-cultural practices, culture and tradition linked festivals for protection of nature has to be seen with more seriousness and reverence. The role of ethnic communities in conservation of nature should be properly documented and propagated for upcoming generations. The bio-resources of the region have to be

protected as agriculture is the main source of income of the agrarian communities of North-east. Traditional knowledge management for sustenance of its progenitors should be taken care of with due legitimacy and fortitude in the fast transforming cyber culture of the country.

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# **Role of tribals in conservation of Biological Diversity: Study on Konda Reddys of East Godavari district, Andhra Pradesh, India**

**Dr. T Ravishankar**

*Independent International Consultant, Forest & Biodiversity Policy, Access and Benefit Sharing, Mangroves and NTFP, Kakinada 533004, Andhra Pradesh. Email: rthupalli@hotmail.com*

## **INTRODUCTION**

Over thousands of years, human beings have been utilising the plants from wild and cultivated for food, medicine and other purposes. Tribal communities living in biodiversity rich areas possess a wealth of knowledge on the utilisation and conservation of Plant Biological Diversity. This traditional knowledge developed over years of observation by trial and error method, inference and inheritance has largely remained with these people living in harmony with nature. India is the home of rich biological and cultural diversity and there are about 67 million tribal people belonging to 573 distinct tribal groups living in different geographic locations with various subsistence patterns. There are 27 tribal communities in Andhra Pradesh confined to isolated hills, valleys and adjacent plains. Konda Reddys are one of the dominant tribes who have their own culture, religious rites, food habits and a rich knowledge of agrobiodiversity resources available in their surroundings. The traditional knowledge on properties, utilisation and conservation aspects of these tribal groups are on the verge of depletion with the spread of modern civilisation.

## **OVERVIEW**

It is not wrong to say that given the influence of the so called modern cultures, the traditional knowledge and ecological prudence underlying the genetic conservation ethics of tribal communities may be lost for ever, unless they are recognised and conserved. In many instances, as for example in the case of indigenous health traditions, such knowledge is invaluable. Right from *Cinchona* which is till to date used for curing Malaria to *Rauwolfia* used for hypertension, we are still learning so many medical remedies from the tribal people. Farnsworth and Soejarto (1985) stated that at least three-fourths of the plant-derived drugs in use today were identified by chemists while they were investigating plants used in traditional medicine. Many of these communities from whom the traditional knowledge is collected are becoming endangered with the onslaught of modernization.

The tribal women and men have been playing a crucial role in the *in-situ* conservation of a number of traditional cultivars and land races of cultivated species. The genetic strains of crop plants cultivated and conserved by the tribal communities serve as basic raw material for improvement of many crop varieties. They cultivate a wide variety of millets namely little millet, finger millet, foxtail millet, pearl millet along with pulses and cash crops. The farming practices of these tribes are well suited to their socio-economic conditions, nutritional habits and agro-ecological conditions. Apart from this, the conservation-based farming methods of tribal people can be used as a model to develop a sound sustainable agricultural system.

### **ETHNICITY OF THE TRIBE KONDA REDDY**

*Konda Reddy* means rulers of Hills. *Konda* means Hill in Telugu. They call themselves as *Pandava Reddys* and mostly live on both sides of the Godavari River in East and West Godavari districts. They usually live in hilly tracts and cleared forest areas. The habitats of those living in the interiors are small and confined to Reddys only. However, those living in other areas co-habit with *Koyas* and other villagers. Their houses are usually square or rectangular. They are built with woven mats or mud walls with thatched roofs. In places, where they are cohabiting with other castes, all their huts are built in a selected area. They consider *Koyas* as inferior to them and hence live separately.

The main occupation of *Konda Reddys* is agriculture and allied crafts. They practice permanent field agriculture as well as shifting agriculture. Their method of shifting cultivation in the hilly areas on both sides of Godavari River is very famous and well known. Other means of livelihood for these people are fishing and collecting small forest produce and selling and also working as labourers in the forest works.

They eat various types of fruits, tubers, roots of trees and also leaves available in the forests. They drink a type of toddy tapped from 'Jeelugu', - Fish tail palm, botanically known as *Caryota urens*. They even use the pith of the above tree and the nuts of mango fruits as food. They are very fond of Pork. Ancient types of plough, a digging stick with a steel tip, iron hoe; different types of knives, axes bow and arrow are the main household implements.

The *Konda Reddys* worship deities considered superior to nature, for seeking blessings for a peaceful and comfortable living. Starting from sowing of seeds, to harvesting the crop, every activity is begun only after worshipping and conducting a festival of the concerned deity in which women play an important role. Important among these festivals are Mamidi Kotha (Mango harvest) Bhudevi Panduga (Goddess of Earth) Gangamma Devatha (Goddess of Water) Panduga and Vana Devi (Goddess of Forest). During the festivals, animals are sacrificed to the village goddess Muthyalamma, Bhudevi, Gangamma, Pandavula Devatha, Gautamma and Saralamma and worshipped with great devotion and reverence. They firmly believe that planetary ill effects and witchcrafts cause diseases, death and illness. Whenever a person falls sick, a physician or magician is summoned and the reasons for the illness is elicited and remedial measures are taken.



## AREA OF STUDY

The study was conducted in Tadepally, Maddhiveedu, Mallavaram, Doramamidi, Putta Gondhi Lanka, Kodavati lanka and Nethedichilaka hamlets of Konda Reddys, which are situated 19 km away from Rampachodavaram near Rajahmundry in Andhra Pradesh. These hamlets lie at an altitude between 450 and 500 MSL. Approximately there are 1500 people and more than 500 houses. The entire landscape is undulated with lot of hillocks, which are very much used by the tribes for podu cultivation. The forests are of dry deciduous to moist deciduous type and fall under Eastern Ghats in Andhra Pradesh.

### Vegetation type

The study area in East Godavari district is rich with luxuriant vegetation and is located on the Eastern Ghats. The vegetation types, in general, are determined by climate, altitude, edaphic and biotic factors. The district with its unique physiographic characteristics and natural resources support a wide range of vegetation. The categories that were identified are deciduous forest, degraded forest or scrubland and forest plantations. The deciduous forest is a climatic-climax type of forest having an aerial extent of 21.46 percent to the total geographical area. This is confined to an altitude of 500-1000 metres above Msl on well-developed soils and abundant rainfall. The degraded forest/scrub lands are represented by thorny scrubs resultant due to degradation of the natural forest due to biotic interferences. Some of the areas identified under this category include the bald hilltops occurring amidst reserved forest areas. The forest blanks, appearing amidst forest areas are mostly being used for “podu or shifting or slash and burn cultivation” by the local tribes.

## METHODOLOGY

Hilly areas inhabited by tribal communities possessing traditional knowledge and with a good vegetation cover were selected based on reconnaissance survey. The potential tribal groups were selected based on whether they still practice their own social customs, traditional beliefs, religious rites, taboos, totems, food habits, medicinal and agricultural practices, as it was observed that the utilisation and conservation practices of tribes are intertwined with their taboos, beliefs and cultural practices. This kind of life style has created a proper understanding between them and the nature, which has resulted in enormous amount of knowledge now available with these tribal groups. The exploration trips were periodically conducted in the forests adjoining the tribal areas and their podu fields. The periodic visits enabled familiarity with tribes which helped in open discussions with the women on various aspects related to podu cultivation and shared their knowledge on utilisation of plant resources of Ethnobotanical value. Data on utilisation and conservation practices of tribal people revealing information on the informal innovation in utilising the Agrobiodiversity resources were observed and recorded with passport details.

In the initial visits, before attempting to start the Ethnobotanical and Agrobiodiversity studies, detailed discussions were made with tribal people of all ages. Initially, the stay in tribal areas was for shorter periods as the initial trips were aimed at establishing rapport with the tribals. Gradually the stay was extended for longer

periods to cross check the data and also for correct identification of plant species used by them. Longer stay in tribal hamlets helped in establishing evening talks and enduring social relationships with the tribals, which helped in collection of information on conservation aspects of plant genetic resources. Headman or priest of the tribal hamlet was consulted to develop mutual confidence and to have proper access and approach to the tribal people and also to explain the purpose of the study. For Ethnobotanically valuable Plants, following details were recorded. Whether the plant is used in fresh or preserved condition. Whether it is used exclusively or with other ingredients. Whether the medicine is administered internally or externally applied or practiced both. The duration of administering the medicine and dietary restrictions followed and whether the information procured is informed by their ancestors or collected from old manuscripts were also recorded. Herbarium was prepared according to methods suggested by Fosberg and Sachet (1965) and Jain and Rao (1977). The plants were identified by referring Floras of Cooke (1903), Gamble (1936) and Hooker (1897) and confirmed by comparing with the authentic or type specimens at Madras Herbarium (MH) at Coimbatore, Tamil Nadu, India. Nomenclature of each species has been made up-to-date as per the rules of International Code of Botanical Nomenclature (ICBN).

## RESULTS AND DISCUSSION

A detailed study was conducted on the Ethnobotany and Ethno agricultural aspects of the *Konda Reddys* in the conservation and sustainable utilisation of micro-level plant biodiversity. Ethnobotanical information on wild plant species used by these people for their food, medicine and other requirements were documented (Table 1 & 2). Voucher specimens of the plant species used were collected for herbarium. Traditional agricultural practices of the tribes were studied in detail, observations of which are discussed. 21 varieties of local land races were identified. This observation indicates the richness in the diversity of the crop plants that are cultivated by the local communities. A few of these varieties are being maintained under ex-situ conditions in the Community Gene Bank of M. S. Swaminathan Research Foundation, Chennai, India.

### Knowledge on Plant Biodiversity Resources

At first the Konda Reddys wanted to know why the study is being undertaken. When it was explained about the need for chronicling and revitalising their dying traditions and its importance to the humanity they agreed to share their knowledge on the value of Agrobiodiversity. The *Konda Reddys* are very knowledgeable on the value and in sustainable harnessing methods of biodiversity. They procure food items from the wild according to the season or whenever they are required. The Konda Reddy women prepare a kind of porridge/gruel with pounded flour of Corn - *Zea mays* and Finger millet - *Echinochloa frumentaceae*. The porridge once prepared will last for up to two days, which is stored in the fruits of *Lagenaria ciseraria*. This porridge serves as staple food for these people from June onwards till the next crop comes on. It is a common sight during the season that many old women are engaged in peeling of edible portion of corn from the cobs for preparing the porridge. Other millets

like common millet and foxtail millet are consumed after steaming and seasoning or cooked like rice and eaten. During summer months they depend on Jack and wild mango fruits. Konda Reddy women peel out the ripened Jackfruits, which are eaten and also prepare flour out of mango seeds, which they highly relish. A wild legume - *Mucuna* sp., locally called as *Dhamalu*, belonging to Family Papilionaceae, cultivated by Konda Reddys, is a very hard species and the locals consume this after thorough processing by repeatedly washing it in running water. Women do preserving and processing of seeds before cooking.

According to many in the community each plant species has its own value. However a few elderly people like Andhala Bhoomi Reddy and Chavala Potti Reddy of Maddhiveedu who have a sound knowledge on the ethnobotanical value of plants have been identified and involved as key informants. Kondla Somi Reddy of Mallavaram is another key informant who shared his knowledge on the medicinal value of plants. Andhala Bhoomi Reddy's wife explained the various cooking and storing devices made of *Lagenaria ciseraria* and Bamboo. She also brought out of her house and displayed the seeds of land races stored in leafy baskets, fruits of *Lagenaria ciseraria* and a few stored in a cotton cloth.

They also agree that sustainable harvest of existing utility value tree species is a must. According to Kathula Lachi Reddy of Kodavati Lanka if it is done through a systematic way it will be a success. Andhala Bhoomi Reddy of Maddhiveedu and Kathula Sanyasamma a well-known Konda Reddy woman of Tadepalli felt that cultivating or regenerating useful wild plant species is essential. The plant species, which the local people are willing to grow under "Ethnobotanically valuable plant species", include *Terminalia chebula* (Gall nut), *Embllica officinalis*, *Semecarpus anacardium*, *Flacourtia* sp. and *Pongamia pinnata*.

**Table 1: Ethno-biodiversity Resources identified**

No.	Type of plant germ plasm	No.of taxa
1	Ethnobotanically valuable plants	30
2	Plants of commercial value collected as NTFP	11
3	Traditional cultivars cultivated in the Podu\Shifting cultivation	21
4	Traditional cultivars cultivated in the plains	2
5	Vegetables and fruits cultivated	9

**Table 2: Ethnobotanically valuable plants to the tribals**

No.	Botanical Name	Local Name	Use Value
1	<i>Abrus precatorius</i> L.	<i>Guruvinda</i>	Seeds used for abortion
2	<i>Anona reticulata</i> L.	<i>Raama seetha</i>	Fruits edible.
3	<i>Bauhinia purpurea</i> L.	<i>Goddu kura</i>	Tender leaves cooked with any of the pulses, and eaten as vegetable

No.	Botanical Name	Local Name	Use Value
4	<i>Bauhinia vahlii</i> Wight & Arn.	<i>Adda aaku</i>	Leaves used as meal plates. Stem bark used as fibre.
5	<i>Buchanania lanzan</i> Spreng.	<i>Jaaruga</i> or <i>Jaaru Mamidi</i>	Fruits edible
6	<i>Cardiospermum halicacabum</i> L.	<i>Ubbakura</i>	Leaf paste applied on the trunk of the toddy tapping part of <i>Caryota urens</i> for inducing toddy.
7	<i>Caryota urens</i> L.	<i>Jeelugu</i>	Toddy tapped from the tree
8	<i>Cassia fistula</i> L.	<i>Rella chekka</i>	Stem bark grounded with jaggery and taken for chest pain
9	<i>Clausena heptaphylla</i> Wight & Arnott	<i>Jeede kooru/ Adavi kare-paku</i>	Leaves used in culinary as substitute for curry leaves.
10	<i>Cleistanthus collinus</i> (Roxb.) Benth. ex Hook.f.	<i>Odise</i>	Wood is used for cross beams in house construction and leafy branches used for fencing. Fruits used as fish poison.
11	<i>Crinum defixum</i> Ker-Gawl	<i>Seepa chettu</i>	Leaf juice used for ear infection.
12	<i>Digeria muricata</i> (L.) Mart.	<i>Guruva kura</i>	Leaves edible cooked and eaten
13	<i>Dioscorea oppositifolia</i> L.	<i>Thega dhumpa</i>	Processed tubers edible.
14	<i>Dioscorea wallichii</i> Hook. f.	<i>Nara dhumpa</i>	Tubers edible. Processed and eaten.
15	<i>Hemedesmus indicus</i> (L.) R. Br.	<i>Pala</i>	Root juice used for cooling effect.
16	<i>Holarrhena antidysenterica</i> (Roxb. ex Fleming) Wall	<i>Paala</i>	Latex used for cuts and wounds. Stem bark grounded and taken for dysentery one spoonful for threes times
17	<i>Madhuca longifolia</i> (Koen.) Macbr. var. <i>latifolia</i> (Roxb.) A. Cheval	<i>Ippa</i>	Calyx edible. Seed oil used in culinary. Latex used for tooth infection. Stem bark juice dropped into the left ear if tooth decay is on right side.
18	<i>Manilkara hexandra</i> (Roxb.) Dubard	<i>Pedda Paala</i>	Fruits edible
19	<i>Mucuna monosperma</i> DC ex Wight	<i>Gurrapu dekka</i>	Seed paste applied for migraine and mumps
20	<i>Oroxylum indicum</i> (L.) Benth. ex Kunz	<i>Paampana</i>	Stem bark along with Peda thanthemu used for menstrual disorders.
21	<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz	<i>Paathala garida</i>	Fruits used in snakebite and for dysentery.
22	<i>Schleichera oleosa</i> (Lour.) Oken	<i>Kusuma / Boosi</i>	Fruits edible also used in ulcers and gastric trouble. Seed oil used in skin diseases.

No.	Botanical Name	Local Name	Use Value
23	<i>Schleichera tomentosa</i>		Fruits and bark used as fish poison
24	<i>Sterculia urens</i> Roxb.	<i>Kovela</i>	Gum extracted from stem bark has commercial value. Roasted seeds edible.
25	<i>Streblus asper</i> Lour.	<i>Baranika</i>	Fruits edible, latex used for curdling milk. Stem twigs used as tooth sticks
26	<i>Strychnos nux-vomica</i> L.	<i>Musidi</i>	Stem bark ground with turmeric and one teaspoonful administered for speech impairment
27	<i>Strychnos potatorum</i> L.f.	<i>Indhumu</i>	Fruits used as fish poison
28	<i>Syzygium cumini</i> (L.) Skeels	<i>Neredu</i>	Fruits edible
29	<i>Zizyphus xylopyrus</i> (Retz.) Willd	<i>Gotti kaya</i>	Fruits edible
30	<i>Xylia xylocarpa</i> (Roxb.) Taub	<i>Konda tangedu / Adda pikka</i>	Seeds roasted and eaten

**Table 3: Plants of commercial value collected as NTFP**

No.	Botanical name	Local name	Part collected
	<i>Artocarpus integrifolia</i> L.f.	<i>Panasa</i>	Fruits
	<i>Bauhinia vahlii</i> Wight & Arn.	<i>Adda</i>	Leaves and fibre
	<i>Emblica officinalis</i> Gaertn.	<i>Usiri</i>	Fruits
	<i>Madhuca longifolia</i> var. <i>latifolia</i>	<i>Ippa</i>	Seeds and Corolla
	<i>Mangifera indica</i> L.	<i>Maamidi</i>	Fruits
	<i>Schleichera oleosa</i> (Lour.) Oken	<i>Boosi</i>	Fruits
	<i>Semecarpus anacardium</i> L.	<i>Nalla jeedi</i>	Seeds
	<i>Sterculia urens</i> Roxb.	<i>Kovela</i>	Gum
	<i>Syzygium cumini</i> (L.) Skeels	<i>Neredu</i>	Fruits
	<i>Terminalia bellerica</i> Roxb.	<i>Konda thadi</i>	Fruits / Resin
	<i>Terminalia chebula</i> Retz	<i>Karakkai</i>	Fruits

### Traditional Agriculture Practices: Knowledge on land races and practices of Podu or shifting cultivation

Their ancient method of agriculture, now known as Podu or shifting or slash and burn agriculture depends mainly on the short hoe (spade) and stick (wooden hoe). The Konda Reddys living along the foothills of hillocks in Tadepalli and adjoining areas viz. Kodavati lanka, Putta Gondhi lanka, Mallavaram and Madhivedu practice “podu” cultivation. They cultivate variety cereals, millets, vegetables and pulses in the podu or slash and burn or shifting cultivation along hill slopes and also in plains (Table 4 & 5). Even though they have settled houses in these hamlets, these people tend to live in their farmhouses in the high/ low slopes of their podu fields during

the cultivation season, which will be from July to January. Each family prepares its own Podu fields by cutting down trees and large shrubs in an area of 1 to 2 acres of forestland. Both men and women are involved in preparing the podu and women are involved in cutting the trees also. They also cultivate traditional varieties of vegetable crops (Table 6). Seeds are sowed in small pits made with hoe. Usually two seeds are sowed in each pit to ensure better survival rate. The *Konda Reddys* of Rajavommangi area cultivate a variety of Paddy- *Oryza* sp. locally called as *Gariki Sannelu*. At present only three out of 40 families are cultivating this variety, which is gradually being replaced with a variety called *Palguna* for the past five years.

Once the fields are cleared off vegetation, they will set fire to the fallen logs and branches, the ash of which supplies the soil with nourishment. This land will be used for cultivation for two years, which, depends on the height and girth of the trees that were felled. The yield of the crops will be good in the first year and the yield will decrease in the subsequent years. Podu cultivation will be started by gradually clearing the forest from the bottom of the hill in phases. They will cultivate in the cleared forest for two years and gradually go upwards with an interval of two years. By the time they clear the top most portion of vegetation the bottom part of the hillock will be having sufficient vegetation ready for further cultivation. It will take nearly five to six years for rejuvenation. Again this land will be used for cultivation in a cyclic manner. If the tribe feels that the vegetation is not sufficient for slash and burn, then he will choose another area, however far the place may be from his hamlet. Generally it is the same family that returns to the place where they had cultivated. But at times it will be taken over by other family of the community. The yield of the crop depends on the timely sowing of the seeds. The sowing period is between June and July when there are rains. If the forest area consisted of large trees before it is slashed and burnt, the cultivation could continue for three years, which is a natural phenomenon.

**Table 4.: Traditional cultivars cultivated in Konda podu - Shifting cultivation**

No	Traditional cultivar	Botanical name	English name
	<i>Arisanda/Alisanda</i>	<i>Vigan</i> sp.	Black eyed peas
	<i>Bobbarlu</i> <i>Nalla Bobbarlu</i>	<i>Vigna</i> sp. Two varieties available	Beans
	<i>Dhamalu</i>	<i>Mucuna</i> sp.	Wild beans
	<i>Dippalu</i>	<i>Lagenaria ciseraria</i>	Bottle gourd
	<i>Donki</i>	<i>Lagenaria</i> sp.	Bottle gourd
	<i>Gantelu</i>	<i>Pennisetum typhoides</i>	
	<i>Gariki Sannelu</i>	<i>Oryza</i> sp.	Paddy
	<i>Gongura</i>	<i>Hibiscus sabdariffa</i>	Roselle plant
	<i>Konda Benda</i>	<i>Hibiscus esculentus</i>	Okra
	<i>Konda Bontha</i>	<i>Echinochloa</i> sp.	
	<i>Konda Budama</i>	a variety of <i>Oryza sativa</i>	Paddy
	<i>Konda Chaamalu</i>	<i>Panicum miliare</i>	Little millet

No	Traditional cultivar	Botanical name	English name
	<i>Konda Jonna</i> 1. <i>Thella Jonna</i> 2. <i>Yerra Jonna</i>	<i>Sorghum biclor</i> Two varieties of white and Red are cultivated.	Sorghum
	<i>Konda Kandhi</i> 1. <i>Thella Kandhi</i> 2. <i>Yerra Kandhi</i> 3. <i>Nalla Kandhi</i>	<i>Cajanus cajan</i> Three varieties of white, red and black colour is cultivated.	Red gram
	<i>Konda Korralu</i>	<i>Setaria italic</i>	Italian millet
	<i>Konda Mokka Jonna</i>	<i>Zea mays</i>	Maize or Indian corn
	<i>Konda Sode/Chollu</i>	<i>Eleusine coracana</i>	Finger millet
	<i>Kulamalu</i>	<i>Cucurbita</i> sp.	
	<i>Pandiri pandlu</i>	<i>Lycopersicon</i> sp.	Tomato
	<i>Minumulu</i>	<i>Vigna</i> sp.	Mug bean
	<i>Vari</i>	<i>Oryza sativa</i>	Paddy

**Table 5: Crops cultivated in the plains**

No.	Traditional cultivar	Botanical name
1.	<i>Vari</i>	<i>Oryza sativa</i>
2.	<i>Adusulu</i>	<i>Guizotia</i> sp.

**Table 6 : Vegetables and fruits cultivated**

No	Local name	Botanical name	English name
1.	<i>Gummadi</i> 1. <i>Gummadi</i> 2. <i>Pulla Gummadi</i>		Pumpkin
2.	<i>Donda</i>	<i>Coccinia</i>	Coccinia
3.	<i>Mirapa</i>	<i>Solanum</i> sp.	Chilly (very hot)
4.	<i>Saema</i>	<i>Colacasia</i> sp.	Colocasia
5.	<i>Eedae pallu</i>	<i>Citrus</i> sp.	A variety of Orange. This variety is available in Maddhiveedu only.
6.	<i>Parindi</i>	<i>Carica papaya</i>	Papaya
7.	<i>Panasa</i>	<i>Artocarpus integrifolius</i>	Jack
8.	<i>Nara mamidi</i>	<i>Mangifera indica</i>	Wild mango
9.	<i>Raama palamu</i>	<i>Anona reticulata</i>	Bullock's heart

**Traditional methods of Seed storing:** Seeds are stored in the fruits of *Lagenaria ciseraria* and also in the leafy granary made out of leaves of *Bauhinia vahlii*. The Konda Reddy women mix domestic ash to the seeds and preserve them in earthen pots. Only during sowing time the seeds are touched. According to them frequent touching with hands will result in contamination.

**Suggestions to improve livelihoods and strategies to increase the yield from podu cultivation:**

The Borassus palm – *Borassus flabellifer*, is extensively distributed in the tribal areas. Leaves are used for thatching houses. Fibre from leaves is used for house construction. The fibre has commercial value and is sold @ of 7 to 8 Rs. per kilogram. Fruits are edible. Tender fruits are highly relished. Tender sprouts are cooked and eaten. Toddy is extracted from mature trees and forms more like staple diet for the local people. It takes nearly 20 years for a plant to reach maturity. The population of Borassus trees needs to be increased to meet the requirements of local people, which in a way will improve the livelihoods of the tribals.

During the fallow period if the tribes are encouraged to grow fast growing leguminous crop species of economic value, they can start cultivating in the same field within a span of five to six years and cultivation period could be for three years instead of two years. The tribes should also be encouraged to do cultivation alternatively leaving fallow and natural vegetation. This will decrease the chances of soil erosion and allow vegetation growth in a better way. Leguminous herbs like *Tephrosia purpurea*, etc and shrubby species of short life cycle can be cultivated in the in podu fields during the fallow period. This will not only prevent soil erosion but also retain soil fertility by maintaining moisture regime.

According to Thumbudu Raja Reddy and Kathula Lachi Reddy of Doramamidi approximately two acres of forest needs to be cut down every season for podu cultivation. According to this practice, each year approximately 3000 acres of forest area is cleared in around Tadepalli panchayat area for cultivation. A detailed survey is indeed necessary to assess the actual forest area (in acres) in and around Tadepalli area to look at the percentage of forest area cleared which would help in assessing the impact of Podu on standing vegetation and to develop alternative strategies towards better utilisation of podu areas. Efforts for enhancing the Agrobiodiversity resources used for and required by tribal women and men should be undertaken with long term objective of ensuring sustainable supply of resources to the tribes.

**CONCLUSION**

The tribal people have been conserving the agro-biodiversity as well as the knowledge on their utility value, without expecting anything in return. They continue to live in remote forest areas under very hard conditions that are prone to chronic epidemics. Therefore it is highly essential that the contributions of tribal women and men should be recognised and they must be suitably rewarded in order to improve their economic stake for their informal innovations and contributions towards conservation and sustainable utilization of plant genetic resources judiciously thereby eliminating the question of over exploitation. Mahatma Gandhi said, “Nature provides for Everybody’s need but not for Everybody’s greed”. In this context, this paper is concluded with a remark as follows: “Why the poorest of the poor particularly the women who are subjected to “driven poverty” (Poverty that is driven on women) should carry the heaviest burden of conserving the Agrobiodiversity, when the benefits of their contributions of conservation is being enjoyed by the humankind all over the world, over the past millennia.



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## ***Hortus Malabaricus* and the Biocultural Diversity of India**

**Dr. T Sabu\*, Dr. C R Suresh\*\* and Dr. Babu Ambat\***

\*Centre for Environment and Development, Thiruvananthapuram 13, Kerala

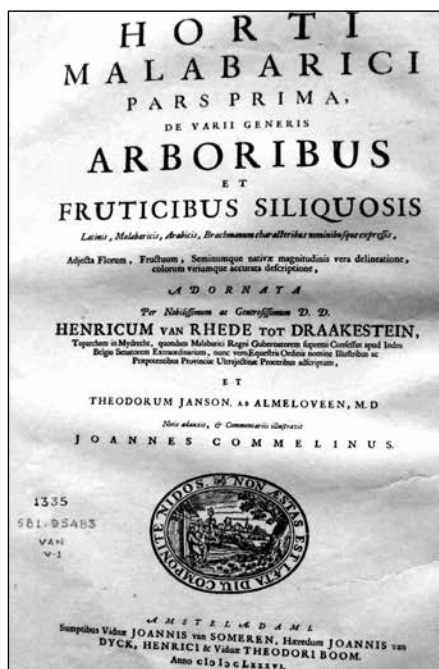
Email: [sabut@cedindia.org](mailto:sabut@cedindia.org)

\*\* Cheriyanasseril, Cherayi, Ernakulam Dist., Kerala

### **INTRODUCTION**

*Hortus Malabaricus* is a classical, monumental and comprehensive 12 volume book on the natural plant wealth of South India published from Amsterdam, in Latin language (English meaning Garden of Malabar), during the period 1678-1693. The book, which deals with the valuable plant wealth of Malabar (Kerala) was compiled by Hendrik Adriaan Van Rheede, the Dutch Governor of the former princely State of Cochin during 1670-1677. It contains details of 742 plants, belonging to 690 taxa (Nicolson et. al., 1988) found in Kerala, together with their descriptions and medicinal and other uses, in Latin. The descriptions are supported with 794 unusually beautiful illustrations with plant name in four scripts (Malayalam, Konkani, Roman and Arabic). In essence, it forms an effective documentation of the knowledge of four local physicians by a Dutch administrator.

The work has diverse importance to the people of India. Even though Van Rheede's basic interest was to record the details of local medicinal plants of South India, with their traditional uses and method of application, the work later becomes the first authentic regional floristic survey of Asia. Further, it is considered as collaboration between local physicians and the Dutch colonial



Front cover of *Hortus Malabaricus*

authorities and historical example of exchange and influence between and within the West and the East abound in the fields of art, sculpture and engineering.

In spite of the incomparable significance of the book, *Hortus Malabaricus* has not been projected as a classical work on our bio-cultural heritage till recently. The main reason may be that the entire text of the book, except the Malayalam name engraved in the illustrations, is in Latin and thus not accessible to many. It was the work of Professor K S Manilal and his students at Calicut University Botany Department which attracted some attention to this classical monumental work. Accordingly, 320 years after the last volume of the original publication, the book has been translated into English (Manilal, 2003) and later to Malayalam (Manilal, 2008) by the University of Kerala. This gives plenty of opportunities to Indian students, especially to the Kerala people to explore and utilize the information for future studies and application. This requires more popularisation of the work and awareness creation among the local people and policy makers.

### **Biocultural Diversity**

Biodiversity is a term now very familiar to us. According to Wilson (2010), "It is the key to the maintenance of the world as we know it and is what makes life so resistant to extremes". Because life adapts and fills every niche, diversity is healthy, and "homogeneity means vulnerability." Biocultural diversity is comparatively a new term which in its broad sense denotes an inseparable link between the diversity of life forms, their ecosystems and environments on the one hand and the array of human-made expressions in relation to these (Unnikrishnan et. al, 2013). In totality, this view has come to encompass genes, species, ecosystems, landscapes, and seascapes to worldviews, belief systems, knowledge, morals, values, norms, languages, rules, artistic expressions, artifacts and institutions of a region that have generally been passed on through an intergenerational transmission process and shared by a group (Haverkort, 2006). A socio-ecological approach here reiterates the inherent, dynamic relationship between nature and humankind and hence a biological and cultural diversity perspective for development towards a sustainable future.

The natural environment provides the basic canvas for a variety of cultural processes. Places and landscapes play a significant role in shaping the lives of communities that live within them. This long-term intimate contact is manifested in the ecological knowledge of communities. The last few decades show a slow shift in policy across the world to incorporate social and ecological perspectives in community engaged policy development. It is slowly being proved that the traditional knowledge and practices associated with the culture and heritage of a region balance the risks associated with technology based interventions to achieve the goal of sustainable development. The Convention on Biological Diversity (CBD) has also taken initiative to protect the biocultural diversity. The article 8 of the CBD particularly calls for the acknowledgement and wider application of local knowledge systems as they may contribute to the protection of biodiversity in natural surroundings. Accordingly, biocultural protocols are being designed and implemented, all over the world, to regulate access to biodiversity and sharing the benefits arising from its utilisation at the local level as a concrete way to operationalizing the Nagoya Protocol on Access

and Benefit-Sharing under CBD. The eleventh meeting of Conference of Parties to the Convention on Biological Diversity (CBD CO P 11) in Hyderabad, India in October 2012 considered 'Biodiversity and Livelihoods' as an important topic of attention. The World Health Organization (WHO) has recognized the importance of traditional medical practices and estimated that it cater to a major percentage (up to 70-80%) of the world population's health requirements especially in developing countries in Asia and Africa (WHO 2008).

Even though the biocultural diversity of India holds major untapped potential for its traditional knowledge mainly with respect to the medicinal use of bioresources and local livelihood development in various sectors, there are no concentrated efforts for the wise use of the already documented knowledge and its dissemination. The appreciation of the contribution of relevant traditional and indigenous knowledge in relation to actions in support of biodiversity conservation and its sustainable and equitable use goes beyond its simple validation in the context of conventional science-based approaches to the study of biodiversity. Traditional and indigenous knowledge related to biodiversity is central to elucidating its status and trends and for developing reasonable scenarios based on community participation with regard to the way biodiversity is conserved and used.

The traditional knowledge and practices documented in the past has a significant role in educating the people on past culture and there is a need for re-investigation for it's better use in the changed environment. The importance of *Hortus malabaricus*, a good example for the documentation of the biocultural diversity of India is discussed here in this context.

### **USING HORTUS MALABARICUS FOR CONSERVATION EDUCATION**

Any activity related to the conservation of biocultural diversity requires providing proper education to the local people, especially to the younger generations and policy makers. This should be based on solid materials. Now the passing over of traditional knowledge to the next generation is not happening and is only safeguarded by aged healers, who has carried the legacy of it from their family. The traditional knowledge on herbal medicine has thus a diminishing trend.

The importance of the book, *Hortus Malabaricus*, which provides detailed illustrations of the plants used as medicine and food, it's medicinal property along with method of use, has to be analysed in this context. The contribution of Hendrik Adriaan Van Rhee in documenting the



Hendrik Adriaan Van Rhee

biocultural diversity of India, especially south India, and the importance of his work has already been dealt in detail by many authors like Heniger (1968), Manilal (1978, 1979, 1980a, 1980b, 1984, 2003a, 2005, 2007, 2009a, 2009b and 2012), Nicolson et. al.(1988), Mohan Ram (2005), Suresh (1987), Vaczy, (1980) etc. Their works have reiterated the scope for using the book as a promising tool for communicating the importance of documenting the traditional knowledge and conserving the habitats of specific interest.

The major aspects of *Hortus Malabaricus* to be highlighted for using it for conservation education and research on biocultural diversity of India shall be categorized into five major groups viz. (i) Botanical importance (ii) Medicinal importance (iii) Conservation importance (iv) Socio-cultural importance and (v) Research application

### Botanical Importance

*Hortus Malabaricus* with detailed descriptions and illustrations of 742 plants (belonging to 690 taxa) found in Kerala, has of immense botanical value today. The preparation of the book is considered as the first regional floristic survey of Asia with information of Kerala, primarily those found around Kochi but including several others from Kollam in the south to Kozhikode in the north (Manilal, 2012). There are two earlier works published in 1563 (Garcia da Orta's *Coloquios dos simples e drogas cousas medicina da India*) and 1578 (Christobel d' Asosta's *Tracado de las drogas y medicine de las Indias Orientalis*) but are dealt only with about 100 plants which are scattered in Goa and Cochin.

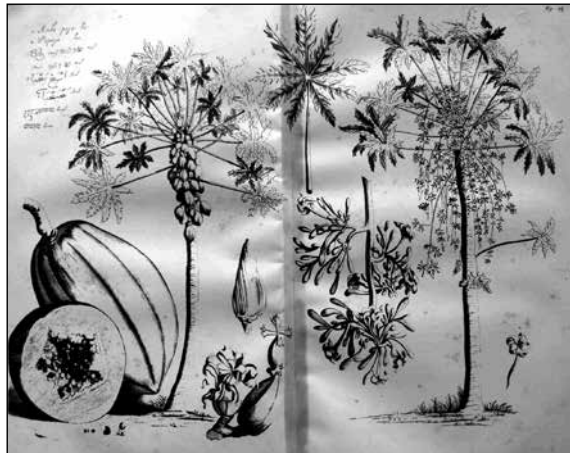


Illustration of *Carica papaya*

*Hortus Malabaricus* provides an opportunity for tracing the history of botanical science in India, the indigenous scientific system of classification of plants that was prevailing in Malabar, showing a high degree of understanding that the local traditional physicians had about the inter-relationships of different species. The plants described include not only the flowering plants (Angiosperms) but also lower groups except Algae and Fungi. Gymnosperms (2 species), Pteridophytes (16 species) and Bryophytes (1 species) are represented in the book.

Another major aspect of the work is that it represents a landmark in plant science history and was extensively referred to by Carolus Linnaeus, the Swedish Botanist who pioneered plant classification and is considered the father of modern Botany, 75 years after publication of its first volume. It formed an important reference for the

Asian plant species included in his '*Species Plantarum*' published in 1753. Around 50% of the plants (350 nos.) in *Hortus Malabaricus* were used by Linnaeus under various stages of his classical work. 55 species in 49 genera were solely created based on Rheede's elements (Eg. *Dendrobium ovatum*, *Zizania terrestris* etc.). No other region in India contributed to so many vernacular Indian plant names to *Species Plantarum*, than the small province of



Illustration of *Cocos nucifera* in Hortus Malabaricus (Toddy pot rounded)

Malabar (Manilal, 1980b, 2012; Manilal et. al, 2003). Many Malayalam plant names were also used to coin the binomials (Eg. *Eletteria cardamomum*, *Averrhoa bilimbi*, *Carica papaya*, *Mimusops elangi*, *Michelia chambaca* etc.)



Illustration of *Eletteria cardamomum*

The introduction to the first edition of *Genera plantarum*, published in 1737 by Linnaeus, titled 'Account of the work' *Ratio operis* has clearly mentioned that "I did not trust any authors with the exception of the famous Dillen in his *Hortus Elthamensi*; Rheede in his *Hortus Malabaricus*, whom I have observed to be most accurate:..." (Staffan and Reeds, 2007). Linnaeus had also properly acknowledged the work of Rheede by providing the generic name for an American plant as *Rheedia*.

Many other eminent botanists like Adanson, Amon, Blume, DeCandolle, Dennstedt, Dillwyn, Hamilton, Jussieu, Rumphius, White, et al., followed Linnaeus and named many taxa based on *Hortus Malabaricus*. Thus the work forms the basis for floristic and taxonomic investigations of Asian and tropical plants.

The illustrations in *Hortus Malabaricus* still shall be cited as good examples of the botanical illustrations and can be taken as a model for students in Botany. In most cases the entire plant is drawn, right from the root to fruits and seeds. The male and female plants were drawn separately ( *Carica papaya*). In some cases the size of the plant is compared by drawing a man along with the plant (*Eletteria cardamomum* Vol.11). The economic value of the species was clearly demonstrated in many cases (Eg. *Cocos nucifera* Vol. 1).

### Medicinal Importance

*Hortus Malabaricus* is considered as the earliest available document of a systematic scientific treatment of folk medicinal practices from Asia. It has great significance in its reliance on local medical knowledge. The study provides a detailed account on the medicinal plants, the diseases to treat which they are used, the preparation and the method of application of the drugs mentioned, revealing the uniqueness of the popular indigenous medical knowledge of Malabar that were existing six centuries ago, which are not authentically recorded in any other document. The authenticity of the data is well established from the fact that the author has collected the information from a well known traditional healer of that time, Itty Achuden (the key informant) supported by three other Konkani priest-physicians, Ranga Bhat, Vinayaka Pandit and Appu Bhat, and is edited by experts like Arnold Seyen (vol.1), J. Munnicks (Vols. 2-5), T.J. Van Almeloveen (Vol.6) and A Van Post (vol.1), J. Munnicks (Vols. 2-5), T.J. van Almeloveen (Vol.6) and A. Van Post (Vols. 7-12) (Manilal, 1984 and 1996). The Collatt Vaidyans, in Cochin during 17<sup>th</sup> century has maintained a family book consisting of several volumes of palm leaf manuscripts in *Kolezhuthu* Malayalam, in which were recorded names of medicinal plants, methods of preparation and application of drugs and the illnesses for which they were used. The family book not only served as a guide, but was in turn constantly enriched by recording the experiences of the individual physician of a new generation. The head of the family who practiced medicine was known as *Collatt Vaidyan*. When a *Collatt Vaidyan* died, his practice and title went to his eldest son, Itty Achuden, the key informant of Rheede.

Attempts were made by later researchers also for establishing the authenticity of the work. An analysis of the data on the medicinal plants recorded in *Hortus Malabaricus* was provided by Manilal and Ramesh (2010). This revealed that among the 675 species mentioned (nomenclature confirmed), 554 plants are used in medicines, 121 plants are cited as no use among the local physicians. *Hortus Malabaricus* is a source of more than 2789 prescriptions for more than 210 diseases which were rampant in the 15<sup>th</sup> to 17<sup>th</sup> Century, that are common even today. The medicinal plants described in Rheede's *Hortus Malabaricus* was reinvestigated by Renuka et. al. (2003). The medicinal Pteridophytes in Rheede's *Hortus Malabaricus* were studied by Ramesh et. al. (2003).

The information on the medicinal use of plants described in the book is of immense importance in the context of the growing global demand for natural drugs as well as the Intellectual Property Rights regime and Biological Patent Laws (Mohan Ram, 2005).

### Conservation Importance

An analysis of the species described in *Hortus Malabaricus* as indicated by Suresh (1987) and Nicolson et. al (1998) with respect to its conservation importance status is made as part of this review (Table 1). Out of the 690 species hitherto identified, 47 are of great value for conservation, considering its limited distribution and threat of extinction. 44 species are found only in India. 30 species are confined to the Western Ghats (WG) of which 19 are restricted to the Southern Western Ghats (mainly the

Kerala part of WG). 10 species are endemic to Peninsular India. 11 species are important with respect to the IUCN threatened category, of which 8 are in both endemic and threatened category. There are 2 endangered species both of which are endemic to WG.

**Table 1**  
**Plants in *Hortus Malabaricus* with more conservation value**

Sl. No.	Botanical Name	Family	Hortus Reference	End-emism*	IUCN Category
1	<i>Blepharistemma serratum</i> (Dennst.) Suresh	Rhizophoraceae	Tsjerou-poeam, 5:111, t.56	SWG	Vulnerable
2	<i>Blumea eriantha</i> DC.	Asteraceae	Manja-adeca-manjen, 10:33,t.17	India	
3.	<i>Bulbophyllum sterile</i> (Lam.) Suresh	Orchidaceae	Theka-mara-vara , 12:45, t. 23	PI	
4	<i>Calamus rheedei</i> Griff.	Arecaceae	Katu-tsjurel, 12:123, t. 65	SWG	
5	<i>Calamus travancoricus</i> Bedd.	Arecaceae	Tsjeru-tsjurel, 12:121, t. 64	SWG	
6	<i>Canscora perfoliata</i> Lam.	Gentianaceae	Cansjan-cora, 10:103, t.52	WG	
7	<i>Canthium rheedei</i> DC.	Rubiaceae	Tsjerou-kara, 5:73-74, t.37	PI	
8	<i>Capparis rheedei</i> DC.	Capparaceae	Badukka, 6:101, t.57	WG	Vulnerable
9	<i>Chionanthus mala-elengi</i> (Dennst.) P. S. Green	Oleaceae	Mala-elengi, 5:109-110, t.55	PI	
10	<i>Cinnamomum malabatrum</i> (Burm. f.) Blume	Lauraceae	Katou-karua, 5:105-106,t.53	SWG	
11	<i>Corypha umbraculifera</i> L.	Arecaceae	Codda-pana, 3:1-6, t.1-12		Data Deficient
12	<i>Cynometra beddomei</i> Prain	Fabaceae	Iripa, 4:65-66, t.31	SWG	Endangered
13	<i>Dalbergia horrida</i> (Dennst.) Mabb.	Fabaceae	Ana-mullu, 8:73-74, t.40	SWG	
14	<i>Dendrobium ovatum</i> (L.) Kranz.	Orchidaceae	Anantali-mara-vara, 12:15-16, t.7	WG	
15	<i>Dioscorea alata</i> L.	Dioscoreaceae	Katsjil-kelengu, 7:72, t.38	India	
16	<i>Gnetum edule</i> (Willd.) Blume	Cycadaceae	Ula, 3:9-14, t.13-21	PI	
17	<i>Hedyotis pruinosa</i> Wight & Arn.	Rubiaceae	Poutaletsje, 4:117-118, t.57	SWG	Vulnerable



Sl. No.	Botanical Name	Family	Hortus Reference	End-emism*	IUCN Category
18	<i>Helixanthera wallichiana</i> (Schult.) Danser	Loranthaceae	Kanneli-itticanni, 10:9, t.5	WG	
19	<i>Holigarna arnottiana</i> Hook. f.	Anacardiaceae	Katou-tsjeroe, Cheru, 4:19-21, t.9	SWG	
20	<i>Hopea ponga</i> (Dennst.) Mabb.	Dipterocarpaceae	Inga, Pongu, 4:7374, t.35	SWG	Vulnerable
21	<i>Hydnocarpus pentandra</i> (Buch.-Ham.) Oken	Flacourtiaceae	Marotti, 1:65-66, t.36	WG	
22	<i>Impatiens latifolia</i> L.	Balsaminaceae	Valli-onapu, 9:91, t.48	SWG	
23	<i>Impatiens minor</i> (DC.) Bennet	Balsaminaceae	Man--onapu, 9:95, t.50	PI	
24	<i>Impatiens tilo</i> (DC.) Suresh	Balsaminaceae	Tsjeria--onapu, 9:93, t.49	SWG	
25	<i>Indigofera uniflora</i> Buch.	Fabaceae	Tsjovanna-manneli, 9:91, t.38	PI	
26	<i>Ixora malabarica</i> (Dennst.) Mabb.	Rubiaceae	Bem-schetti, 2:19, t.14; Kilcola-tsjetji, 10:113, t.57	SWG	Vulnerable
27	<i>Kammetia caryophyllata</i> (Roxb.) Nicolson & Suresh	Apocynaceae	Kametti-valli, 9:23-24, t.14	SWG	
28	<i>Lindernia oppositifolia</i> (Retz.) Mukerjee,	Scrophulariaceae	Kondam-pullu, 9:57, t.31	PI	
29	<i>Litsea quinqueflora</i> (Dennst.) Suresh	Lauraceae	Mala-poenna, 5:17-18, t.9	SWG	
30	<i>Memecylon subcordatum</i> Cogn.	Melastomataceae	Nedum-schetti, 2: 21-22, t.15	SWG	
31	<i>Myristica malabarica</i> Lam.	Myristicaceae	Panam-palca, 4:9-10, t.5	WG	Vulnerable
32	<i>Naregamia alata</i> Wight & Arn.	Meliaceae	Nela-naregam, 10:43, t.22	PI	
33	<i>Neanotis rheedei</i> (Wall. ex Wight & Arn.) Lewis	Rubiaceae	Tsjeru-taludama , 10:49, t.25	WG	Endangered
34	<i>Ochlandra scriptoria</i> (Dennst.) C.E.C. Fisch.	Poaceae	Beesha, 5:119, t.60	WG	
35	<i>Ochlandra travancorica</i> (Bedd.) Benth. ex Gamble	Poaceae	Nola-ily, 5:119-120, (no illustration)	SWG	
36	<i>Olea dioica</i> Roxb.	Oleaceae	Kari-vetti, 4:111-112, t.54	India	

Sl. No.	Botanical Name	Family	Hortus Reference	End-emism*	IUCN Category
37	<i>Pandanus kaida</i> Kurz	Pandanaceae	Kaida, 2:1-2, t.1-5	India	
38	<i>Pandanus unipapillatus</i> Dennst.	Pandanaceae	Perin-kaidataddi, 2:5, t.7	PI	
39	<i>Psychotria dalzellii</i> Hook.f.	Rubiaceae	Katou-theka, 4:59-60, t.28	WG	
40	<i>Santalum album</i> L.	Santalaceae	Malla-katoutsjambou, 4:17-18, t.8		Vulnerable
41	<i>Saraca asoca</i> (Roxb.) de Wilde	Fabaceae	Asjogam, 5:117, t.59		Vulnerable
42	<i>Sonerila rheedei</i> Wight & Arn.	Melastomataceae	Soneri-ila, 9:127, t.65	SWG	
43	<i>Spermacoce hispida</i> L.	Rubiaceae	Tardavel, 9:149, t.76	PI	
44	<i>Symplocos monantha</i> Wight	Symplocaceae	Perin-patsjotti, 5:	SWG	
45	<i>Theriophonum infaustum</i> N.E. Br.	Araceae	Nir-tsjembu & Nelenschenaminor, 11:33-34, t.16 & 17	SWG	
46	<i>Vateria indica</i> L.	Dipterocarpaceae	Paenoe, 4:33-34, t.15	WG	
47	<i>Xanthophyllum arnotianum</i> Wight	Xanthophyllaceae	Karin-kara, 4:49-50, t.23	WG	

\*SWG=Sothern Western Ghats (Kerala), WG= Western Ghats, PI= Peninsular India

### **Ecosystem Diversity**

Rheede's preface to Volume III of *Hortus Malabaricus* provides an overview of the vegetation of the area. He made extensive travels to the entire area of Malabar and provided beautiful descriptions of the forests in plains (mainly the sacred groves), mountains, coastal areas etc. His main journeys fell within the period 1663-69. During these years he particularly travelled over the whole coastal area from Goa to Tuticorin (Heniger, 1980). In his words "I judged not without reason that this part of India was truly and



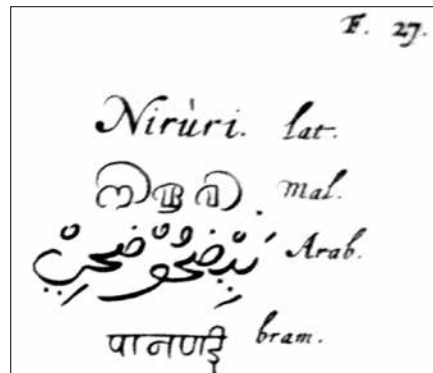
Illustration of *Osbeckia aspera* with habitat on background

rightly the most fertile part of the whole world and that it was largely similar to the Island of Taprobana (Sril Lanka), especially to that part which is situated in the same climate as the Malabar region". (During 1667 to 69 he was stationed at Colombo as first captain of -later as sergeant-major – of the Ceylonese army). Some of the drawings well reflected the scenic beauty of the habitat where it grows (Eg. *Osbeckia aspera* t. 43 vol. 4, 1683).

In the volume 3-8 of the book Rheede has given the names of the localities, where the plants mentioned in the book were commonly growing. The reinvestigation studies by Professor Manilal and Dr Suresh has made sincere efforts of about 20 years (1968 to 1987) to re-collect all the plants described in *Hortus Malabaricus*, from the localities from where Rheede originally reported them over three centuries ago. This was very difficult task since his times, several of the place names have undergone changes or modifications, some of them beyond recognition. The investigation found that several of his plants no longer occur in their original localities but have migrated to places far away. Such plants were collected from places nearest to Cochin or to their original localities, resulting in a re-collection of most of Rheede's plants. However, it has been found that several plants described in *Hortus Malabaricus* have disappeared altogether from the entire Malabar region, some having become extinct. A good example is *Pandanus furcatus*, collected by Suresh (1987) from Cherthala (Alapuzha district), is not available now anywhere in the state. Sunilkumar (2009) has made an extensive study on the Flora of Alappuzha district has not been able to locate this plants in the entire district. Another interesting observation is that around 50% of the plants recollected by Suresh (1987) were from sacred grooves ("Kavu") in the area from Quilon to Beypore and a good number of plants were collected from paddy fields, stream banks and ponds all over Kerala. The sacred groves and wetlands like paddy fields, stream banks, ponds etc. are major ecosystems in India, especially in Kerala, which are facing rapid changes because of current way of development. Thus these findings have more relevance now and it reiterates the need for preserving our traditional ecosystems, like the "Kavus", streams, ponds and paddy fields and initiating awareness building and capacity development among community as well as policy makers.

### Socio-cultural Importance

The unique position of *Hortus Malabaricus* in the social and cultural history of peninsular India is well documented (Manilal, 2012a & b). The book was of particularly important to the people of Kerala because it represented the earliest example of printing in the Malayalam language, now spoken by at least 30 million literate people all over the world. However, they are the exact transliteration of the spoken form (*vaamozhi*) that was in use in the



Inscription on the illustrations

17<sup>th</sup> century, written in an old script. As the technology was in its infancy then, engraving the mirror images on each page was done on copper plates. The engravers at Amsterdam had no knowledge of Malayalam language or its script and all these resulted in certain distortions. Malayalam has also been printed in the book to reproduce two certificates and to depict the names of plants alongside their illustrations. This is not only the first but the only printed book in which both the *Kolezuthu* and the *Aryaezuthu* scripts of Malayalam language and numerals are used together. The plant name is given in three other scripts also viz. Nagari, Roman and Arabic. In most cases, their Konkani, Portuguese and Dutch names are also given. Thus, it becomes instrumental for studying the history of evolution of linguistics and scripts of Malayalam language, a forgotten milestone in the history of Konkani language, history of Arabic and Arabi-Malayalam script and their evolution, stages in the history of evolution of Roman and Malayalam numerals and numerical systems, history of printing etc. (Manilal, 2012a).

The socio-cultural conditions in the 17th century Malabar and India well reflected in the work of Van Rheedee. Van Rheedee's main purpose in producing the volumes was to prove Malabar's superiority in terms of ready supply of valuable spices, cotton, timber and the availability of essential drugs for Dutch officers and their families in the East Indies," Van Rheedee was able to show that many valuable drugs purchased in European cities, including those used for the treatment of Dutch officers in the Indies, were actually made from medicinal plants originating in Malabar and exported through Arabian and other trade routes. The book on Plants of Malabar became instrumental in deciding the political history of India and of Netherlands in the 17th century and perhaps those other European maritime powers that followed the Dutch to India (Manilal, 1984).

*Hortus Malabaricus* is not only historical, but actually created history. Apart from its manifest botanical and medicinal importance, *Hortus Malabaricus* throws light on the intense rivalry between European maritime powers on the coast of Malabar and in Ceylon (Sri Lanka) and on the socio-cultural history of these regions. The book decided the political fortunes of Malabar and Ceylon and was in fact the product of political rivalry between Van Rheedee and the formidable Gen Ryklof van Goens, who was bent on establishing the Dutch colonial capital at Colombo rather than Cochin. The Dutch government approved the opinion of Van Rheedee over that of his superior while his publication went on to create a stir in the scientific and political circles of Europe, further stimulating the rivalry for colonies in India. But the Dutch, who had captured Cochin from the Portuguese in 1663 after years of coastal warfare, lost it to the British in 1795. They later withdrew forever to the East Indies, leaving behind in what became modern Kerala and Sri Lanka, a string of ruined fortifications and, of course, the *Hortus Malabaricus*. However, the treatise would be invaluable to nature conservationists trying to trace the migration, disappearance and possible extinction of many useful plants from their original habitats in the Western Ghats of peninsular India, a zone recognised as one of the world's biodiversity hotspots (Manilal, 2012b).

It can also be cited as an evidence of team work and communal harmony. Van Rheedee's *Hortus Malabaricus* is the result of about 30 years of compiling and editing by a team of the best among 17<sup>th</sup> century European physicians, professors of medicine

and botany. Indian scholars and vaidyas (physicians) of Malabar and adjacent regions, and technicians, illustrators and engravers, together with the collaboration of company officials, clergymen (D. John Caesarius and Father Mathew of St. Joseph College) are among them. This stupendous undertaking by the Dutch Governor of Cochin was greatly assisted by the King of Cochin and the ruling Zamorin of Calicut. The manuscripts and illustrations prepared at Cochin were sent to Netherlands and were edited there by at least by 7 Europeans as mentioned elsewhere in this text.

Unlike other illustrated herbals compiled at the time, Van Rheedee relied almost entirely on indigenous collaborators: three Konkani Brahmin scholars, who provided textual reference, but more importantly, Ayurvedic physicians from the Ezhava or low-caste toddy tappers, Itty Achuden, who provided the empirical plant knowledge and functional taxonomies of classification. Itty Achuden was born in the Collada family, famous for hereditary physicians in a place called Kodakkarapalli near Cherthala. He belonged to the Ezhava caste, who were then treated as untouchables by the Malabar Hindu community. In privileging the Ezhava, or non Brahmin view of the world, Van Rheedee transformed not only Ayurveda itself (often understood as an orthodox elite Brahminical tradition) but also colonial botany and thus Western science. Ezhava botanical classifications and medicinal garden schemes were recreated intact in Leiden. Indeed, Linnaeus is said to have directly incorporated both the order and the functional taxonomy originally provided by the Ezhavas (Sita Reddy, 2006). The great historian Richard Grove (1996) describes, that the main Ezhava informant, Itty Achuden, not only shared his community's secret texts with Rheedee but also selected, procured, and classified the plants for inclusion in *Hortus Malabaricus*.

The work of Van Rheedee not only drove commercial trade routes and colonial exploration, but also because of its seminal influence on the scientific development of



Itty Achuden and his *Kuriala* (Burial place/Lamp house) at Kadakkarapilly

botany, tropical medicine and medicinal gardens in cosmopolitan centers of learning like Leiden and Padua. Van Rheedee's conceptualization of Malabar as "the garden of the world" persuaded him to make a more fundamental set of associations between landscape and people and between forests, medicine and health, all of which were to have a decisive impact on Dutch colonial responses to deforestation (Sita Reddy, 2006).

### SCOPE FOR FUTURE RESEARCH

It is now widely recognised that processes at the science-policy interface, such as the Intergovernmental Panel on Climate Change and the newly-created Intergovernmental

Science-Policy Platform on Biodiversity and Ecosystem Services, must also work with non-peer reviewed, grey literature and with relevant knowledge held by local and indigenous communities. Studies have indicated that despite the exalted nature of global goals, they become relevant only when defined and shaped into pragmatic objectives and actions. This would require cooperative action by researchers, academicians, policy makers etc.

A sincere attempt for providing a detailed authentic record on the identity and distribution of the plants mentioned in *Hortus Malabaricus* was done by the second author under the guidance of Professor Manilal (Suresh, 1987). Major part of this work was later published as a book by Nicolson et. al (1998) and is still remain as the basic literature for future initiatives in taxonomic studies. The study revealed that the 742 plants described in *Hortus Malabaricus* represents 690 taxa belonging 143 families. Out of this 660 species were recollected from its original location mentioned in the book or from other locations in Kerala. About 30 species yet to be collected. However, the study could not be able to recollect many plants from its original location mainly due to habitat degradation. After this reinvestigation, completed in 1987, there also occurred enormous changes to the ecosystem where the plants are originally located and later studies in this region could not collected some plants collected by Suresh (1897) from this area (eg. Sunilkumar, 2009).

Studies has revealed that many of the uses/application of the plants mentioned *Hortus Malabaricus* are purely unknown to the present system of medicine, both indigenous and modern systems, and are of great significance. Medicinal uses of 554 species are specifically mentioned in the book and there are many other plants for which the medicinal uses are not mentioned (Manilal, 2010). However, later studies have proved the medicinal values of these plants also. A good example is that studies by Savita et.al. (2011) has shown that *Maytenus emarginata* (a plant described in *Hortus malabaricus* without any medicinal uses) has significant antitumor properties that support to use in the treatment of cancer.

Under the changed scenario of the conservation efforts initiated under various programs, there is further scope for detailed reinvestigation of the work by Van Rheede. As the book contains information on diverse topics, there is scope for future investigations from many disciplines like science, engineering, sociology and literature. Some topics of interest are:

- Floristic and habitat conservation studies
- The historical aspect of plant classification system
- Correct identity of plants used as medicine
- Ethno medical knowledge on parts used, methods of preparation and application etc. and it's validation to modern systems including patenting.
- Economic value of the plants which has not mentioned any medicinal use in the book
- Study on the political history of India and its linkage to *Hortus Malabaricus*
- Evolution of linguistics and scripts
- Caste system and communal harmony prevailed in ancient India
- The history of printing technology
- A search for traditional books related to plant use as medicine, food fiber etc.

## CONCLUSION

Assuring conservation and sustainable use of biological resources is increasingly becoming a high priority area in the sustainable development (SD) agenda. Whereas regulated, sensitive use is important for sustenance of biological diversity, augmented, active use as social traditions is vital for revitalizing as well as protecting traditional knowledge practices. Increasing social and economic disparity and inequitable access to resources and benefits is an area which has been in active discussions both at international as well as national policy processes. Recognizing the potential of local livelihoods through appropriate Access and Benefit Sharing (ABS) mechanisms is an area which is still in nascent stages.

India, in spite of its mega biodiversity, is now experiencing rapid economic and social transition and loss of its biocultural diversity. Studies all around the world have proved that this loss will have negative impacts on the livelihoods, production systems and health of local communities (TEEB 2010, Suneetha and Balakrishna 2010). Maintaining and revitalizing the community-specific knowledge with local ecosystems is an important mechanism for asserting the identity and social cohesion. This again has a crucial role to play in local livelihoods and socioeconomic and cultural systems.

The language constraint for reinvestigating and wise use of the valuable document, *Hortus Malaricus* has been resolved now by its translation to English and Malayalam (Manilal, 2003 and 2008). The multilingual volumes, with their introductions, forewords, dedications, references, and certificates given by Van Rhee to the native physicians, all of which contained extensive biocultural and historical information about India, is now open to all researchers and academicians. By translating and interpreting this valuable document in English and Malayalam, Professor Manilal has contributed significantly towards the safeguarding of our natural plant wealth and indigenous knowledge from being exploited by foreign commercial interests.

The *Hortus Malabaricus* and its English and Malayalam translations hold a new relevance in today's world where natural drugs are gaining much recognition but are controlled by biological patent laws and IPRs. The translation of the volumes needed to be widely publicized to highlight the biocultural glory of India, especially Kerala and there is also a need for the future policy processes to ensure the wise use of our already documented and yet to be documented traditional knowledge to ensure sustainable implementation of the present day development activities.

A remarkable attempt to popularize the book as well as to portrait the works of Professor Manilal was successfully attempted by Joseph Antony (2012). The book, prepared as the biography of Professor Manilal, in local language (Malayalam), gives a clear understanding on the importance of *Hortus Malabaricus* as well as Professor Manilal's 50 years of work to generate public interest on it.

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# **Sediment Bound Organic Carbon in Ponds of Palakkad, Kerala: Case of Sequestration by a Heritage Water Structure**

**Dr. K P Thrivikramji<sup>1</sup> and Dr. Jobin Thomas<sup>2</sup>**

*<sup>1</sup>Professor Emeritus & Program Director, CED and <sup>2</sup>C-GIST & Department of Environmental Sciences, University of Kerala, Trivandrum 695 581*

## **INTRODUCTION**

Since the advent of human settlement into communities and societies, ponds of variable aerial extent have been part of the agrarian culture and now part of our heritage. Primarily, the small and large ponds, met the water needs of the community like ablution, source of drinking water for cattle, and irrigating farms and fields. Natural depressions on the land surface or such lows walled in by soil and/or rock plus soil embankments quite efficiently stored rain- or snow melt-water for later use during times of water scarcity. Such large and small storages ensured the needs of the community and thereby secured the food grain needs of member families and indirectly to some extent fodder needs of cattle. Further the environs of large and wide pools of stored water (i.e., ponds or small lakes), also evolved into a locii of places of worship, art and culture. In fact, in the southern states of India like Tamil Nadu, Karnataka, and Andhra Pradesh, the large rain fed ponds historically functioned as massive water storage structures meant for irrigation and other water needs of community, while the population centers near these ponds came to be known or named after the pond (e.g., Vettuvan kulam, Karisal kulam, Periya kulam etc in the state of Tamil Nadu). In Kerala, as the water availability was rather assured throughout the year due to the monsoon climate, right from the antiquity settlements grew primarily around temples or places of worship. But as the Hindu faith demanded the patrons of temples, a bath before stepping into the temple environs, a well kept and maintained pond became part of the temple complex with separate bathing ghats for men and women, as well as roofed and sheltered bathing ghat for the temple priest. The latter was built and designated so that the priest would be sheltered from the seasonal rain fall and therefore not delayed in attending the rituals of temple. Temple ponds are mostly rain fed or ground water fed and have spillway of some sort to let go the excess water. Otherwise water in such ponds came in handy for saving crops only during extreme droughts. However, after the second World War, with the dawn of modern agricultural practices like use of canal irrigation, farm machinery for plowing, sowing, harvesting, introduction of fertilizers, quality assured seeds or

planting material, the conventional ponds and small lakes gradually went into the oblivion, especially in respect of upkeep and care. Another outcome of the modern agriculture is the entry of farm residue laden waters into the ponds, transforming them from oligotrophic to the current eutrophic state. India is the cradle of canal irrigation and with the spread of distributary canals, the ponds gradually lost their “glitter” as they no longer served the water needs of the farmers, and slowly slid into neglect, poor maintenance and transformation to marshes or patches of hydric soils.

Current state of Ponds of Kerala is no exception and in fact our ponds are a snapshot of the state of ponds of India. The Department of Fisheries, Government of Kerala, in one of their publications, “Panfish”, provides a district-wise data set on the number, genre and aerial extent of ponds (viz., private, panchayat and quarry) of the state (i.e., total number=41784 and area = 23814 ha or 238.0 km<sup>2</sup> or only 0.61% of the land area of Kerala). Several large and small ponds are topping the list of sites eligible for filling and reclamation and use as free hold land for new developments. Kerala has a relatively smaller land area and higher density of population: area=38863.0 km<sup>2</sup>, population 2010 census=3.18 crores, density of population =819 per km<sup>2</sup> (Panfish, 2002). During the early 50's, the brownish yellow waters of monsoon rains on diversion filled the neighborhood ponds for later use, i.e., chiefly for paddy. At the offset of monsoon and drying up of inflow, but for a certain degree of lightening of brownish yellowness, not much changed in respect of the colour of stored water. Again, unlike these days, the micro-algal blooms or macrophytes were unheard of or unseen in those days. And the farmers used the stored water, say, after the second or third week of replanting of paddy. However, currently, the very same ponds are in a state of neglect and in the tight grip of eutrophication. In this research we profile the bottom sediment and water of a set of ponds in the water stressed regions of Palakkad district, Kerala, in order to quantify the sediment bound Organic Carbon to glean further knowledge on the degree of Carbon sequestration by these ponds.

## PREVIOUS WORKS

Globally, the large lakes, by being large, attracted hordes of researchers – limnologists, on the pursuit of examining the biologic, physical, chemical and geologic characteristics. However, after the second World War, with advent of new technologies and tools of research, lake studies or science of limnology gained momentum and covering the smaller lakes and ponds, as the latter are numerically several orders of magnitude more than the larger.

It was Dean and Gorham (1988) who modeled trapping of autochthonous (i.e., by primary production) Carbon in terrestrial lakes, reservoirs, and peat lands by spot lighting the magnitude and significance of carbon burial globally and especially in the context of CO<sub>2</sub> driven climate change. They estimated current yearly accumulation of organic carbon (OC) at 42 Tgy<sup>-1</sup>. The sediments of reservoirs accumulate an additional 160 Tgy<sup>-1</sup> and peat lands contribute 96 Tg y<sup>-1</sup>. Thus these pools of water sink nearly 300 Tgy<sup>-1</sup> carbon, while only covering <2% of the Earth's surface. The mighty world oceans on the other hand trap only about 100 Tgy<sup>-1</sup> of OC. According to Kalff (2001) past estimates of global aerial extent of lakes and ponds as 2.0-2.83 10<sup>6</sup> km<sup>2</sup> is an understatement of the area. Further recent studies by Cole

and Caraco (2001), Sobek et al. (2003), Pace and Prairie (2004) amply underscore the fact that in respect of CO<sub>2</sub> and CH<sub>4</sub> efflux and sediment bound organic carbon trapping, freshwater ecosystems play a major role. Downing et al (2006) believed that the sheer large number and extent of small lakes and ponds over the large ones will make the limnetic process reach global significance especially in regard to global carbon cycle. Freshwater ecosystems like lakes and ponds (numerically dominated by smaller systems) are generally considered to cover only a small portion of the earth's land surface (i.e., say 1.3 to 1.8 % of the total). Downing (2009) and Downing and Duarte (2009) also showed that the inland water bodies processed 1.0 Pg y<sup>-1</sup> more Carbon, than was estimated earlier. As a consequence, the limnologists reframed their research questions to address the smaller lakes and ponds as to their role in nutrient as well as carbon cycling, especially in regard to the rates or extents of carbon trapping or re-release of carbon/methane to the atmosphere. Moreover, ponds and small lakes are very much likely to be transformed, modified or even eliminated by landscaping or sedimentation. For instance, for a sedimentation rate of ~ 1.0 mm y<sup>-1</sup>, very small lakes and ponds (0.01 km<sup>2</sup>) will have lifetimes of <1000 y or under a millennium.

Nationally, past research in Indian Universities and institutes primarily focused on the limnetic aspects of ponds and small lakes, along with the physical and chemical characteristics of water and sediment column as well as rate of sedimentation. Dhanya et al (2012) looked at the ponds of Pallippuam Panchayat of Cherthala taluk, Kerala and identified 873 ponds (66% unused, 33% used purposes other than drinking and only 11 ponds as drinking water source). The study looked at the algal blooms only and not the chemistry of sediment or water. Recent reports on temple ponds of Kerala had primary focus on the water column's characteristics, like physical and hydrochemical properties of water samples and biological content and counts. In spite of the estimates on dissolved CO<sub>2</sub> in water, its implication to the larger question of atmospheric CO<sub>2</sub> build up did not get any attention, i.e., the role of impounded water/sediment as a terrestrial Carbon sink (Anithakumari, and Aziz, 1989; Prameela, Maya and Menon, 2001; and Sulabha and Prakasam, 2006). Among other aspects, a good deal of data is reported on water chemistry, nutrients, organic life and sediment chemistry of Kerala rivers like Pamba, Chalakudy, Bharathapuzha and Anjarakandy rivers (Anonymous, 2011). The report on sediment chemistry, in fact, has not missed reporting on the OC content, yet was without any attempt to scale it up to the annual accumulation or flux or sequestration. For e.g., OC content in Pamba is in the range of 0.56 -1.62 mg kg<sup>-1</sup>, in Chalakudy 0.83-1.45 mg kg<sup>-1</sup>, while OC stood at 0.4 -1.24 mg kg<sup>-1</sup> in Bharathapuzha and 0.07 -1.19 mg kg<sup>-1</sup> in Anjarakandy-Mahe samples. In another, in depth report on the soil quality of Vilappil, Koratty and Cheruvannur Panchayats of Kerala (Anonymous, 2012), soil organic carbon (SOC) content (highest SOC in % is in a sample from Koratty, i.e., 8.37%) in scores of samples is tabulated sans a mention of the wider implications to Carbon sequestration or advantages of burying biochar. A welcome departure from the past classical approach can be seen in Begum, John and Sreekumar (2013), wherein, based on studies in experimental plots, efficiency of Cassava –a common food crop in Kerala- plant's carbon sequestration is quantified and demonstrated. Thrivikramji (2005) proposed a classification of the ponds of

Kerala chiefly from the point of setting of ponds in the terrain and socio-cultural attributes, which motivated the authors to take a closer look at the ponds of eastern Palakkad - a set of well known water stressed blocks identified by the CGWB.

### **THE PALAKKAD DISTRICT**

Palakkad dist (area = 4480 km<sup>2</sup>; Pop.= 2, 617, 072; Pop. Density = 584/Km<sup>2</sup>) is the second largest district among the 14 districts of the State, devoid of a shoreline and contained wholly in the midland (Elv. Range = 7.5-75.0 m) and highland (Elv. = >75.0 m) regions of Kerala. The midland region consists of valleys and plains. It leads up to the highland which consists of high mountain peaks, long spurs, extensive ravines, dense forests and tangled jungles. Among the five taluks, viz., Mannarkkad, Ottappalam, Alathur, Chittur and Palakkad, Ottaappalam fall entirely in midland, while the others straddle between the midland and highland. Most of the land area of the district is drained by the Bharathapuzha ( area = 6186 Km<sup>2</sup>) and tributaries - second longest river of Kerala as well as an interstate river.

### **Climate**

Though the Palakkad district enjoys a humid tropical climate, yet it differs from rest of Kerala in respect of rainfall, temperature distribution and wind pattern due to the influence of the Palghat Gap- a topographic discontinuity in the otherwise continuous Western Ghats. In other words, the eastern parts of the district are drier, in comparison with the wetter western segment. Rainfall averages annually at 2106.6 mm (IMD, Pune) but decreases easterly, i.e., 2850.0 mm at Mannarkkad in the west to 1757.0 mm at Chittur in the east. The annual average maximum and minimum temperatures are 32.3 and 23.4°C respectively. 75% of rain fall yield is during SW monsoon. Anirudhan (1990) analyzed the IMD weather data for stations at Ponnani, Cherplachery, Mannarkkad, Ottappalam, Alathur, Parali and Palakkad – all in the Bharathapuzha basin. Stations like Ottapalam, Mannarkkad and Parali fall in the Koppen's Am field (tropical monsoon), whereas Alathur, Palaghat and Chittur are in Aw or Tropical wet-dry climate and easterly of Chittur in B,S (Semi arid) climate. A hot season from March to May is followed by a wet season from June to February. Rainfall in South West Monsoon is far more (70%) than the NEM (Das, 1986). Average annual rainfall is 2676mm (for 1986) and rainfall shows a distinct decrease from west (2956mm) to east (1794mm) at Chittur. Rainfall data east of Chittur show that av. annual rainfall is only 765mm.

### **Ponds of Palakkad**

The Panfish (2002) a publication by Department of Fisheries, Kerala state, among other data also lists district-wise distribution of ponds and under three categories. In Palakkad district there are private (n=3061, area= 948.7 ha), panchayat (n=629; area =176.84 ha) and quarry ponds (n= 136; area= 55.16 ha). In fact, 3826 ponds add up to cover a total area of 1180.27 ha or 11.8 km<sup>2</sup> of land area. In the month of July, 2012, one sediment and one water sample each were collected from a selected pond in the water stressed blocks of Srikrishnapuram (a=200 m<sup>2</sup>), Trittala (a= 311 m<sup>2</sup>), Palakkad (a=2034 m<sup>2</sup>), Kollenkod (a=5793 m<sup>2</sup>), Chittur (a=11446 m<sup>2</sup>) and Attappady (a=20 m<sup>2</sup>) following standard APHA prescriptions on sampling, packing, transport

and storage in the laboratory. The analyses were carried out in the laboratory of the Department of Environmental Sciences, University of Kerala, Kariavattom. Summary of analysis of water and sediment samples are given in Table 1. Due to the comparatively small size of the pond screening of samples of this pond was not carried out. Dry bulk density of sediments ranged between 0.9 to 1.4 gm cm<sup>-3</sup>. But the OC content showed a wider range from 1.0% to nearly 5.0%. Assuming a very low rate of sedimentation of 1.0 mm/y, our calculated OC burial in the five ponds from the water stressed blocks of Palakkad dist stands at 585.11 t C y<sup>-1</sup>, which is an area-dry sediment bulk density-OC weighted estimate. All the ponds listed in the “Panfish” under Palakkad dist jointly sequester at the rate of 442,414.0 t C y<sup>-1</sup>.

**Table 1**  
**Physico-chemical attributes of water and sediment of ponds & estimates of C sequestration.**

Pond ID	SKPM	TTLA	PLKD	KLD	CHTR
a. Water attributes					
pH	7.1	7.8	7.6	7.2	7.1
Turbidity (NTU)	3.1	3.2	7.8	5.7	6.1
Conductivity ( $\mu$ s/cm)	0.24	0.11	0.18	0.12	0.22
TDS (mg/l)	37	18	21	28	31
Total Alkalinity (mg/l)	21	19	16	25	28
Chloride (mg/l)	15.2	21.4	24.7	18.1	19.5
Nitrate (mg/l)	2.13	2.14	4.23	0.17	1.04
Phosphate (mg/l)	0.0011	0.0042	0.00	0.00	0.0121
Total Hardness (mg/l)	5.4	6.4	6.7	4.4	5.6
b. Sediment Physical properties					
Organic Carbon, OC, (%)	4.1335	0.973	3.3357	1.752	5.741
Inorganic Carbon (%)	2.3988	0.5644	1.9473	1.0162	3.3299
Dry Bulk Density (g/ cm3)	1.18	1.14	1.16	1.46	0.94
Textural Class*	fszC	zC	fzC	fszC	fszC
c. Yearly OC burial					
Area, m2	311.0	5793	11446	2034	200
t C/y	15.18	64.26	442.89	52.03	10.75
Total Burial, t C/y	585.11				
d. Yearly OC burial all ponds, Palakkad dist					
Type/title	area		Quantum		
Private Ponds	948.27 ha		355,612.0 t C/y		
Panchayath Ponds	176.84 ha		66,287.0 t C/y		
Quarry Ponds	136		55.16 t C/y		
All Ponds	1180.27		442,414 t C/y		

SKPM-Srikrishnapuram; TTLA-Trithala; PLKD - Palakkad; KLD-Kollenkod and CHTR-Chittur)

\*f=fine, s=sand, z=silt, and C=clay

## DISCUSSION

The IPCC report in fact had suggested examining the details of terrestrial sediment bound carbon sequestration through soil, inland waters including streams, natural ponds and small lakes, large lakes, large river water impoundments as well as the sediment accumulating in there, as well as CO<sub>2</sub> in dissolved state in the water column. Dean and Gorham (1988) created global picture of the various terrestrial OC sequestration domains and compared these with the annual oceanic sequestration of Carbon. Researchers also cautioned the need to assess the re-emission of OC as methane, CH<sub>4</sub> (a gas 24 x powerful to CO<sub>2</sub>), from the terrestrial repositories back to the atmosphere is imperative. In this report, we made an assessment of annual Carbon burial rates in the ponds under investigation, and used the average OC content over to ponds (like, private, panchayat and quarry) of Palakkad dist to highlight the C burial by these water heritage structures.

## CONCLUSION

The results of our study of ponds in the water stressed blocks of Palakkad dist, viz., Srikrishnapuram, Trithala, Palakkad, Kollenkod and Chittur are:

- i. None of the ponds fall under the category of oligotrophic type; instead they are either in the mesotrophic or eutrophic state. The organic matter in the sediment is nearly purely of autochthonous origin. With the exception of the pond in Attappady (not part of this report), all are perennial in nature. The presence and level of inorganic carbon is attributed to influx of farm residue (anthropogenic) as well as in put from the limestone basement in portions of the district.
- ii. The sequestered C from the atmospheric carbon dioxide, mediated by algal photosynthesis, in permanently deducted from the lower troposphere leading to a reduction the bulk. Advantages of such photosynthetic capture of C, by the phyto-planktons and its binding in the sediment-organic-matter are as important as the role of forests in mitigating CO<sub>2</sub> driven global climate change. Thus the ponds, with deep roots in the culture of any society, are heritages to posterity and are passively and effectively involved in Carbon Capture and Sequestration. , thereby restating the adage “old is gold”.

Therefore it is the obligation of the scientific community to refine the numbers relating to ponds and small lakes vis-à-vis carbon capture and sequestration. Such knowledge, we hope will provide a new role to these water heritages or ponds and small lakes.

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***Subtheme III:  
Culture, Heritage and Health***



# Traditional and Folk Practices - Contemporary Relevance and Future Prospects

## Dr. S Rajasekharan

*Senior Project Consultant , Division of Ethnomedicine and Ethnopharmacology,  
Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI), Palode,  
Thiruvananthapuram, Kerala – 695 562, Email: drrajsek@yahoo.com*

### INTRODUCTION

Traditional and Folk Practices are the art of learning and healing that originated from almost all ancient civilizations of the world. Scientific evidence shows that human population had migrated to the Indian subcontinent since pre historic time. 'Excavations at different sites suggest that medical interventions such as dentistry and trepanation were practiced as early as 7000 BCE in the Indian subcontinent. Organized forms of agriculture practiced by the people of the Indus civilization, the importance they gave to certain medicinal plants and trees and the emphasis on water, sanitation and hygiene suggest an advanced awareness of health management. Trade routes linked the Indus civilization to other parts of the subcontinent and westward to Persia, Mesopotamia and the Arabian Sea, and northward to Central Asia. It is highly likely that botanical and medical commodities and knowledge were among the prized items of exchange. Recent archaeo-botanical excavations give evidence for the use in the Middle Gangetic region of medicinal plants since the 2<sup>nd</sup> millennium BCE that are still used by Ayurvedic physicians and folk healers'<sup>1</sup>.

India is one among the countries which stood in the forefront to systematically document traditional and folk practices. Unfortunately, due to frequent invasions of many foreign traders/dynasties, we had lost our ancient wisdom on many occasions. The best practice prevalent on health care among the different communities including tribal communities of India is that, we have preserved such unique healing art to a certain extent. They developed methods of indigenous diagnostic procedures to detect diseases and various types of treatment protocols. Treatment is mainly based on the utilization of locally available bio-resources especially the plants used for food and medicine including animal products. Apart from this, they also effectively utilized abiotic components like minerals, metals and other natural products. Ancient healers also evolved an indigenous taxonomy of flora and fauna and documented the habit, habitat and distribution of different species especially used for food and medicine.

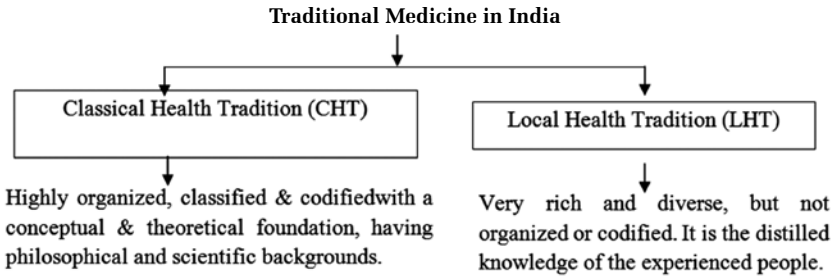
Traditional Knowledge (TK) is considered as the mother term which is directly linked with the tradition and culture of the individual countries. It generally refers to experiences of longstanding traditions and practices of certain regional, indigenous or local communities. TK also encompasses the wisdom, knowledge, teaching and experience of these communities and usually it is orally transmitted from generation to generation. Since it is restricted to location specific knowledge of common people including ethnic communities, residing in a particular region/country, the knowledge is confined to the genetic and non-genetic resources available within their surroundings. 'More than 80% of the livelihood need of the world's poor, directly or indirectly depend upon the use of biological resources and associated TK. It is now under threat and is deteriorating rapidly because of the changing lifestyle of the people. There is an urgent need to document such valuable information for the welfare and betterment of posterity'. As per the recent estimate, nearly 4.4 billion people comprising 80% of world's total population rely on Plants for their primary healthcare. In the present era of medical engineering, plants play significant role in discovery, designing and development of life saving drugs. Over the counter cost of herbal drugs is roughly estimated to be US\$ 500 billion all over the world. It is growing consistently @ 10 – 15 % annually and likely to touch US \$ 5 trillion during the next 30 – 40years<sup>2</sup>. In this paper the author highlights the following topics to discuss the need for the systematic documentation of Traditional and Folk Practices and its appropriate effective utilization in the field of health care. The topics are Traditional and Folk practices in India- a Perspective, Symbiotic Relationship between Classical Health Tradition and Local Health Tradition, Significance of Ethnomedical Studies/Traditional and Folk Practices, Traditional and Folk practices in Kerala and also discussed some of the interesting case study recorded from the Traditional and Folk Practices of Kerala.

### **TRADITIONAL AND FOLK PRACTICES IN INDIA**

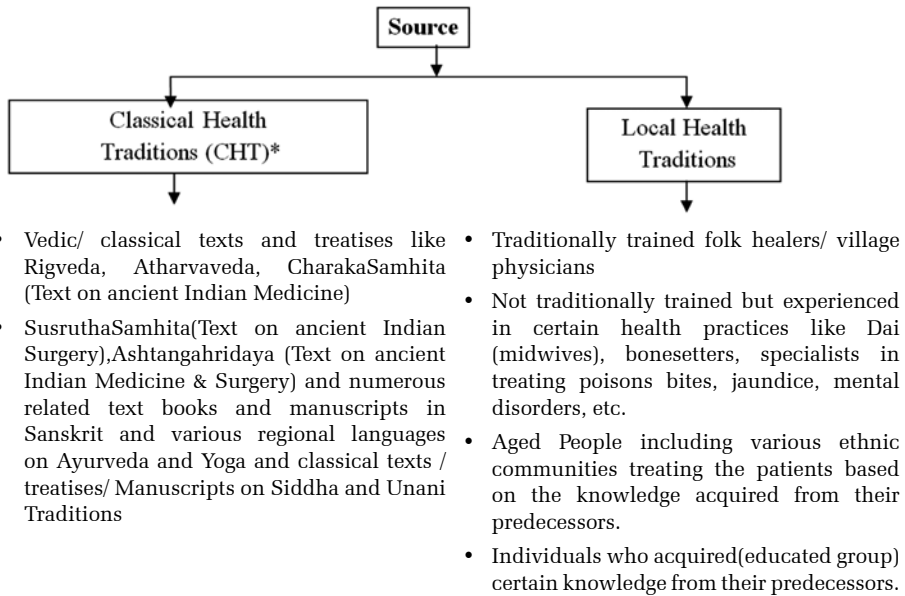
India is one among the seventeen mega-diversity nations of the world. The total number of species that exists on the earth is more than 10 million. Out of these, near about 2% species are described. More than 50% of land species occur in the tropical moist forests. This rich biodiversity offers inestimable opportunities for developing new modern drugs/herbal drugs, nutraceuticals and other useful health care products. India is considered as the home land of the most diverse and richest traditional and folk knowledge systems because of its unique cultural expressions which are directly or indirectly connected with environment, ecology, biodiversity, etc., ranging from coastal, desert and plains to mountainous regions. This varied and diverse topography is the result of the typical climate, edaphic factors and physiogeographic conditions which in turn resulted in a rich variety and variability of flora and fauna, especially the plants used for food and medicine. Medicinal and Aromatic plant wealth of India is immensely rich and diverse and has attracted the attention of traders from all over the world. The diversity that occurs in the flora and fauna has played a major role for evolving a unique Classical Health Tradition (CHT) and Local Health Tradition (LHT) in India. Since time immemorial, traditional Vaidyas (Physicians) of India have been utilizing the location specific edible/medicinal plants. They administered various effective drugs made from these plants for Primary Health

Care and also effectively applied them for treating various ailments, both acute and chronic in nature.

**HEALTH TRADITIONS IN INDIA**



**Source of Traditional Medicine in India**



\*Classical Health Tradition in India has been included and recognized AYUSH systems (A-Ayurveda, Y-Yoga & Naturopathy, U-Unani, S-Siddha and H-Homeopathy). As a department under the Ministry of Health and Family Welfare, Government of India

**Symbiotic Relationship between Classical Health Tradition and Local Health Tradition**

Scholars of classical health tradition have emphasized to maintain the positive health of an individual by conditioning his spiritual, mental and physical faculties. To deal with the same, they prescribed certain specific measures in terms of prevention, promotional and correction under Swasthavritha – that is to maintain the health of

the healthy person in a positive way. Apart from this, guide lines have been given for daily routine (Dinacharya), seasonal regimen (Ritucharya), including regulations of diet, personal hygiene, physical and mental exercise, etc. Athuravritta deals with diseases, disease management/treatment and rehabilitation. The major part of Athuravritta is medicine and surgery. Acharya Charaka, who has written the ancient Indian medical treatise (CharakaSamhitha) was the first to describe the concept of Ethnomedicine.

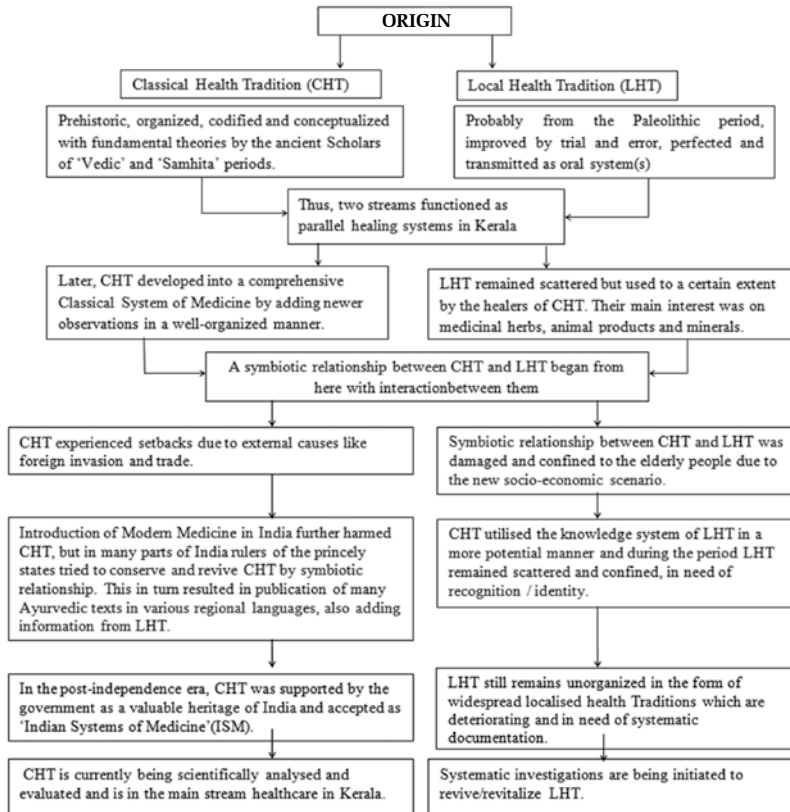
*'Oushadinamarupabhyamjanatehyajapavane, avipaschaviagopasca ye canyevanacarina.....'*

In this connection, Charaka stressed the importance of correct identification of a plant as most important for designing treatment protocol. He further stated that simply confirming the name of a plant does not help in treatment and therefore, one should be well versed with morphological characters. To acquire such knowledge of plants including its therapeutic uses, one should interact/inter associate with the hill tribes, cowherds and sages of the forest. This concept was well appreciated and considered as the basic concept of Ethnomedical research even in the modern era.

#### **Significance of Ethnomedical Studies/Traditional and Folk Practices**

- Ethnomedicine/Traditional knowledge is directly linked with the cultural heritage of the people.
- It has been handed over from generation to generation.
- Ethnomedical knowledge is getting eroded rapidly because of the changing life styles of the people.
- There is an urgent need to document such valuable information for the welfare and betterment of posterity.
- Bio-prospecting of plants used for food and medicine based on Ethnomedicine/Traditional/Folkpractices is an important area of research
- It is important for developing diverse novel products which are essentially required for taking care of human health.
- To evaluate medicinal and food value of plants, the role of Ethnomedical leads is important.
- These leads will help to formulate therapeutically active formulations which are commercially viable.
- Technology transfer of these products will further ensure their commercialization and benefit sharing with the knowledge providers.
- Answers to the unsolved health/medical problems of mankind.
- Alternative drugs with fewer/no side effects.
- Safer, inexpensive substitutes for expensive drugs.
- Development of life saving drugs (modern/herbal).
- Utilization of Ethnomedical/Traditional knowledge on plants, animals, minerals for enriching Ayurvedic/Indian Pharmacopoeia.

### Symbiotic relationship between Classical Health Tradition and Local Health Tradition in Kerala



### TRADITIONAL AND FOLK PRACTICES IN KERALA– A PERSPECTIVE

The history of the Traditional and Folk Practices in Kerala goes back to the history of the origin of Kerala. According to mythology, Parasurama an incarnation of Lord Vishnu descended from Heaven and threw his axe into the sea. The areas where the axe landed from shaft to blade rose from the sea and came to be known as Kerala. A land of prosperity, its geographical position has contributed immeasurably to its economic, social and cultural development. Historians further reveal that, Kerala was once under the sea, and was possibly thrown up by volcanic or seismological eruptions. This historic event can be very well connected with the legend. Chronologically, the history of traditional and folk practices in Kerala can be divided into three phases: pre-Parasurama tradition (phase-1) the Parasurama tradition (phase 2) and post- Parasurama tradition (phase-3). There are no authentic records available to explain the history of traditional and folk practices in Kerala before the Parasurama tradition (phase-1). According to oral tradition, it is said that before the creation of the existing mainland of Kerala, geographically there were only a number of small



islands and mangroves located in these areas. It is believed that the aborigines of these regions might have started their life in the islands and later were conquered by the Dravidians, a set of aboriginals who dominated southernmost part of ancient India. After the creation of Kerala (phase-2) Sage Parasurama invited Sage Agasthya from Himalaya to conduct Yagna (sacrifice) for attaining the stability of the newly created land and also the welfare of all living beings. After conducting the Yagna, Sage Parasurama permitted 64 Brahmin Families to migrate and establish their colonies in the land of Kerala. In view of ensuring the welfare of these families he constituted 18 SABHAMATAS (Centre for higher education). For administrative convenience, he brought these Centres under three main faculty namely 'SastraSabha' Mata (Faculty of Holistic Science), 'SannyasaSabha' Mata (Faculty of Spiritual Learning), and 'KarmySabha' Mata (Faculty of Vedic Studies). Apart from this, to deal with the health care of the people, Sage Parasurama trained a selected group of individuals who later became the scholars in Ashtangas of Ayurveda and this group was named 'Ashtavaidyas' (Physicians). They were called 'Ashtavaidyas' of Kerala (phase-3) because they mastered all the 8 disciplines of Ayurveda namely Kayachikitsa (Internal medicine), Shalyatantra (General surgery), Shalakyatantra (Ophthalmology and Otorhinolaryngology), Agadatantra (Toxicology), Rasayanatantra (Gerontology), Vajeekaranatantra (Conditioning the reproductive system) and Bhutavidya (Psychiatry). They were also known as 'Poornavaidyas'<sup>3</sup>.

Traditional and folk practices in Kerala is directly linked with the Traditional Knowledge System prevailed in the coastal area known as Kadalarivu, Knowledge from the plains (Nattarivu), and the Knowledge from the hilly and forest areas especially from the Tribal communities known as Kattarivu. These knowledge systems are directly or indirectly associated with ecology, biodiversity, agriculture, food, medicine, bio-techniques and cultural expressions. In the earlier period, the primary source of folk medicine was associated with the places of worships. People usually discussed their health problems initially with priests and sought remedial measures. Such practices still exist in Kerala. For example, to induce vomiting is a treatment to cure a number of illnesses like asthma and mental disorders. They also used this procedure for detoxification and de addiction. This kind of practices are still popular in a Shiva temple of Thiruvizha of Alappuzha district of Kerala. (See Case study – 4)

Folk healers of Kerala are sometimes specialized in treating some specific ailments with location specific medicinal plants. Some of the typical examples are given in Table 1.

**Table 1**  
**Medicinal plants in treating some specific ailments with location**

Botanical name	Local name	Parts used	Disorders
<i>Drynaria quercifolia</i>	Marappanna	Rhizome	Jaundice
<i>Moringa oleifera</i>	Muringa	Tender leaves	Conjunctivitis
<i>Pterospermum rubiginosum</i>	Elluripatta	Bark	Bone setting

<i>Aristolochia tagala</i>	Valiaarayan	Root	Snake bite
<i>Alangium lamarkii</i>	Ankolam	Root	Dog bite
<i>Chenopodium ambrosoides</i>	Cheriyapeechemba	Whole plant	Rabies
<i>Eclipta alba</i>	Kaithonni	Whole plant	Asthma
<i>Cephalandra indica</i>	Koval	Root	Mental disorders

Traditionally, each and every village in Kerala has minimum two or more folk healers. Their number will be more than 2500. Some of the folk/ tribal healers of Kerala are reported to have cured illness of chronic nature which otherwise have been declared incurable by other systems of medicine.

To assess the situation of folk/ tribe medicine, the author and his team made an attempt to conduct an in depth field study in Kerala under the All India Co-ordinated Research program on Ethno biology Sponsored by the Ministry of Environment and Forests, Government of India. The study was conducted in such a manner as to assess the folk/tribal healing practice in Kerala and was able to document various aspects of their health tradition and also systematically documented the therapeutic uses of 500 single plant remedies and more than 200 single formulations. Some very rare information on folk medicine was collected from certain ancient inscriptions on palm leaves, writings which are said to be as old as 400-500 years. Information collected from these writings is found to be very rare and deals with remedies for de-addiction, fertility (both male and female), antifertility, pre mature greying of hair, diabetes, jaundice, urinary calculi, nervous disorders etc.

### **Contribution of 'Ezhavas' to Folk Medical Tradition in Kerala**

There is no authentic record about the origin of 'Ezhava' community in Kerala. The Thiyyas of Kerala, also known as 'Ezhavas' are believed to have migrated from 'Ezhathunadu' (Srilanka). They reached Kerala by accepting the invitation extended to them by King Cheraman Perumal of Kerala during the 8<sup>th</sup> century A D. According to Logan, the coconut tree was first brought to Kerala by 'Ezhavas'. The local cast name 'Ezhava', is derived from another similar term 'Zhythunadu' which denote the name of a place from where this community originally migrated to Kerala. Another statement is that 'Ezhavas' originally belonged to Kerala and were directly connected with the 'Uzhavar', 'Channar', 'Villor' ethnic communities who lived in Kerala during the Sangam period. Traditionally, Ezhavas did farming, coconut climbing and toddy tapping. They are one of the non-Brahmin castes in Kerala which preferred to learn Sanskrit<sup>4</sup>. The introduction of Sanskrit and its literature to Kerala in general was accomplished by the early Jain and Buddhist travellers and missionaries. The Jain and Buddhist missionaries taught Sanskrit along with Prakrit as a part of their scheme of educating masses. Thus, the beginning of Sanskrit studies in Kerala can be associated with an aspiration to casteless. As a result, parallel to the formidable Sanskrit tradition fostered by the Brahmins who settled and captured power in Kerala during the later centuries, the non- Brahmin castes and Avarnas like 'Ezhavas' became well informed in Sanskrit and its various branches of sciences like Ayurveda and Astronomy. 'Ezhavas' in depth knowledge of Sanskrit and Ayurvedic system

of medicine further accelerated revitalizing of the folk medical tradition in Kerala. They made an attempt to integrate the folk medical knowledge with Ayurveda and produce a number of publications in the regional language. 'Yogaritham' written by Uppot Kannan, 'Oushadhi Nighantu' (Lexicographic works on Medicinal plants) by Thayyil Kumaran Krishnan<sup>5</sup>.

The foremost classical work in botany/medicinal flora in the world 'HortusMalabaricus' by Heinrich Van Rheede was written in Kerala. It was published between 1686 and 1703 in 12 volumes (with illustrations of 794 plant species, out of which 539 are identified as medicinal plants). It is also said that, this text book formed a main reference work for Carl Linneus. The book was published with the help of Itty Achuthan, a great scholar of Traditional and Folk Practices of Kerala, from the ancient Kollatt family of traditional Ezhava community. The Kollatt family are natives of Kadakkarapally a coastal village, north west of Cherthala town, in Kerala. According to Mr. Sugathan Vaidyar of Pannavelli of Alapuzha district who also belonged to Kollatt family claimed that, the information provided to 'HortusMalabaricus' was mainly based on the work of Itty Achuthan's 'Keralaramam', an unpublished script written in palm leaves on medicinal plants of Kerala<sup>5</sup>. He disclosed this information during the year 1988 while the author was conducting the ethno biological survey among the traditional/ tribal and folk healers of Kerala. Major contributors on folk medicine and Ayurveda include Ezhava physicians like Thrikunnapuzha Nanu Vaidyan, Chirayinkezhu Chavarcodu Marthandam Vaidyan, Valappadu Cholayil Kunhiraman Vaidyan, etc<sup>5</sup>.

Some of the interesting case study recorded from the Traditional and folk practices of Kerala is discussed here.

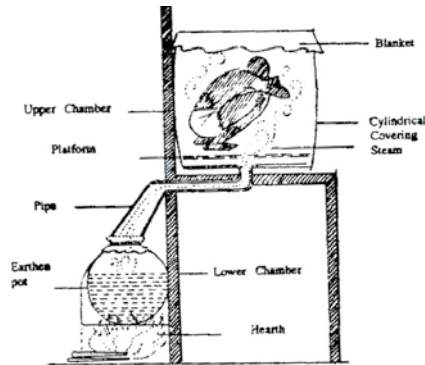
### **HEALING ART OF KANI TRIBE**

The health tradition of Kani tribe, inhabiting the forests of Southern Western Ghat region of Kerala, is one of the richest knowledge systems of Tribal Medicine in India. Kanis are one of the forest dwelling tribes of Kerala mostly found in Thiruvananthapuram District of Kerala. Ethnically the tribe shows a racial origin having Dravidian, Vedoid and Negrito features. The tribal physician among the Kanis is known as 'Plathi' - who is a repository of medical wisdom.

#### **Case study: Sudorification**

Sudorification is a therapy (a kind of medicated steam bath) designed and practised by a few Kani tribal healers of Thiruvananthapuram district of Kerala, India. In this treatment method, artificial sweating is induced for a period of 7 to 14 days. There is a special hut constructed for this treatment which has two chambers at different elevations. The ground chamber consists of a large conical hearth and an earthen pot fitted with a medium sized bamboo pipe. In the upper chamber, there is a platform made of bamboo stem with large cylindrical covering of five feet height and three feet diameter. The covering which is made up of *Ochlandra* stem and coated with cow dung helps to maintain a closed area of steam around the patient seated on the platform. Top of the covering is closed by a blanket during the process. There are 68 raw drugs well cleaned and pounded to be placed in the earthen pot along with water in the ratio of 1:4. When uniform heat is provided in the hearth, steam from the pot passes through the pipe and reaches the upper chamber where the patient is

seated. As a result, the patient perspires well. The patient should remain there for a period of 15 to 40 minutes, as per the direction of the healer. The above treatment is indicated for various dermatological conditions due to bite/poison of snake, dog, spider or scorpion and even for Psoriasis. A decoction prepared with 47 drugs is also recommended for internal use. The ultimate aim of this therapy is to detoxify the toxins accumulated at cellular level of the human body.



### Medicated steam bath

Some important medicinal plants used in Sudorification are: *Acacia catechu* (Karigali), *Aristolochia tagala* (Valiyaarayan), *Coscinum fenestratum* (ManjaValli), *Hemidesmus indicus* (Naruneendi), *Humboldtia unijuga* (Palakan), *Pongamia glabra* (Punku), *Terminalia bellerica* (Thanni), *Tinospora cordifolia* (Amruthuvalli), *Vetiveria zizanioides* (Ramacham) etc.



*Aristolochia tagala* (Valiyaarayan)

Certain ingredients of the decoction prescribed for internal use are: *Acalypha indica* (Kuppameni), *Acorus calamus* (Vayambu), *Alpinia galanga* (Chittaratha), *Aristolochia indica* (Cheriyarayan), *Embelia ribes* (Vizhalari), *Ficus benghalensis* (Peral), *Ficus religiosa* (Arayal), *Terminalia chebula* (Kaduka) etc.



*Ficus benghalensis* (Peral)



Late Shri. Suryan Kani , healer from Njaraneeli (Ilangium)Thiruvananthapuram (1987)- knowledge provider .

**Case Study: 'Amrithapala' - *Decalepis arayalpathra* (Joseph & D Chandras.)**

**Venter.** (Syn: *Janakia arayalpathra* Joseph & Chandrasekharan)

Amrithapala, a rare and endemic plant species found in the southern forests of Western Ghat region of Kerala is used by the local 'Kani' tribe as an effective remedy for peptic ulcer, cancer like afflictions and as a rejuvenating tonic. Search made in Ayurvedic literature indicates that the plant may be 'Thamprarasasyani' mentioned in the Oushadha Nighantu of ThayyilKumaran Krishnan (1906).

***Ethnic Legend***

According to an interesting Kani legend, the plant Amrithapala was one of the divine drugs brought by Hanuman along with other divine drugs like Visalyakarani, Santhanakarani and Mrithasanjeevani on the orders of Chiranjeevi Jambavan to revive Lakshmana who became unconscious after the Nagapasa (a sort of magical noose made of poisonous snake to entangle and make the enemy unconscious during the war of Lord Rama with Demon King Ravana as said in the great Indian epic, 'Ramayana'). It is said that Hanuman (the trusted aid and lieutenant of Lord Rama)

drunk the milky juice of this plant to relieve himself from the fatigue and restlessness that he experienced after his strenuous journey to bring the medicinal plants from Himalaya to Lanka, the war site where Lakshmana was lying unconscious.

### **Method of Preparation and Mode of Administration**

Expressed juice or pounded mass of the fresh tuberous root of Amrithapala is mixed with equal quantity of the expressed juice of fresh coconut kernel. The mixture is then boiled for some time to attain a semi solid form which after cooling is administered at a dose of 10-15 gms twice daily for 15-30 days to cure all kinds of peptic ulcers and cancer like afflictions. It is also recommended as stamina booster and blood purifier. (Knowledge provider: Lakshmikutti, Mottamoodu tribal settlement, Kallar)



Ethnopharmacological and phytochemical studies has been carried out and published 4 research papers and obtained 2 Indian patents.

## **HEALING ART OF MALAVEDAN TRIBE**

### **Case study: An Absorbent Technique for Snake-Bite Using ‘VishaKallu’ – A kind of Medicated Stone**

Vishakallu is a kind of medicated stone potentiated with anti-poisonous properties. Preparation of the stone is a very lengthy and complex procedure. Ingredients required for the preparation of the stone are:

1. Pebbles from the river (Vellaramkallu) – 50gm. approximately
2. Expressed juice of the leaves of *Ocimum tenuiflorum* (Krishna thulasi), *Anisomeles malabarica* (Perumthumba), *Leucasaspera* (Thumba), *Piper betle* (Vettila) – 20 ml. each approximately and paste of *Santalum album* (Chandanam) – 50gm. approximately.

### **Method of preparation**

The pebbles are ground well and mixed with the said ingredients and prepared in the form of paste. The paste is then covered with seven leaves of *Aristolochiatagala* (Valiyaarayan) and placed on a rock and roasted using the wood of *Chukrasiatabularis* (Chuvannaakil), *Santalum album* (Chandanam), *Ocimum tenuiflorum* (Krishna thulasi) and Camphor (Karpooram). The roasted material is again covered with paste of termite soil and soil content obtained from the trees. The above materials are again covered with the leaves of *Aristolochia indica* (Cheriyarayan) or *Aristolochia tagala* (Valiyaarayan) and then kept under a low fire. When the essence of the soil is fully

absorbed by the mass, the soil is removed. The mass is then transferred into water for one hour. It is then covered with the pounded mass of the stem bark of *Alstonia venenata* (Analivegam) or *Pittosporum nilgherrensis* (Analivegam/Analivenga) and again kept over a low fire for half an hour and later stored for a period of one week. After one week the mass is again covered with a paste prepared with the ashes of coconut shell or *Kunthelariakeralensis* (Kariveppilavalli) and sun dried for 3-4 days. The dried material is then shaped in the form of a stone and kept in the ashes of cow dung or dried leaves of *Cannabis sativa* (Kanchavu) or *Nicotiana tobacum* (Pukayila) to maintain the potency of the stone.



Vishakkallu-medicated stone potentiated

Analivegam- *Pittosporum neelgherrense* Wight. & Arn. with anti-poisonous properties

### **Mode of Application**

The tribal healers directly apply the stone on the bitten part which will stick automatically and absorb the poison from the body. During the process, they chant mantras to propitiate Lord Siva. When the absorption is complete, the stone falls down on its own.

### **Preservation Technique**

After this process, the stone is to be transferred and stored in cows milk for 2 hours for necessary purification. Then it is taken out, dried and kept in the ashes of cow dung for re- use. In this manner one stone can be used at least 20 times.

This kind of practice is prevalent among Malavedan tribe and traditional Ayurvedic physicians of Kerala. The claim is yet to be scientifically validated.

### **Case Study: Fumigation therapy for treating piles**

This is a novel method of fumigation therapy exclusively applied to cure piles. In this treatment patient is seated on a specially designed hollow shaped wooden stool. The stool has an inner space where the ingredients of specially designed formulation with three raw drugs consisting of dammar, *Achyranthes aspera* etc. including a small piece of flesh removed from the head of the forest cane turtle (Kareelama). The flesh is removed without killing the animal. The ingredients are fumigated inside this special stool and the patient suffering from piles or hernia is made to sit on it for

5 to 10 minutes. This is a unique treatment developed by the tribes (Muthuvan, Malaarayar, Mannan and Kurichiyar) of Vellaramkuthu colony of Kuttampuzha, Ernakulam district. This kind of treatment is neither described in Ayurveda nor Modern medicine.



Fumigation *Achyranthes aspera*

### **Case Study: Folk Medical Traditions of Kerala**

Inducing vomiting is a treatment to cure a number of illnesses like asthma, mental disorders, elimination of poison, intoxication etc. This kind of practice is still popular in a Shiva Temple at Thiruvizha of Alappuzha district, Kerala.

Thiruvizha Sree Mahadevar Temple is one of the ancient temples in Kerala. The temple was consecrated by Swamy Vilwamangalam. This temple of Lord Kalakandha (Lord Siva who swallowed poison during Palazhimadhanam) is very famous for the treatment mentioned below.

### **Thiruvizha Chardhi**

Thiruvizha Chardhi is one of the treatment procedure adopted exclusively for inducing vomiting through the administration of a medicinal plant known as *Lindernia crustacea* (Scrophulariaceae) locally known as Meenagani or Nilakanthiram. The term Thiruvizha denotes a Place and Chardhi means Vomiting. This is similar to one of the 'Panchakarma Therapy' known as 'Vamana Karma' practiced by the Ayurvedic physicians of Kerala. The ultimate objective of this kind of treatment is to cleanse the nervous, respiratory and digestive systems.

### **Procedure**

Thiruvizha Chardhi is a unique and strange ritualistic procedure, which is used to detoxify the alimentary canal as a whole. The ritual begins in the previous night with the Guruthi Pooja. The aim of this practice is to purify the mind and body of the patient which is prerequisite. Next day morning, the medicinal herb (whole) is to be collected fresh and juice is expressed. The juice is then mixed with cow's milk and offered to the deity to potentiate the efficacy of the drug through the blessings of Lord Shiva. Subsequently, the prasadam (medicine) is given to the patient by chanting the Panchakshari Manthra. Immediately after the administration, the patient is advised to encircle the shrine. Lukewarm water quenches their thirst as the precisions moves the patients vomit one after another. The ritual comes to a close with the drinking



of tender coconut water followed by the intake of Payasam (sweet dish) prepared with rice gruel, milk and jaggery /sugar. This kind of treatment is effectively applied to cure insanity, alcoholism (de-addiction) and also acts as medicine to detoxify the whole body and mind.



Shiva Temple at Thiruvizha of Alappuzha district, Kerala.



Lindernia crustacea

### Research and development based on Traditional and Folk Practices

Research carried out based on traditional and folk practices led to several new discoveries not only in the medical field but also other sectors like Agriculture, Biodiversity, Art and Culture, Forest Conservation etc. Currently, scientists are engaged in conducting multidisciplinary, multi-dimensional and multi-sectorial research programmes in a collaborative manner at the global level. Some of the highly effective, safe modern medicines have been developed based on TK/ Indigenous knowledge which includes; Aspirin-Anti-inflammatory & Analgesic (*Filipendula ulmaria*), Pilocarpine-Anti-glaucoma, (*Pilocarpus jaborandi*), Vinblastine- Anti-cancer(*Catharanthus roseus*), Reserpine-Tranquilizer (*Rauwolfia serpentina*), Cocaine – Topical anesthetic (*Erythroxylum coca*), Morphine - Painkiller, Codeine - Anti-cough (*Papaver somniferum*), Cardiac glycosides- Congestive heart failure (*Digitalis lanata*) Artemisinin- Anti-malarial (*Artemisia annua*), Taxol - Breast and ovary cancer, Anti-tumour (*Taxus baccata* and *Taxus brevifolia*), Berberine- Leishmaniasis (*Berberis saristata*), Pristimerin-Anti-malarial (*Celastrus hypoleucus*), Plumbagin-Anti-bacterial ,Anti-fungal (*Plumbago indica*), Gossypol- Antispermogenetic (*Gossypium mbarbadense*) Allicin-Anti-fungal, Amoebiasis (*Allium sativum*), Nimbodin- Anti-ulcer (*Azadirachta indica*), Forskolin-Hypotensive, Cardiotonic (*Coleus forskohlii*), Podophyllin-Anti-cancer (*Podophyllum emodi*), Camptothecin-Anti-cancer (*Camptotheca acuminata*) and Glycyrrhizin-Anti-ulcer (*Glycyrrhiza glabra*) etc.

The Ethnomedicine and Ethnopharmacology Division of JNTBGRI, was started in 1992 with a view to conduct detailed ethnopharmacological studies of medicinal plants based on traditional knowledge. Therefore, a systemic documentation of TK on medicinal plants / food plants is very essential to obtain leads for development of novel herbal/ modern drugs for treating diseases like cancer, osteoporosis, diabetes, liver disorders, Alzheimer's disease, rheumatoid arthritis, malaria etc. This will also help to enrich the Ayurvedic pharmacopeia. Some of the leads obtained based on the Ethnopharmacological studies carried out by JNTBGRI are given in Table 2

**Table 2**  
**Leads obtained based on the Ethnopharmacological studies carried out by JNTBGRI**

Sl No:	Name of the Plant Species	Family	Local name	Ethnopharmacological leads obtained based on Traditional Knowledge
1	<i>Spilanthes ciliata</i> H.B.K	Asteraceae	Akravu	Hepatoprotective
2	<i>Rhinacanthus nasuta</i> (Linn.) Kurz	Acanthaceae	Nagamulla	Hepatoprotective
3	<i>Helminthostachy szeylanica</i> (L.) Hook.	Ophioglossaceae	Pazhutharakali	Hepatoprotective
4	<i>Ixora coccinea</i> L.	Rubiaceae	Kattuthetti	Hepatoprotective Anti-Tumour Chemoprotective
5	<i>Pittosporum neelgherrense</i> Wight & Arn.	Pittosporaceae	Analivegam	Hepatoprotective
6	<i>Hedyotis corymbosa</i> (L.) Lam.	Rubiaceae	Parpadakapullu	Hepatoprotective
7	<i>Thespesia populnea</i> L.	Malvaceae	Poovarasu	Hepatoprotective
8	<i>Sida acuta</i> Burm. f.	Malvaceae	Kurunthotti	Hepatoprotective
9	<i>Hibiscus hispidissimus</i> -Griff.	Malvaceae	Uppanacham	Hepatoprotective
10	<i>Utleria salicifolia</i> Bedd. Ex. Hook. f .	Periploaceae	Mahalikizhangu	Hepatoprotective Potent antiulcer
11	<i>Cyclea peltata</i> (Poiret) Hook. f. & Thomson	Menispermaceae	Padathali	Hepatoprotective Potent antiulcer
12	<i>Saraca asoca</i> (Roxb.) De Wilde	Caesalpiniaceae	Asoca	Hepatoprotective
13	<i>Drynaria quercifolia</i> (L.) J. Smith	Polypodiaceae	Attukalkizhangu	Anti-inflammatory Analgesic
14	<i>Kaempferia rotunda</i> Linn.	Zingiberaceae	Chengazhaneerkizhangu	Wound healing Anti-inflammatory Analgesic
15	<i>Justicia gendarussa</i> (Burm.)f.	Acanthaceae	Vathamkolli	Anti-inflammatory Analgesic
16	<i>Barringtonia racemosa</i> (L.) Sprengel	Lecythidaceae	Samudrapacha	Anti-inflammatory Analgesic
17	<i>Commiphora caudata</i> (Wight & Arn.) Engl.	Burseraceae	Kilimaram	Anti-inflammatory Analgesic
18	<i>Cassia occidentalis</i> Linn.	Caesalpiniaceae	Ponnariveeram	Anti-inflammatory Analgesic, Anti-allergic Anti-lipid peroxidant
19	<i>Rhaphidophora pertusa</i> (Roxb.) Schott	Araceae	Anamakudam	Anti-inflammatory Analgesic
20	<i>Wattakaka volubilis</i> (Linn.f.) Stapf	Asclepiadaceae	Wattakaka	Anti-inflammatory Analgesic
22	<i>Ficus religiosa</i> Linn.	Moraceae	Arayal	Anti-inflammatory Analgesic
23	<i>Erythrina indica</i> Lamb.	Fabaceae	Mulmurukku	Anti-inflammatory Analgesic

25	<i>Psoralea corylifolia</i> L.	Fabaceae	Karkokilari	Anti-Tumour
26	<i>Elephantopus scaber</i> Linn.	Asteraceae	Anachuvadi	Anti-Tumour Chemoprotective
27	<i>Tinospora cordifolia</i>	Menispermaceae	Chittamrtu	Anti-diabetic
28	<i>Plumbago rosea</i>	Plumbagaceae	Chuvana-koduveli	Anti-diabetic
29	<i>Withania coagulans</i> Dunal	Solanaceae	Pakpaneer	Anti-diabetic
30	<i>Pisonia alba</i> Span.	Nyctaginaceae	Maduracheera	Anti-diabetic
31	<i>Trichopus zeylanicus</i> ssp. <i>travancoricus</i> Burkill ex Narayanan	Trichopodaceae	Arogyapacha	Antioxidant, Anti-fatigue, Aphrodisiac, Antiallergic, immunomodulatory, Anti-Tumour, Hepatoprotective, DNA protective activity etc.
32	<i>Decalepis arayalpatra</i> Joseph & V Chandras	Periplocaceae	Amritapaala	Anti-Tumour, Anti-ulcer

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# Culture, Health and Well-being

## Dr. Biju Soman

Associate Professor, AMCHSS, Sree Chitra Tirunal Institute for Medical Sciences & Technology, Thiruvananthapuram-11

### INTRODUCTION

Humans are social beings. This implies that harmonious relationship with one another and society is essential for complete fulfillment of human life. Health researchers are increasingly being convinced that subjective notions are very important in defining and safeguarding ones health.(Ali, 2012; Alvarez et al., 2010) The subjective notions of health and wellbeing have strong connections to our cultural ethos and practices. Therefore understanding cultural connotations of health and well-being is essential for public health practitioners to achieve their stated goal of bringing in positive health outcomes.

For better comprehension of the topic, we shall first look at the current and evolving concepts on health and wellbeing followed by ways and means to understand culture and then compare across cultural differences. We shall move on to the interplay of culture and health, with emphasis on the epidemiological scenario of Kerala in particular and that of India in the larger context. Towards the end we shall dwell on potential practical implications of this approach in real life.

### EVOLVING CONCEPT OF HEALTH AND WELLBEING

The discussions on health occur around the classical definition of health by the World Health Organization (WHO) as “*the state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.*”(Ali, 2012) According to econometricians this definition is too broad or rather abstract for practical purposes and they have come up with other measurement tools like Disability Adjusted Life Years (DALY) and Health Adjusted Life Years (HALY), etc.(Murray et al., 2012) These tools measure health in a much more objective way and used to compare health status across communities and nations.(Lozano et al., 2012)

On the other hand there is a growing demand to make the WHO definition of health more holistic by including spirituality as the fourth dimension to the definition. (Ali, 2012) Current approaches try to make it wholesome yet measurable by bringing

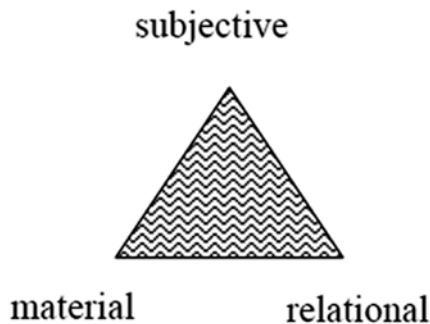
in concepts like Quality of Life and Wellness.(Camfield and Skevington, 2008) The terms wellness and wellbeing are used alike in many situations; as in this review, although theoreticians place well-being at a higher level of achievement than wellness.(Seligman, 2011) Inspired by Hettler’s initiative, several groups are come up with competing approaches to analyze the notion of wellness.(Hettler, 1976)

**Figure 1**  
**Hettler's Six dimensions of Wellness**



The New Brunswick select committee on Wellness defines wellness as ‘*the state of emotional, mental, physical, social and spiritual well-being that enables people to reach maintain their personal potential in their communities.*’(New Brunswick et al., 2008) The Economic and Social Research Council(ESRC) funded Wellbeing in Developing Countries (WeD) project has come up with a promising framework for analyzing wellness with three broad dimensions (subjective, material and relational) and two cross cutting spheres(time and space).(Johnson, 2009) .

**Figure 2**  
**The triangle of wellbeing subjective**



Source:(White, 2009)

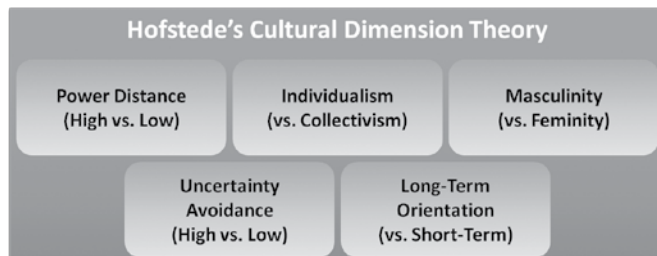
This model which is biased towards more affluent societies is quite suitable to do this exercise in Kerala, which has achieved near total universal coverage of its basic social needs. The subjective dimension is central to this concept and includes personal values, perceptions and experience. The moral and spiritual values of the individual; their notions on meaning of life; trust between one another; and personal notions on confidence in oneself and in the society are included in this domain. The material domain concerns wealth, education, physical health, access to services and income and it can be equated to more familiar human capital concept. The relational domain encompasses love, support systems, social organizations, and cultural connotations, etc. more akin to the social capital approach. The dynamic cross cutting parameters like time and space helps one to contextualize health to a particular community in a specific timeframe. Another advantage of this framework is that it could visualize *wellness* in the societal perspective rather than at the individual level making the tool more ideal for public health purpose.

One may wonder about the utility of this much detailed analysis of wellness; this is purposefully done to safeguard the concept from misinterpretation as occurs often in healthcare policy deliberations. One recent notorious example for that would be how the Arogyasree project has equated good health with more surgical interventions, thereby siphoning off public money to lucrative private enterprises in Andhra Pradesh.(Prasad and Raghavendra, 2012) In a recent development, the Harvard Business Review in association with the New England Journal of Medicine has launched an initiative to explore potential healthcare innovations. The basic concept and design of the much acclaimed Integrated Practice Units (IPU) is similar to the Primary Health Care(PHC) system that exists in India.(Porter and Lee, 2013) The idea here is to understand the concepts clearly and not to get carried by the loaded words. We need to place due credit to our systems and try to improve those with present day technological options.

### CULTURE AND HEALTH

In simple terms culture is defined as *‘the beliefs and values shared by two or more individuals that shape their behavior’*(“Culture and Health,” 2001). Geert Hofstede emphasizes the divisive nature of culture and defines *culture as the collective programming of the mind that distinguishes members of one group or category of people from others.* (Ly, 2013)

**Figure 3**  
**Geert Hofstede’s Cultural dimensions**



### **Understanding cultural differences**

Reef Hofstede's framework on culture that relates how individual notions and belief systems influence their practices helps to understand cultural overtones in health and wellbeing. ("Dimensions - Geert Hofstede," n.d.)(Triandis, 2004) In its latest version there are six domains namely Power Distance Index(PDI), Individualism versus Collectivism(IDV), Uncertainly Avoidance Index(UAI), Masculinity versus Femininity(MUS), Long Term versus Short Term Orientation(LTO) and Indulgence versus Restraint(IND). PDI is an indicator of how the less powerful members of the society accept inequality. In highly individualistic society, individuals are more interested in themselves and their immediate family, whereas in collectivist societies, the kinship behavior is being promoted. In societies with high UAI people would be relatively intolerant to ambiguities and get used to stringent laws and rules. High MUS societies are more competitive and regard quantity rather than quality of achievements whereas low MUS societies work through consensus and tolerance. In societies with high LTO, people honor hard work and saving mentality; people generally accept traditional restrictions for long term prospects. On the contrarily in high IND societies, people look for immediate gratification and give more importance to enjoying life. People's perception about their health and illness behavior is much influenced by these cultural patterning.

### **The interplay of culture and health**

The ongoing epidemiological shift towards lifestyle diseases in India, in particular in Kerala, demands longer term treatments and lifestyle adaptations. India is having the double burden of first generation health issues like infections and malnutrition along with increasing load of second generation health issues like diabetes, cardiac problems and other lifestyle diseases. If Kerala can be taken as a epitome of what will happen to India in the coming decades; the situation is more wearisome. At present in Kerala nearly 30% of adults are hypertensive and around 15% of adults are diabetic; yet there is hardly any societal intervention against the ever-increasing unhealthy trends in obesity or sedentary habits in the society.(Thankappan et al., 2010) The willingness of people to undertake active lifestyle and control their weight will depend on their cultural scores of LTO and IND domains. Environmental sanitation and hygienic practices are crucial in our fight against infectious entities that mostly affects the poor most in the society. Because of our lower IDV scores and higher MAS and PDI scores people generally expects the government to take corrective action, or at-least spearhead the intervention.

One would naturally expect that the notions on right and wrong would be different in various parts of India because of its multi-cultural and multi-ethnic nature. But across board, the ruling class in the country including bureaucrats and top political leadership, who are mostly trained in western way of education, if not trained in the Western Universities itself, mostly consider the western values as modern and desirable. According to them the reason for the perils in India is the laziness and laid-back nature of our villagers and their dump(old, not modern) values. We have a very delicate situation here, that of the vast majority of rural communities still clinging on to the Indian tradition of tolerance and consensus(high PDI, low IDV, high MAS, low UAI, high LTO, low IND), whereas the so-called *educated* urban elites(who are the decision makers although a minority in numbers), attains more aggressive and

competitive notions. Unfortunately the so called modern medicine trained doctors largely fall under *the educated urban elite* strata, and only a few among them could withstand the forceful molding of modern medical education to be more humane in their notions and behaviors. The biased ruling class appreciates states like Kerala, which apparently succeeded in improving physical living conditions, by imbibing the western notions of values, thanks to its *educated* womenfolk.

Actually this is an unequal and unjust comparison of an aggressive and indifferent fighter with a tolerant and benevolent saint! It is high time one need to look beyond the rosy figures of health indicators for Kerala, to see how much the so-called progress has contributed to the wellbeing of people. The dwindling social health indicators, like rising suicide rates (31 per 100000), alcoholism, and violence in the society could be pointing to the deterioration of wellbeing indices.(Soman, 2007) This failure of Kerala model of health is because of the inherent deficiency in the modern (western) concept of progress, its failure to take cognizance of the cultural values of the society. We need to strategize ways to attain progress without totally negating our existing value systems, and should provide ample time and space for the traditionalists to catch up with dignity. This is going to be a herculean task, given the rapid phase of developments in this era of globalisation and infotainment. However it is a must for healthcare professionals to have a definite understanding on the overtones of health and wellbeing for the benefit of the society and themselves. Health professionals should spend enough time to explore cultural notions of their clients as there are many cultures and subcultures within our society.

### **CULTURAL EXPLORATION OF SOME HEALTH ISSUES IN KERALA**

The leading health problem in Kerala is life style diseases like hypertension, diabetes, etc. The well established modifiable risk factors to these are tobacco use, sedentary habits, obesity, unhealthy diet, increased salt intake and alcohol abuse.(Murray and Lopez, 1997) But most of these factors are attached to notions of affluence in our traditional society, posing an uphill task for the healthcare professionals to popularize healthy life behaviors. The overarching influence of the government ban on smoking in public places in Kerala, which gave a high impetus to the control strategies, highlights the cultural patterning (low IND, low UAI, and high LTO) of our society. Although a highly inebriated society compared to other states(alcohol consumption in Kerala is much higher than the national average), one can see long and enduring queues in government beverage outlets for buying *legitimate alcohol*(which is ironically named Indian Made Foreign Liqour), even though illicit alcohol is attractive and cheaper option given the weak regulatory measures. This single example is sufficient to highlight the law abiding nature of Keralites that is culturally pruned. Researchers have opined that consumption of alcohol gives an excuse for deviation from decent behavior, in many tight societies like in the Japan. (Triandis, 2004) This could be one plausible cultural explanation why most crimes in Kerala society can be linked to alcohol consumption.(Engs, 1990, 1990; Lawyer et al., 2002; Poulson et al., 1998; Sinha et al., 2012)

Our notions on cleanliness can have huge impact on infectious diseases. The teaching of Ayurveda, the basis of our notions on health and well-being, does not recognize germ theory; as Ayurvedic principles got codified much before the germ



theory came into existence. Germs and pathogenic organisms, if at all appreciated, are part of our eco-system protected by the dictum of *MAA NISHADA!* (don't kill any being!) Although treating infections with drugs are acceptable, disease eradication, meaning extermination of the disease causing organism from entire world, brings in many ethical dilemmas to Indian minds. This poses a real threat to our notions on health and wellbeing. In the traditional belief system, we honor raw natural materials as pure and healthy and much fauna and flora around us serve as zoo-therapeutic agents. (Alves et al., 2012) This disconnect between high personal hygiene and low environmental hygiene could also be explained in terms of cultural patterning. The acculturate minority, meaning the educated and affluent sessions of present day society, could keep themselves and their immediate surroundings clean but cannot understand the logic of keeping public places like markets clean!

Distortion with cultural ideas is more acute in the realm of mental health. Mental health specialists trained in western ethos many often fail to understand the cultural richness of our knowledge base on mental health. (Lang and Jansen, 2013) We often mistake spirituality as religious beliefs and disregard that valuable dimension of health and wellbeing. The influence of one's notions on hopelessness and helplessness on his/her physical and psychic health is increasingly getting documented. (Ree et al., 2013) To address the rising trends of increasing young suicides, moral education sessions need to be reintroduced in schools and teachers and parents are given training to recognize early signs and symptoms of mental distress in children. (Kalmár, 2013)

## CONCLUSION

Here we have briefly gone through the changing concepts in health and well-being and its intricate and fundamental linkages with culture. Till very recently, even in the West, health professionals and health programs were calling on culture as an entity that should be looked into when concerned with minority health issues, or aborigine's health, or health of African or Indian tribes. However the relevance and potential of serious engagements with culture for the overall well-being of society is increasingly being recognized at policy levels all across the world. With the horrendous challenges posed by lifestyle diseases and their risk factors, there is no way for the healthcare professionals, but to step aside and give way to the thinking class to take the society forward to a more tolerant and acceptable world.

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# Culture, Heritage and Food in India: Changing Paradigms

**Dr. A Biju Kumar<sup>1</sup> and Dr. C R Rajagopalan<sup>2</sup>**

<sup>1</sup>*Department of Aquatic Biology & Fisheries & <sup>2</sup>Department of Malayalam,  
University of Kerala, Thiruvananthapuram 695581, Kerala.  
Email: bijupuzhayoram@gmail.com; rajgopalcr@gmail.com*

## INTRODUCTION

India had a rich food culture and the variety of food in India is a reflection of the rich biodiversity of the nation and the varied cultural practices prevalent in different biogeographic regions. The ecosystem specific agricultural practices and their sustainability helped the ancient culture and its life supporting systems for centuries. The tacit wisdom of many scholars in India reveals that most discourses on food have centred on health and nutrition and on social, cultural and religious rituals (Nandi, 2004). In ancient India food was also considered as God (*'Annam Brahma'*). Foods that are too bitter, too sour, salty, hot, pungent, dry and burning are dear to those in the mode of passion and such foods cause distress, misery and disease (**Bhagavad-gita** 17.9).

The food heritage of India remains connected with historical, ethnic and geographic situations prevalent in India. Wheat did not form part of the dietary of the Rigvedic Indians as it is not mentioned in the Rig Veda. Barley seems to have been the staple food grain of the Aryans. Rice seems to have been the staple food grain of both the Proto-Australoids and the Dravidians. By the time of the compilation of the Samhitas of the Yajur Veda, wheat and many varieties of rice, and lentils had become part and parcel of Indian dietary. The Satapatha Brahmana calls wheat the second best of the food articles. Its introduction in the Aryans dietary might have been due to the contract of the Aryans with the Dravidians, who had been using wheat as far back as 2500 B.C. Early Aryans used meat of oxen, barren cows, and goats for preparing non-vegetarian dishes but they most probably used fish as a food article only when they came in contact with the Proto-Australoids and the Dravidians. The early Aryans used clarified butter as the frying medium. Only the non-Aryans used oil for frying. But the lawgivers later permitted the use of oil if clarified butter was not available. The excavations at some Neolithic and Chalcolithic sites in the Deccan and at Harappa suggest the widespread use of dates, melons, pomegranates, lemons and coconut by the people associated with these cultures. Sugarcane and bananas were important Indian crops even in the times of the sutras. The common vegetables

used by early Aryans were cucumber, lotus stalks, roots of lotus and bottle gourd. From the sutras it is known that leafy vegetables were also cooked and formed part of the diet of the Indians but respectable people avoided garlic, onions and leeks. Of these it seems that the Aryans included bottle gourd as a result of their contact with the Proto-Australoids.

Later, the food culture has become highly influenced by religious and cultural choices and therefore, vegetarian food dominated among Indian cuisines. The wide variety of geographical areas, economies and the rich biodiversity contributed towards the development of rich food culture. Further, seasonal availability of vegetables and fruits also shaped Indian ethnic cuisine. There has also been Central Asian influence on North Indian cuisine from the years of Mughal and Turkic Delhi Sultanate rule (Gesteland and Gesteland, 2010). Historical incidents such as foreign invasions, trade relations and colonialism have also played a role in introducing certain foods to the country and the Indian cuisine continues to evolve under the influence of the cultural interactions with other societies. To cite an example, potato, a staple of Indian diet was brought to India by the Portuguese, who also introduced chillies and breadfruit (Balasubramanian, 2008). Indian cuisine has also shaped the history of international relations; the spice trade between India and Europe is often cited by historians as the primary catalyst for Europe's Age of Discovery. Spices were bought from India and traded around Europe and Asia. It has also influenced other cuisines across the world, especially those from Southeast Asia, the British Isles and the Caribbean (Anon., 2009).

## EVOLUTION OF FOOD CULTURE

Indian cuisine reflects a 5000-year history of various groups and cultures interacting with the subcontinent, leading to diversity of flavours and regional cuisines found in modern-day India. Later Mughals British and Portuguese influence added to the already diverse Indian cuisine. A normal diet in early India consisted of fruit, vegetables, grain, eggs, dairy products, honey, and sometimes meat. Over time, segments of the population embraced vegetarianism. The advent of Buddhism affected this shift, as well as an equitable climate permitting a variety of fruit, vegetables, and grains to be grown throughout the year. A food classification system that categorised any item as *saatvic*, *raajsic* or *taamsic* developed in Ayurveda. The Bhagavad Gita prescribes certain dietary practices (Chapter 17, Verses 8–10). During this period, consumption of beef became taboo, due to cattle being considered sacred in Hinduism. Historical books in India such as *Mānasollāsa*, (Sanskrit, The Delight of Mind), written in the 12<sup>th</sup> century, describes the need to change cuisine and food with seasons, various methods of cooking, the best blend of flavours, the feel of various foods, planning and style of dining amongst other things.

### Diversity of ingredients

Staple foods of Indian cuisine include pearl millet (*bajra*), rice, whole-wheat flour (*atta*), and a variety of lentils, pigeon pea, black gram, and mung bean; split lentils, or *dal*, are used extensively. Pulses such as chickpea (*channa*), kidney beans (*Rajma*) are commonly used, especially in the northern regions. Many Indian dishes are cooked

in vegetable oil; while peanut oil is popular in northern and western India, mustard oil is popular in eastern India and coconut oil along the western coast, especially in Kerala. *Gingelly* (sesame) oil is common in the south since it imparts a fragrant nutty aroma. Of late, sunflower and soybean oils have become popular across India. Hydrogenated vegetable oil, known as *Vanaspati ghee*, is another popular cooking medium. Butter-based ghee, or *desi ghee*, is used frequently, though less than in the past. The most important and frequently used spices and flavourings in Indian cuisine are whole or powdered chilli pepper (*mirch*) (introduced by the Portuguese in the 16th century), black mustard seed (*sarso*), cardamom (*elaichi*), cumin(jeera), turmeric (*haldi*), asafoetida (*hing*), ginger (*adrak*), coriander (*dhania*), and garlic (*lehsun*). One popular spice mix is *garam masala*, a powder that typically includes five or more dried spices, especially cardamom, cinnamon (*dalchini*), and clove. Some leaves commonly used for flavouring include bay (*tejpat*), coriander, fenugreek, and mint leaves. The use of curry leaves and roots for flavouring is typical of Gujarati and South Indian cuisine. Sweet dishes are often seasoned with cardamom, saffron, nutmeg, and rose petal essences.

### **Traditional Food Diversity**

The wisdom of food culture, which expresses the diversity and seasonal food habits in Kerala is seen in this folk song:

*'Thalum Takarem mummasam (For three months use leaves)*

*Chakkem Mangem mummasam (for three months use fruits)*

*Chenem Koorem mummasam (for three months use roots)*

*Anganem inganem mummasam' (ast three months use any vegetables)*

'Food is the medicine, medicine is not the food' - This folk saying reveal the indigenous world view of the local communities.

Fish is also part of the local food practices of the indigenous fishing communities in India. They have their own system to identify, classify and cook the fishes. 'Kochukuttan from Poyya, Thrissur District in Kerala classifies local fish in the river into three categories such as lower level fish, middle level fish, and upper level fish. According to him different fish produce different sounds, Mola's humming, Mullans rough noise, Korukkas and Vatta's noise with 'kurukuru' tone; shrimps are described as creatures that stab even when dead, and they produce a 'Kilukila' sound before death. A crab species that lives long when crawl deep under water produce bubbles. Crabs and shrimps exuviate as snakes do. Shrimps have 'fever' from Ashtami day and become normal after Ekadasi. The flesh of the shrimps is hard during the month of Vrishikam and Dhanu (December – January) and is soft during Meenam- Medam (April-May). During the month of Kanni (September - October) even crows do not eat Kanambu (mulletts) as they don't have fat in their body during the season. (Rajagopalan, 2004). These observations also indicate precise nature observation of ethnic groups, especially on food items.

Kerala had a rich variety of low cost and highly nutritive traditional food items based on the local agrobiodiversity. Some of the principal indigenous food items that are prevalent in the state even now are the following:

**1. Kanji:** Rice was well-boiled in water and used in semi-liquid form. Buttermilk, curry leaf, ginger, etc were added to the gruel. Usually stews made of leafy vegetables or jackfruit accompanied the gruel. Mango pickle used to be one important side dish item.

**2. Pazhamkanji:** This is kanji prepared on the previous night. Usually, *pazhamkanji* was served as breakfast. Gruel water freezes in winter when *pazhamkanji* is used in solid form.

**3. Thavidukanji:** The water drained from gruel was kept in earthen pots for two or three days and then boiled with rice and bran of rice. This is a nutritious food item; which had an agreeable sour taste.

**4. Thavidu:** This is bran of rice collected at the time of paddy dehusking rice. Water is sprinkled on bran and kneaded with or without jaggery. Consumption of braw was the prerogative womenfolk; men were denied this item of food on the pretext that it would prevent development of masculine characters like facial hair growth. This item of food is a good preventive measure against jaundice.

**5. Pukkan:** The boiled rice juice is kept for a full day. Into it is added rice powder and then boiled. This is an easily digestible food item.

**6. Ottada:** Rice is ground into paste. Coconut and jaggery are added. It is then pasted on the inner side of plantain leaf, folded, and placed on a cloth tied over the mouth of an earthen pot containing boiling water. The paste is boiled in steam into a delicacy.

**7. Kuzhakkatta:** Rice is soaked in water and ground into a semi-solid paste. After adding coconut scrapings to the paste, it is made into balls and boiled in water for half an hour. The water in which the rice-balls are boiled is also consumed after coconut scrapings are mixed with it.

**8. Pathila** (leaves of 10 herbs): A seasonal food of ten leaves in the rainy season (*Karkidakam*, Months of June - July)

**9. Marunnu kanji** (medicated rice- gruel): A medicinal food in the season of *Karkidakam*. "There used to be a tradition of having *Marunnu kanji* in Kerala households. This is done during the month of *Karkidakam*. It is believed that one course of *Marunnu kanji* will provide one years 'immunity against most common ailments. Ingredients of the *kanji* are as follows: raw rice, bark of the drumstick tree, *Vitis quadrangularis*, *Desmodium triflorum* etc. There is also the tradition of preparing *Marunnu kanji* with the Navara variety of rice in place of ordinary raw rice (Unnikrishanan, 2004).

## 10. Dishes from Mango:

- (a) Pickles of different types were made from mango. Tender mangoes were preserved in salt water and green chillies large earthen pots called *Kuttuam*.
- (b) The endocarp of mangoes were collected and dried in sun. Its endosperm used to be taken out and powdered. This powder is mixed with rice powder. This is then boiled in water. It is a nutritious drink.
- (c) *Manga kach*: From ripe fruits the fleshy part was taken, made into a juice, spread over palm-leaf or bamboo mats and dried in the sun. The solid sheet was a delicious item of food.

- (d) *Preparation from seeds*: Seeds are kept for germination. After germination, the seed coat is removed and the cotyledons are dried under sunlight. Thereafter they are powdered. Various food items used to be prepared from this powder. The powder is boiled in water with jaggery, small amount of ginger powder, coriandrum and coconut milk. This is tasty *Payasam*. Powdered mango cotyledons are mixed with water, coconut scrapings and jaggery to form a paste; it is spread on plantain leaf, folded and baked in earthen vessel. This is called *Manga Ada*.

**11. Dishes from Jackfruit**: (a) Jackfruit used to be a dominant food item especially among lower strata of the society. The seeds are used as food during the monsoon season. It is roasted in earthen vessels and after peeling the outer coat is consumed straight or mixed with coconut and jaggery. Seeds may also be munched after baking in choolah directly. Jackfruits used to be plenty during the rainy season. And the seeds were stored for off season by coating them with mud paste, drying them and then storing them in earthen vessels. (b) Unripe fruits are used to make different dishes. Not only seeds, but also the seed pod and other parts of fruits are used to prepare various types of dishes. Tender fruits are cut into pieces, dried and stored. The ripe fruits are very delicious. For storage, it is mixed with jaggery and baked into a paste like form. Ghee, cashew nuts etc are added for taste and flavour. This dish called *Chakka Varatty*, can be stored for long periods of more than a year.

**12. Tapioca**: Though cultivation of tapioca was limited to a small area, poor people used to purchase tapioca from market as a cheap source of carbohydrate, particularly during lean period. Various kinds of preparations were made from tapioca. Tapioca was stored for future use in two ways – (a) Small pieces of tapioca are semi boiled and dried in sunlight. It can be stored for months in gunny bags (*Vattu kappa*). (b) Tapioca is cut into larger pieces and dried in sun without boiling. This is called *Vellukappa*. It is powdered and used for preparing *puttu* (steamed powder)

**13. Arrowroot Ada**: Arrowroot powder is mixed with a large quantity of water and is kept for settling. The precipitate is mixed again and the final product is collected and dried. This powder is used for preparation of *Ada*.

Rice is ground into paste and spread on taro leaf. Coconut and jaggery are placed over it and the leaf is folded. It is baked in steam. The dish is eaten along with the taro leaf. Leaves of plantain or jack tree are also used to make this item delicacy.

**14. Choondappana Choru**: Choondappana is *Caryoya urens* (family Palmaceae). The innermost part of the trunk of the tree is cut into small bits, ground and mixed with water. The precipitate is collected and dried. It is used to prepare porridge and bread.

**15. Nannari Coffee**: Root of *Nannari* (*Hemidesmus indicus*) is cut into small pieces and roasted with coffee seeds and powdered. It is used to prepare coffee. Not sugar, but jaggery was used. Milk was not usually an ingredient of the preparation of coffee. Sometimes ghee would be added to coffee. Tea was not very common. Coriander, cumin etc were boiled with milk and consumed.

## FOOD AND BIODIVERSITY

The rich diversity of Indian food is directly linked to the agro-biodiversity in the country. Like many large tropical countries, India is characterised by a complex

mosaic of distinct agro-ecosystems, differentiated by their climatic, soil, geological, vegetational, crop-growing, and other features. Classification by the National Bureau of Soil Survey and Land Use Planning distinguishes 20 broad agro-ecological zones, separated by natural features and crop growing periods. Each of these agro-ecological zones is in turn comprised of myriad micro-habitats. It is within this diversity of habitats that an amazing variety of crops and livestock has been developed over the millennia, by Indian farmers.

The Indian region is one of the world's eight centres of crop plant origin and diversity, distinguished by Russian scientist N.I. Vavilov. Reports of National Bureau of Plant Genetic Resources reveal that at least 166 food/crop species and 320 wild relatives of crops have originated in India (though many of them also have origins or centre of diversity in other regions). These include rice, pigeon pea, turmeric, ginger, pepper, banana, bitter gourd, brinjal, okra, coconut, cardamom, jack fruit, sugarcane, bamboo, taro, indigo, sunhemp, amaranthus, mango, and gooseberries. Species which may have originated exclusively in India include mango, taro, cucumber, pigeon pea, pepper, eggplant, and cardamom. While the species diversity among Indian crops is significant, what is truly mind-boggling is the genetic diversity within each of these species. To give some examples, one species of rice (*Oryza sativa*) has been diversified into at least 50,000 or even up to 100,000 varieties. One species of mango (*Mangifera indica*) has yielded over 1000 varieties. Other crops with rich diversity in India include wheat, sugarcane, legumes, sesame, okra, eggplant, banana, jackfruit, *jamun*, jute, ginger, turmeric, pepper, cinnamon, cardamom, sweet potato, yam, kidney beans, velvet bean and coconut.

India also has amongst the world's largest diversity of domesticated animals, with some 26 breeds of cattle, 40 of sheep, 20 of goats, 8 of camels, 6 of horses, and 18 of poultry, apart from the yak, the mithun, and several species and breeds of birds including geese, ducks, pigeons, and doves. It is noteworthy that the characterisation of Indian livestock breeds was last done in the first half of this century. Since no recent estimates are available, and surveys in some regions are far from complete, some scientists feel that the diversity may be even greater. Although the predominant patterns of agricultural development in the last several decades have increased yields, they have also significantly reduced the genetic diversity of crop and livestock varieties and agro-ecosystems, and have led to other kinds of biodiversity losses including plant genetic resources, livestock, insects, and soil organisms. This erosion has caused economic losses, jeopardizing productivity and food security, and leading to broader social costs.

There should be a better understanding that agricultural biodiversity of all food species is a vital sub-set of general biodiversity, highly threatened by globalisation of food markets and tastes, intellectual property systems and the spread of unsustainable industrial food production, but it provides the basis of the food security and livelihood security of billions of people and the development of all food production, including for industrial agriculture and for the biotechnology industries. It is the first link in the food chain, developed and safeguarded by farmers, herders and fishers throughout the world.



Changes in food habits towards 'fast', processed, treated and/or stored foodstuff of low nutritional value and the changing lifestyles could be considered as the major contributor to this scenario. The drastic decline in the diversity of crops and vegetables in our food also play a part towards this. The industrialization of agriculture and corporate driven food supply chains are now thrusting junk food habits on people. The increasing affinity towards fast food culture is part of "deliberate" efforts by multinational corporations (MNCs) in pursuit of capturing food processing sector by tending to spoil India's biodiversity. The gradual shift to new trends in eating, especially the rapid and pervading growth of fast food, is destroying this vital food culture. The devastating effects of corporate driven foods, often referred to as fast or junk food, and the agro-technology based farming systems are turning agriculture into an extractive industry and food into a health hazard. Traditional food cultures the world over have their innate strengths and are often highly scientific for a given culture and region. These are being vanquished by the spreading fast food culture and the effects are visible in the health of the people. The residues from aggressive farming like pesticides, hormones, colouring agents and preservatives reach human body and trigger diseases. When the agro-biodiversity of the farms disappears, the cultural diversity of the food systems also decline. Further, the modern food production systems also contribute considerably to environmental problems such as climate change and solid waste, besides wastage of food.

The local food culture and the farming systems have evolved through centuries of trial and error and have enormous wisdom inherent in them. The diversity of food, seasonal variations, taboos of specific foods at various times, case specific food like those for mothers and children are all part of the repertoire. There is also food, which gets used as medicine, and many of the food items cultivated in homesteads are of medicinal values more than nutritional value (eg. ginger, pepper, *kasthuri manjal* etc). Such practices are seen all over India where traditional medicines help save money and time. The wealth of traditional knowledge about these uses is also getting lost in the new generations and together with the resources, where there is need for intervention.

### **FROM TRADITIONAL TO 'JUNK' FOOD**

While food was considered in Indian culture as part of healthy living, the contemporary society faces problems produced by eating unhealthy food. Modernisation has not assured easy access to a diverse indigenous food, but often stereotyped eating habitats of Indians, besides providing non-nutritive, expensive, often seductive, cleverly marketed food, decreasing the choices for selection. According to Pingali and Khwaja (2004) the process of diet transformation in India can be seen as involving two separate stages: (i) Income-induced diet diversification: At the start of the process of faster economic growth, diets diversify but maintain predominantly traditional features; (ii) diet globalisation: As globalisation begins to exert its influence, we see the adoption of markedly different diets that no longer conform to the traditional local habits. A critical implication of globalisation is the severing of the link between diets and the local availability of resources and local food habits. In the second stage

of diet globalisation in particular, consumers have access to varieties of food that were not previously available to them. Thus, consumers are no longer constrained in their demand to purchasing local produce.

The term 'junk food' refers to is a food that is of little nutritional value and often high in fat, sugar, salt, and calories. They are fast foods which are easy to make and quick to consume and common junk foods include salted snack foods, fried fast food, candy and sugary carbonated drinks. The globalisation has facilitated introduction of junk food in the country and all the cities in India will now get pizzas and burgers of corporate companies and a series of companies have established their networks to sell these products. The powerful media in the globalised era helped homogenization of Indian culture and the loss of cultural diversity; simultaneously we are losing out the rich diversity of food and beverages, which India is proud of. A child in India choosing cola drinks in place of traditional beverages and junk food in place of traditional low calorie nutritionally balance food and eating it singly watching television in place of eating together are all impacts of the media.

Of late, fast food has become so ingrained in our culture that it's hard for the young generation to live without it. Notwithstanding the health implications of junk food, it is consumed in larger quantities and modern life styles contribute to the health implications. A single cheeseburger takes up somewhere between about 7 and 20 mega joules in energy, which can be converted to a CO<sub>2</sub> emission of between 1 and 3.5 kilograms. Fast food tends to get a lot of the blame for the rising levels of obesity across the world – especially the increase in obesity among kids. The junk foods have very high fat content, especially trans fats [Trans Fat is the common name for unsaturated fat with *trans*-isomer (E-isomer) fatty acid(s)]. Trans fats have caused alarm in the medical profession since it was revealed that these dangerous fats, created when oils are heated and reheated, are believed to contribute towards an increase in rates of heart disease in the people who eat fast food and foods containing trans fats regularly (Crupkin and Zambelli, 2008). A study by Johnson and Kenny (2008) at the Scripps Research Institute in suggested that junk food consumption alters brain activity in a manner similar to addictive drugs like cocaine or heroin.

According to the National Restaurant Association of India (NRAI) 2010 report, the fast food industry in India is currently estimated to be between Rs 6750- Rs 8000 crore, growing at a compound annual growth rate of 35-40 per cent. A major chunk of these markets is ruled by global players such as McDonald's, Coca Cola, etc. The first study on the nutritional quality of junk food in India was done by Centre for Science and Environment (CSE, 2012). They examined twenty three junk food samples comprising Potato Chips, Indian Snacks, Instant noodles, burgers, Pizza, Fries and fried Chicken. The results of the study indicate that junk food contains high levels of sugars, salt and trans fats. High levels of trans fats are a public health concern due to its association with chronic heart diseases. The trans fat content was highest in French fries (8.1% of total fat) followed by instant noodles (4.6% of total fat) and potato chips (4.5% of total fat). The dietary guidelines for Indians, published by National Institute for Nutrition are provided below.

**Table 1.**  
**Recommended Dietary Guidelines for Indians**

<b>Carbohydrate</b>	<b>Free Sugars</b>	<b>Protein</b>	<b>Salt</b>	<b>Fat</b>
50-60%	<10%	<10% 10-15%	6 g per day	20-30%

Source: National Institute for Nutrition (2011)

Junk Food is not standardized under Indian regulations. It comes under the category of food which is only expected to declare their composition or nature of food and comply with general regulations under the Food Safety and Standards Act in India.

The provision of nutritional information is currently not a legal requirement unless a claim is made. None of the takeaway foods like pizzas, burgers, fries, and potato chips provide nutritional information on the product packs. The absence of nutritional data per/100g makes comparisons between products difficult. There should be mandatory labeling, at least for serving size, trans fats, saturated fats, sugars and salt along with already mandatory labeling nutritional information for all processed foods including takeaway foods (CSE, 2012).

As the junk food industry targets children, it is important to ban junk food from schools and places where children have easy access to these foods. Government should also start awareness campaign to increase awareness of consumers about the ill health effects of regularly consuming junk foods. The increased consumption of high-caloric and more energy-dense food could lead to increased incidence of obesity and of diet-related diseases, like diabetes, coronary heart disease and certain types of cancer. It seems clear that dietary patterns are contributing to a clear change in the trends of chronic diseases in India (Shetty, 2002).

Several areas require stronger policy recommendations; however, such as the need to eliminate the aggressive marketing of unhealthy foods to children. In England, considering the health impacts of junk food, fast food outlets were banned near the schools. On January 21, 2011, WHO formally issued a recommendation asking for a ban on junk food in schools and playgrounds in order to promote healthy diet and tackle child obesity". Settings where children gather should be free from all forms of marketing of foods high in saturated fats, trans-fatty acids, free sugars or salt. Only with such comprehensive efforts we will be able to move away from a world that so easily promotes unhealthy eating, and toward a world where healthy eating is the default choice.

We have the responsibility to make better choices to create a better food chain. Educating and inspiring consumers is the most effective means to change their buying/eating patterns. Reviving the traditional food and sources of good food in the minds of people is a big step for reinforcing the food security of the land. Nutrition counselling is a process by which beliefs, attitudes, environmental influences and knowledge about food and health are channelized into actual practices which are sound and consistent with the individual needs, purchasing power, food availability, health and socio-cultural background. It is one of the most effective tool of changing the food habits without affecting their sentiments (Monga *et al.*, 2008).

## THE WAY AHEAD

The concept of food sovereignty was first introduced in 1996 by an international farmer's organization, La Vía Campesina. According to La Vía Campesina "Food sovereignty is the right of peoples to healthy and culturally appropriate food produced through sustainable methods and their right to define their own food and agriculture systems. It develops a model of small-scale sustainable production benefiting communities and the environment. It puts the aspirations, needs and livelihoods of those who produce, distribute and consume food at the heart of the food systems and policies rather than the demands of the markets and corporations. Food sovereignty prioritizes local food production and consumption. It gives a country right to protect its local producers from cheap imports and to control production. It ensures that the rights to use and manage lands, territories, water, seeds, livestock and biodiversity are in the hands of those who produce food and not the corporate sector.

As Michel Pimbert points out, policies for food sovereignty pursue three types of objectives:

**Equity:** securing the rights of people and communities, including their fundamental human right to food; affirming and celebrating cultural diversity; enhancing social and economic benefits; and combating inequalities, such as the ones responsible for poverty, gender discrimination and exclusion.

**Sustainability:** seeking human activities and resource use patterns compatible with ecological sustainability.

**Direct democracy:** empowering civil society in decision-making, as well as democratizing government institutions, structures and markets. Even though it may not be expressed directly, food sovereignty offers not only food security, which means that people have access to food at all times, but also a good life. The food culture and heritage in India has to be evaluated in this context.

We have to recognize that biodiversity is the real capital of food and farming. Augmenting homestead biodiversity in the rural areas will be an effective tool for sustainable development and food security and will enable the communities to achieve food self-sufficiency. We are poorer as the biodiversity of our farms disappears and the cultural diversity of our food systems disappears. It is high time that we have to take a proactive role in moving towards a new food culture that ensures not only supply of healthy and ethnically produced food but also facilitates conservation of rich biodiversity at grass roots. We need a new popular initiative that preach and practice good food habits, conservation of local biodiversity to enrich food diversity, and ultimately aim at food sovereignty and food security at local levels (Brown, 2012). With the global food prize constantly escalating, the efforts in India should be always to promote local agricultural practices, promote sustainable eco-friendly farming and consumption, besides realising the importance of Indian food culture.

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***Subtheme IV:  
Culture, Heritage and Technology Development***



# Crafts Industry, Culture and Heritage

**Dr. K P Dileepkumar**

*Independent Consultant, 'ZOOM', Koorkenchery P.O. Thrissur*

## INTRODUCTION

There is a question about the distinction between a craft, an art, and an occupation. Although there is much confusion in terms, in general practice the so called fine arts are distinguished from the crafts. Hence painting and sculpture are considered as art rather than craft. Moreover the crafts demand on the whole a greater degree of training and skill than does the occupation. The crafts of India are diverse, rich in history and religion. Throughout centuries, crafts have been embedded as a culture and tradition within rural communities. They are a constant source of inspiration for contemporary designers and the subject for global exhibitions representing India. India is a land where every corner is evident with the greatness of art and craft. The paper describe in detail about the Crafts industry, the Culture behind and the heritage associated.

## CRAFT TRADITIONS

The traditional quintessence of Indian art and craft can be seen even in the daily used objects like earthen pot, mugs, bed-sheets or any such things. India is one of the major producer and supplier of Handicrafts products in the world. Before the industrial development, this art and industry was a potential economic advantage for the country. The objects are created with a great creativity that portrays magnificent work of art. It is indeed, in crafts that one can observe with special clarity the operation of tradition. Until relatively recent times, craft techniques and designs were passed down within one family for many generations or were transmitted by the apprentice system wherein a boy learning the craft served for as long as, even years under a master craftsman. Only recently has the older traditional system of transmitting the skills and knowledge of a craft been partially supplanted by formalized training. The strong traditional element in the craft is also apparent in the great antiquity of many crafts. The making of pottery, for example is immensely old and has changed little over the centuries. Tradition usually has a geographical as well as an historical



spread. Pottery was made in most parts of the world prior to the spread of European culture.

### **Traditional craftsmanship**

There are numerous expressions of traditional craftsmanship: tools, clothing and jewellery; costumes and props for festivals and performing arts; storage containers, objects used for storage, transport and shelter; decorative art and ritual objects; musical instruments and household utensils, and toys, both for amusement and education. Many of these objects are only intended to be used for a short time, such as those created for festival rites, while others may become heirloom that are passed from generation to generation. The skills involved in creating craft objects are as varied as the items themselves and range from delicate, detailed work such as producing paper votives to robust, rugged tasks like creating a sturdy basket or thick blanket.

### **History of Indian Crafts**

The history of Indian handicrafts goes back to almost 5000 years from now. There are numerous examples of handicrafts from the Indus Valley Civilization. Going back to the Indus Valley Civilization we find a rich craft tradition and a high degree of technical excellence in the field of pottery, sculpture (metal, stone and terracotta), jewellery, weaving etc. The Harappan craftsmen not only catered to all the local needs but traded with the outside world via sea routes. In the Vedic age (1500 B.C.), we find numerous references in the Vedas of artisans involved in pottery making, weaving, wood craft etc. The Rig Veda refers to a variety of pottery made from clay, wood and metal. There is a reference to weavers and weaving. In the Mauryan age we find great development in the field of sculpture. In this period more than 84,000 stupas are said to be built in India, including the famous Sanchi Stupa, which has beautiful stone carving and relief work done on it. Numerous sculptures from Bharhut, Mathura, Amravati, Vaishali, Sanchi etc show female figures adorned with a display of jewellery, which continues to inspire contemporary jewellery making. During the Kushana period Jewellery, sculpture, textile making, leather products, metal working etc. were the main handicrafts that assimilated foreign influences and used them in accordance with the Indian setting. The Gupta age saw rapid advancement in the field of handicrafts and art forms. The murals at Ajanta and Ellora bear testimony to it. During the Medieval period, the handicraftsmen flourished in the field of pottery, weaving, wood carving, metal working, jewellery etc. The contribution of the Cholas and the Vijaynagar Empire in the field of bronze sculpture, silk weaving, jewellery, temple carving is simply unparalleled. The Mughal period was the golden period in the history of Indian art, craft and culture. The Mughals brought with them a rich heritage. The Mughals introduced methods like inlay work, glass engraving, carpet weaving, brocades, enamelling etc.

### **Prior to the industrial revolution**

Prior to the industrial revolution folk crafts played an immensely important role in traditional society, for practically everything the individual could not produce for himself was produced by craftsman living in his own locality. Stores or shops

as we know them today hardly existed in the countryside in earlier times, and if a farmer needed an item that could not be produced on the farm, he went directly to the craftsman to obtain the item or the craftsman came to farm to produce it. Occasionally farmers travelled to nearby local markets to sell or barter their excess produce and to purchase readymade items, and many areas fairs at which crafts men set up their booths and sold their wares were a regular event eagerly looked forward to. There was a close contact between the craftsman and the customers. The visit of the farmer to other craftsman to order or pick up an item was a social event as well as a business matter. Craft workshops served as centres where men tended to gather to discuss news and local events and to tell stories, and the like. The craftsman and his customer developed a special relationship. The craftsman knew his customer and his family need. The customer received 'designer' products to suit to his special needs.

### **Guild System**

During the early days of prosperity, the handicraft industry in India was organised on Guild system. Guild was an association of artisans formed for an economic purpose and it enjoyed absolute freedom from governmental interference. It ensured a certain group of craftsman engaged in each and every craft based on division of labour. In India, five artisan castes are known as Vishwakarma (Ainkudi Kammalar), which includes five sub-castes: carpenters, blacksmiths, coppersmiths, goldsmiths and sculptors are described in the epigraphical records as descendants of Vishwakarma, the Hindu god of craftsmen and architects. This denotes the importance given to craftsmen in the society.

Earlier the caste system was based on this division. It was later on caste system became rigid and change of caste or profession was barred. The Guilds provided raw materials for manufacturing, controlled quality of manufactured goods and their prices and explored markets for finished products. They were located in urban areas. The artisans belonging to Guilds were well-off and they enjoyed great social status. The Guilds were a source of revenue to the State. The State imposed taxes on their income. In return, the Government provided facilities to them by maintaining roads for the transport of merchandise. Besides, it granted subsidies and loans too. A close examination of the working of Guilds in those times indicates that they had a very strong organisation structure which is comparable to those of the modern successful business organisations.

### **ROLE IN THE DEVELOPMENT OF THE ECONOMY**

During recent years, the importance of handicrafts has been surged due to their cultural and financial values. The small scale industries - including handicrafts can play a major role in the development of the economy of both developed and the developing countries equally. The 90-95% of the total industrial products of the world is produced in small workshops run by less than 100 people. For instance, Japan, which is at the peak of the economic development, has considered 84% of its industries as small and medium scale industries. In countries such as India and China, handicrafts are as high as the mechanized products in quality and volume, and are a major source of their foreign earnings.

## **CRAFT TRADITIONS OF INDIA**

The rich craft heritage of India is unique and diverse as its customs and traditions. Each part of the country has its own unique cultural ethos, which is manifested in the handicrafts of that particular region. Indian crafts and handicraft traditions are influenced by local topography, climate, and socio-religious factors. These craft traditions have withstood the ravages of time and numerous foreign invasions and continue to flourish till date owing to the assimilative nature of Indian culture and broadmindedness of the craftsmen to accept and use new ideas. Indian craft tradition has no parallel in the world, in diversity as well as in technique and use of materials. The craft traditions of India vary from region to region. These crafts not only cater to the day-to-day needs of the people but are also used for decorative and religious purposes. The artisans who practice these arts toil through many days to produce just one piece which is perfect in technique and composition, besides, it bears the heritage of generations of master craftsman. The tradition of crafts in India has grown around religious values and needs of the common people. In addition to this, foreign and domestic trade have also played an important role in the evolution of different craft forms in India. The craft traditions of India have withstood the depredation of time

### **Clay Crafts and Pottery**

The terracotta tradition is the continuation of the Indus valley traditions that date back 5000 years. India also has an age-old tradition of clay toys and terracotta figures. There is hardly any festival or ritual, which is complete without the use of earthen lamps or diya. Terracotta work is centred in the states of West Bengal, Orissa and Madhya Pradesh. West Bengal is also known for unfired clay sculptures. The Bankura terracotta horse is popular all over India. Translucent blue pottery is made in Delhi and Jaipur. Clay crafts are deeply rooted in the tribal societies of our country.

### **Furniture Tradition**

The cultural and regional diversity of Indians not only dictates the variety in furniture but also the material used for making such items. One can find sofa sets, settees, bookshelves, racks, cabinets, tables etc made out of a variety of material like wood, iron, cane bamboo etc. Each state has its own distinct furniture tradition, which is reflected in the motifs and patterns adorning them. Gujarat and Maharashtra are known for lacquered traditional wood furniture. The furniture from Rajasthan is not only decorated with delicate carvings but is also painted in the local miniature style of painting, depicting folklore. Kashmir is famous for intricately carved walnut tree tables and cabinets etc. Wrought iron furniture is in vogue these days.

### **Basket Weaving and Mat Making**

It is one of the oldest craft forms. Man has known basket weaving and mat making crafts since the dawn of history. The tribals do most of the basketry and mat making work in India. The tribals, to reflect their art and culture have used cane and bamboo since ancient times. The materials used for basket, mat weaving and cane work are simple and found in abundance. Locally available natural material like grass, reeds,

leaves etc is used for mat and basket making. Jute, coir and bamboo are also used in basketry and in making mats. States like Bihar, Orissa, Tamil Nadu, Madhya Pradesh and the North Eastern States are known for their basket weaving and mat making traditions. The production of cane furniture is on the rise these days. Jute and coir are relatively new materials, which are being used in making various items.

### **Coir fibre**

Coir fibre is obtained from coconut husk after a lengthy process. Kerala is the largest producer of coir products, which range from mats, mattresses, pillow-covers, carpets, bags, wall hangings etc. Coir items are popular due to their durability. Jute, known as the golden fibre is the cheapest natural fibre.

### **Jute**

A variety of utilitarian items are created using jute. West Bengal is the largest producer of a variety of jute crafts, which range from: mats, floorings, cushion covers, table covers, bags, garments, stuffed toys etc.

### **Toy Making Tradition**

Toy making tradition in India is as old as its history. Children from the Indus valley civilization used to play with small clay toys. A large variety of materials are used to make traditional toys and dolls. Clay, papier-mâché, coir, leather, cloth etc are used in making traditional toy and dolls. Painted wooden toys from Tirupati are popular so are the stuffed leather toys from Madhya pradesh and Karnataka. Lacquered wood toys from Gujarat and Rajasthan are also popular. Madhya pradesh is well known for its range of Papier-mâché toys.

### **Paper -Mache**

Papier-mâché articles are made of waste paper and are moulded according to requirement. A large number of utilitarian items are made from Papier-mâché. Kashmir is well known for day-to-day articles made from Papier-mâché. Boxes, trays, pots, vases etc are made of Papier-mâché and then they are painted in bright colours. Large items also have gold and silver leaf applied to them. Madhya Pradesh is known for Papier-mâché toys and other articles. Punjab is also known for Papier-mâché utensils and storing vessels.

### **Shola Pith**

Shola is a plant that grows in marshy areas. The shola pith has been utilized in Bengal, Orissa and Assam as art decorations. Here decorations for deities are made from shola pith. Craftsmen in Tamil Nadu are famous for structures in pith products. Pith flowers are made in Karnataka and Maharashtra.

### **Coconut Shell**

Coconut shell is used for making a number of products. In Kerala lamps, pots, vases etc are made from coconut shell, while coconut pith is used in making small figurines in West Bengal

**Conch Shell**

Conch in India has from time immemorial had religious and social importance. Blowing of the conch shell during religious functions is considered auspicious amongst the Hindus. West Bengal is the main centre for products made from conch and cowrie (small closed shells) shells. The bangles worn by married Bengali women are made from conch. It forms an integral part of traditional Bengali jewellery. Shallow carving is done on conch shells and small shells are used to decorate bags, shawls etc.

**Leather Craft**

Indians have known the art of tanning since the time of the Indus valley civilization. Popular leather items are footwear, bags, saddles etc. Kohlapur is known for its chappals. Rajasthan is the home of decorated leather products; Mojdis or thick shoes are made of locally cured leather, they are decorated with silk, metal embroidery and beads. Bikaner and Jaisalmer produce decorative saddles for horses and camels. West Bengal is known for its decorated leather bags. Ornamental work on leather can found in crafts of Punjab, Kashmir and Karnataka. Items like lampshades, pouches, stuffed toys etc are also made of leather.

**Home Décor**

A myriad of traditional Indian crafts are used as house decor. The list is endless; wall hangings, bed covers, curtains, showpieces, photo frames, candle stands, pots, vases, carved doors and lintels, masks, boxes, mats, carpets, furniture, papier-mâché products, sculptures, silver and brassware, carpets and floorings etc. The production of such utilitarian items varies from state to state so does the material used, designs and motifs, technique of production etc, which lending colour and variety to the rich tapestry of Indian crafts.

**Woodcarving**

Indian craftsmen have perfected carving in all its manifestations using a variety of raw material ranging from wood, stone, horn, coconut shell etc. Exquisite woodcarvings depicting gods and goddesses and mythological figures are a common place amongst the carved wood products. Woodcarving is popular in the states of Kashmir, Orissa, Madhya Pradesh and the Southern states. The material varies from walnut, redwood, sandalwood and teak etc.

**Stone Carving**

Stone carving too is popular amongst Indian crafts and is practiced throughout the country. Delicate marble inlay work from Rajasthan and Agra is as popular as the carved sculptures from Orissa and South India. Carving on coconut shells is done in the state of Kerala. Shallow relief carving is also done on conch shells.

**Inlay Work**

The technique of inlay basically involves making shallow carvings on the surface of wood or stone (generally marble), the shallows between the normal carvings are then filled either with metal or precious and semi-precious stones. The finished item is a

profusion of patterns and inlaid material. Inlay work is the direct descendant of the Mughal era and shows a strong Persian influence. A large number of products like: tables, pots, trays, boxes, etc have been endowed with beautiful inlay work. Kashmir, Gujarat, Karnataka and Rajasthan are known for their wood inlay work. Inlaying of light metal on dark metal is technically known as damascening. The base metal (usually iron) is decorated with gold wire, in earlier times this was used to enhance the beauty of Armour, swords etc

### **Metal Crafts**

Indian craftsmen had mastered the art of metallurgy 5000 years back. The lost wax process was known to the ancient craftsmen in making pots and sculptures. Metal craft is an integral part of the Indian ethos: pots, utensils, vessels, tools, weapons etc have been made out of a variety of material like iron, copper, bronze, bell metal, white metal, silver etc. The Ladakh region of Kashmir is known for traditional vessels made out of iron and brass. Moradabad is world famous for its array of utilitarian brassware. Engraving using traditional motifs is also done on items made in Moradabad. Making of bronze sculptures is common in Palitana in Gujarat, Vishnupur near Calcutta, Balasore in Orissa and all the Southern states.

### **Painting**

Painting is one of the earliest known activities of man and India is no exception to that. The earliest known paintings can be found in the Bhimbetka caves of Madhya Pradesh. The Ajanta caves is another milestone in the Indian history of painting, not only were the artists rendering realistic images, but they were also well versed with the art of making frescoes. The miniature paintings under the Mughals were the high point of painting in the yester years. Different areas of India have different painting traditions. They differ from each other in technique, style, use of material and rendering of the subject, owing to regional and past influences. Ladakh is known for its Thangka paintings. Tanjore is known for ornate glass paintings. The different miniature schools of Rajasthan lend colour to this arid land. India also boasts of numerous tribal and folk painting traditions: Gujarat, Madhya Pradesh, Maharashtra, Bihar, Orissa, and west Bengal have their own unique painting styles.

### **Glassware**

Glass has fascinated human beings since the dawn of civilized world. Glass is not only used in making utilitarian items such as bowls, bottles, lampshades, perfume bottles, bangles etc, it is also used for making small decorative items such as toys, beads, paintings etc. Ferozabad and Saharanpur in Uttar Pradesh are known for their glassware.

### **Textile Tradition**

The people from the Indus valley civilization laid the foundation of weaving traditions of our country. Ancient texts and archaeological findings verify the rich textile tradition of India. Indian textiles have been popular abroad since ancient times. The legendary muslins from Dacca were the high point of this craft form. Weaving in India has been conditioned by geographical, cultural, economic and social factors. A variety of material like silk, cotton, wool, jute etc is used by the weavers.

### **Sari weaving**

Sari weaving is the main weaving tradition of India. There is a mind-boggling array of styles and brocades throughout the country, which are rich in design and colour. Mysore, Banaras, Surat, Kanchipuram, Paithan, Chander etc are some of the important sari weaving centres. Woven woollen items are also popular in India. Woollen Pashmina and Shahtoosh shawls of Kashmir are world famous. Woollen shawls from North-eastern states and Himachal Pradesh are also popular.

### **Decorative textiles**

India is known for decorative textiles. Embroidery is the beautification of woven material with various types of stitches. A number of embroidery styles flourish in India, they not only vary in technique but also in design and use of fabric. Punjab, Gujarat, Karnataka and Uttar Pradesh are main centres of embroidery. Appliqué work is also practiced widely in India. Gujarat and Punjab are known for rich appliqué work. The tribals of Rajasthan, Orissa and Andhra Pradesh also practice this craft form. Tie and dye, hand printing and block printing techniques are common across the country. The Tie and dye technique of printing in particular is popular in the states of Rajasthan, Madhya Pradesh and Andhra Pradesh. A lot of utilitarian items like bed cover, sheets, cushions, spreads, garments, curtains etc are created using these traditional textile-printing methods.

### **Carpets**

Carpets and floorings are an integral part of Indian homes. Carpets and floorings are made up of a variety of materials, ranging from wool, cotton, silk, jute, coir, bamboo and grass. The Mughals introduced the art of carpet weaving in India and set up centres at Agra, Delhi and Lahore to train and produce carpets of Persian style following the designs of Kirman, Isfahan, Herat, etc. The contemporary Indian craft of carpet weaving is the offshoot of the Mughal tradition and follows the Persian style of carpet weaving. Kashmir is known for its silk carpets while Bhadohi- Mirzapur belt in Uttar Pradesh is the leading hand knotted woollen carpet-producing centre in the country. Tufted woollen carpets are gaining popularity these days. Gabbe woollen carpets, chain stitch rugs and carpets, and namdas are also made in India.

### **Floorings**

Woollen durries and mats are other floorings used in India. Durries not only lend colour to the décor of the house but they are also cheap. Mats are made out of a variety of readily available material like, bamboo, grass, jute, coir etc. India has a varied mat making tradition. Bihar, Orissa, Tamil Nadu, Kerala, West Bengal and North-Eastern States all have distinct mat weaving traditions of their own.

**Gems:** The discussion about Indian crafts and culture is meaningless without the reference to gems. Indians have been obsessed with use of gems from the beginning of Indian civilization. This obsession is not only fuelled by religious practices and myths but also by economic and social reasons. All sorts of material like gold, silver, copper, coral, pearl, precious and semi-precious stones are used in making jewellery. Each region has its own distinct flavour, which reflects local tradition and influences. Rajasthan and Delhi are known for meenakari and enamelling. Pearl jewellery is

common in Maharashtra and Andhra Pradesh. Gold and silver jewellery is common to most regions of the country. Silver predominates most of the traditional jewellery of the tribals. The richly adorned and embellished peacock throne of the Mughals is the finest example of their excellence in working with precious metals and stones. Gems and semi-precious stones have been used by Indians not only in jewellery pieces but also for medicinal and astrological reasons. India is the largest importer of gold in the world and it has the largest gem cutting and polishing industry in the world.

### **Jewellery**

Jewellery made of gold, silver, copper, terracotta and beads have been found from various sites belonging to the Indus valley civilization. Though there is some reference to ancient jewellery making, the Mughal rulers took jewellery making to new heights. Not only Islamic designs and motifs were incorporated into the Indian jewellery tradition, but new techniques like enamelling, damascening, engraving and inlaying were introduced by them. There is a profusion of jewellery styles across the country.

### **SOCIO ECONOMIC IMPORTANCE**

Though Indian Handicraft industry is considered a cottage industry, but it has evolved as one of the major revenue generator over the years. There has been consistent growth of 15% over few years and the industry has evolved as one of the major contributor for export and foreign revenue generation. There is huge demand for the Indian Handicraft products in both national and international market. To match the demand and supply with quality, there is need to have greater technological support and innovativeness with the uniqueness in industry.

The craft or handicraft sector is the largest decentralised sector of the Indian Economy. Craft people, form the second largest employment sector in India, second only to agriculture. Handicrafts are rightly described as the craft of the people. There are 23 million craft people in India today. 63% of exports turnover is from this sector. 9 items dominate exports of handicrafts. These nine items include art metal ware, wood ware, hand-printed textiles, hand-knotted and embroidered textiles, leather goods, stoneware, carpets and floor coverings. Although exports of handicrafts appear to be sizeable, India's share in world imports is miniscule. It is a sector that is still not completely explored from the point of view of hidden potential areas. In India, craft is not merely an industry but a creation symbolising the inner desire and fulfilment of the community. While handicrafts, be it, metal ware, pottery, mats, wood-work or weaving, fulfil positive need in the daily life of people they also act as a vehicle of self-expression, and of a conscious aesthetic approach.

The Indian handicrafts industry is highly labour intensive cottage based industry and decentralized, being spread all over the country in rural and urban areas. Numerous artisans are engaged in crafts work on part-time basis. The industry provides employment to over six million artisans (including those in carpet trade), which include a large number of women and people belonging to the weaker sections of the society. It uses existing skills and locally available eco-friendly raw materials. In



addition to the high potential for employment, the sector is economically important from the point of low capital investment, high ratio of value addition, and high potential for export and foreign exchange earnings for the country.

### **Eco-friendly Crafts for Sustainable livelihood**

Crafts, by their very nature, are not mass produced. But if people are working with their hands, albeit with the assistance of tools and machines, producing goods required in a wide market space, selling to make profits and thereby contributing to national wealth, crafts can be termed as a decentralized creative industry where the human mind and hand is more important than the small machines and tools they may use. Here the machine is the instrument of the maker, owned by the maker or by the community, and to that extent craft is free of domination and exploitation. There is, therefore, a world of industry without industrialization in the traditional sense, and there is both ample scope and need for this to come out of the disorganized, diminishing and low-end profile that it has been carrying for long. Craft products that use environmentally friendly raw materials are increasingly sought after in the market. Environment is a matter of concern for every living being, especially for human beings, because the latter banks heavily on the same for survival and sustenance. Degradation of the environment is becoming a matter of issue. By choosing sustainable materials, these makers make a clear contribution to the sustainability agenda, not only reducing the environmental impact of their work but also introducing new materials to designers. Craftspeople have for centuries quietly led green lifestyles: sustaining nature for raw materials, creatively adapting to maximize local resources, preserving knowledge, heritage and skill. Traditional craft practice can offer society, extensive knowledge about environmental performance, retaining and using this knowledge is integral to our future sustainability.

Crafts are not to be popular just because we get arty things at a fairly in exclusive rate but because health, environment, education, self value, exposition of cultural diversity and other such vitally important areas are linked to the need for sustaining crafts. The mud of the potter goes back to the earth without harming it. Hygiene maintained by ensuring that it is not reused. Paper is saved and non –degradable plastic is avoided. Handicraft is a production process and a wonderful indigenous technology, not an outmoded tradition. The raw materials (cane, cotton, clay, wood, wool, silk, minerals etc.) are not only indigenously available, but also environmentally friendly.

It would be wrong to assume that the craft practices are innately ecologically responsible. In many cases there has to be an active intervention in which sustainable practices and processes of production are to be introduced. Sustainable processes and conscious efforts to work of greening their production processes and new green technologies are to be combined with traditional techniques. It should be seen that they have not compromised the low environmental impact traditional craft practices, which did not consume electricity, or other sources. Fuel should be conserved through using green energy alternatives, such as solar power and rainwater harvesting. Crafts development can represent a constructive, positive contribution to the development of alternatives to resource-destructive agricultural practices, based on the provision of gainful employment.

For women, craft is not only an important source of supplementary income; it also has implications for increased bargaining power, and socio-economic status. The introduction of the so called labour-saving machinery can threaten the hand-made nature of the crafts; moreover, case-studies consistently show that, when advanced technology is introduced, women are generally excluded from access to the new machinery. Thus, any training programme must address these issues and devise ways to meet women's special needs.

Handicrafts constitute an important segment of the de-centralized/unorganized sector of our economy. It is mainly rural based, having reach in backward and inaccessible area. Originally, started as a part time activity in rural areas, it has now transformed into a flourishing economic activity due to significant market demand over the years. Handicrafts have big potential as they hold the key for sustaining not only the existing set of millions of artisans spread over length and breadth of the country, but also for increasingly large number of new entrants in the crafts activity. In India the production of craft products are done on both large and small scale. Because of low capital investment people can start their business on small scale.

### **PROBLEMS**

Arts and crafts industry is in decline. The current industry is far behind as compared to arts and crafts of other countries. There is need for global exposure. In the ancient times, Indian crafts flourished not only because they were skilfully designed but also because they reflected Indian society by and large. But present circumstances hinder artisans from developing beautiful products as they are involved in their daily struggles for survival. There is a swing against small scale village industries and indigenous technologies in favour of macro industries and hi-tech mechanized production. However, with ever-increasing competition from mill-made products and decreasing buying power of village communities due to prevailing economic conditions, artisans have lost their traditional rural markets and their position within the community.

Like other forms of cultural heritage, globalization poses significant challenges to the survival of traditional forms of craftsmanship. Mass production, whether on the level of large multinational corporations or local cottage industries, can often supply goods needed for daily life at a lower cost, both in terms of currency and time, than hand production. Environmental and climatic pressures' impact on traditional craftsmanship too, with deforestation and land clearing reducing the availability of key natural resources.

Despite the increasing demand of traditional art products, there have not been initiatives on the part of government to link artists directly with customers.

The recent thrust on creating self-help groups (SHG) and micro credit schemes is bringing in the organizational and financial components to suit small businesses and the decentralized sector in rural areas, particularly for women.

As social conditions or cultural tastes change, festivals and celebrations that once required elaborate craft production may become more austere, resulting in fewer opportunities for artisans to express themselves. Young people in communities may

find the sometimes lengthy apprenticeship necessary to learn many traditional forms of craft too demanding and instead seek work in factories or service industry where the work is less exacting and the pay often better. Many craft traditions involve 'trade secrets' that should not be taught to outsiders but if family members or community members are not interested in learning it, the knowledge may disappear because sharing it with strangers violates tradition.

Local, traditional markets for craft products can also be reinforced, while at the same time creating new ones. In response to urbanization and industrialization, many people around the world enjoy handmade objects that are imbued with the accumulated knowledge and cultural values of the craftspeople and which offer a softer alternative to the numerous 'high tech' items that dominate global consumer culture.

### **POSSIBILITIES**

Despite these adverse conditions, the traditional professional crafts person has a unique earning power that can be adapted to many new usages and markets. Skills and raw materials also exist enabling handcrafted products to be competitive in both price and aesthetics. Even if one feels there is no future for craft, we cannot ignore the fact that a large section of the population depends on craft skills for its livelihood. India's rapidly burgeoning middle class, in search of an identity that is both Indian and contemporary, provides a natural and growing market for a utilitarian yet aesthetic handcrafted product at a price that is competitive and cost-effective. Many agricultural and pastoral communities depend on their traditional craft skills as a secondary source of income in times of drought, lean harvests, floods or famine. Women struggling to enter the economic mainstream can use craft to become wage earners, provided they are shown how to get access to the market. Their inherent skills in embroidery, weaving, basketry etc. are a natural means to social and financial independence.

### **Tourism and crafts**

Although tourism currently plays a relatively small role in the economy of developing countries, it is projected today as an engine of economic growth and an instrument for eliminating poverty, curbing unemployment problems, opening up new fields of activity, and enhancing the quality of life particularly among the most vulnerable sectors of society. Enormous scope is on the card to combine tourism with handicrafts to propel the local economy by creating employment potentiality and generation of income to alleviate poverty.

In many developing countries, policy is beginning to reflect the potential positive outputs which limited, well-managed eco-tourism can bring in the context of conservation. One particularly promising source of development potential may be found in what is known as "cultural tourism". This approach links tourist attractions to the culture of the indigenous peoples: colourful ceremonial celebrations; exotic dances and music; and intriguing ethnic arts and crafts.

Visitors can also buy handicrafts made by practicing artisans who may live and work in the village. Tour operators offering package tour should be encouraged to include

visit to handicraft fairs or villages in states which produce handicrafts unique in nature. The crafts can be promoted as part of the total tourism offering of a state. Special itineraries and tours covering various crafts can also be promoted. With the recent popularity of concepts like rural tourism, home-stays, bed and breakfast, etc the cottage industries fit in perfectly. So the local self government institutions can take a lot of initiatives in this direction. This will not only enhance the experience of visitors but also give a much needed boost to the crafts as the visitors will be directly involved with the craftsmen. In any case the various products of the cottage and small scale industries have long been bought as souvenirs.

### **Training trade secrets**

The reason why Indian art and craft is highly appreciated and constantly flourishing in domestic and foreign markets are due to its utilitarian nature and high acceptance among people of India and people across the whole world. The goal of safeguarding, as with other forms of intangible cultural heritage, is to ensure that the knowledge and skills associated with traditional artisanry are passed on to future generations so that crafts can continue to be produced within their communities, providing livelihoods to their makers and reflecting creativity. Rather than focusing on preserving craft objects, safeguarding attempts should instead concentrate on encouraging artisans to continue to produce craft and to pass their skills and knowledge onto others, particularly within their own communities. The goal of safeguarding, cultural heritage is to ensure that the knowledge and skills associated with traditional artisanship are passed on to future generations so that crafts can continue to be produced within their communities, providing livelihoods to their makers and reflecting creativity. Many craft traditions have age-old systems of instruction and apprenticeship. One proven way of reinforcing and strengthening these systems is to offer financial incentives to students and teachers to make knowledge transfer more attractive to both. Also, training programmes could be conducted on how to set up a business and understand marketing techniques. Finally, support and encouragement to specialist craft associations who agree to set up common facilities and workplaces would minimize the expenditure of individuals.

### **Traditional skills**

The artisan is an important factor in the equation of Indian society and culture. By performing valid and fruitful social functions for the community, they earn for themselves a certain status and position in society. He is the heir to the people's traditions and waves them into his craft. Most craft people have learned their skills from their fathers to mothers since caste and family affiliations, rather than training of market demand, have primacy in the Indian situation.

### **Legal measures**

Further legal measures, such as intellectual property protections and patent or copyright registrations, can help a community to benefit from its traditional motifs and crafts. Sometimes, legal measures intended for other purposes can encourage craft production; for example, a local ban on wasteful plastic bags can stimulate a market for handmade paper bags and containers woven from grass, allowing traditional craft

skills and knowledge to thrive. In some situations, legal measures may need to be taken to guarantee the access rights of communities to gather resources, while also ensuring environmental protection.

### **CONCLUSION**

In today's set of priorities, productivity and viability are mandatory components that are required to be built into any development programme. If an industrialized and developed nation like Britain, with its mere 32,000 crafts makers can surpass the earnings of its organized industries of motorcycle or sports goods manufacture, the sky can be the limit if India supports craft development. It only needs to partially match the impetus given in the early years of independence to the growth of large and medium industries. Our industrious and enterprising crafts people will do the rest.

# Market Concepts in Traditional Urban Planning - Calicut Port and Fort

**Dr. N M Nampoothiri**

*Dean, Academic Affairs, Centre for Heritage Studies, Hill Palace, Thripunithura, Kerala*

## INTRODUCTION

Urban Geography is a fastly developing branch of study. Location areas, extent and inter- action among the various urban functions are the core of the urban geographers concern. Some of its concepts and generalizations have been clearly formulated and a large number of hypotheses are stated as bases for further investigation of specific areas and circumstances.

This paper is only intended to bring the attention of all scholars about the potential of Inter disciplinary studies related to Evolution of Kerala Culture and is based on the PhD thesis of the author “A Study of place names in the Calicut District” (Nampoothiri , 1988). More details on the topic, tables, maps etc. are available in the chapter 5 (Calicut *nagaram*: Port and Fort) of the thesis.

During the 2nd Chera period “*nakaram*” was a trade corporate system “Nagaram”(sanskrt word) is an Urban centre . Urbanisation aspects including the formation of Calicut city and different stages of its evolution is pointed out here. Planning of the city under the prescription of *vasthu sashtra* is discussed in various papers by the author. See Malabar padanangngal-saamuuthirinaad, Pb: 2010, State institute of languages, Trivandrum.

Calicut starts figuring in the political history of Malabar with the advent of the Zamorins. Therefore the difficulties in the fortune of Calicut were closely inter-woven with those of Zamorins of Calicut. Traditional accounts as a version of Keralolpathi which eulogizes the Zamorins contains sporadic description of the prosperity of Calicut. These are shrouded in legends. Before the Zamorins, Calicut was under the PORLATIRIS of POLANADU according to traditions. In its heyday the glory of Calicut as a prosperous emporium of the Arabian Sea coast spread everywhere to the east and west and attracted the attention of medieval kingdoms from inside and outside India. Consequently royal agent’s private individuals, travelers, and merchants visited Calicut, thanks to the notes of these medieval travelers. We got a picture of Calicut which is highly fragmented and incomplete on many respects viewing from a modern point of view.

The study attempts to re-examine those medieval descriptions to supply hitherto unnoticed pieces of information and to make the picture as complete as possible with the old and new evidences. Such a reconstruction is not only desirable but also rather desideratum. *Firstly* it gives us a specific idea of medieval coastal city complex in Kerala with its structural lay out. This is hoped to throw much light on socio economic and other aspects of an exchange centre. *Secondly* it may help to formulate ideas about the diffusion of cultural patterns within medieval India societies. As far as the city pattern of Calicut is seen elsewhere and it follows the prescriptions contained in some medieval texts. *Thirdly* as we have already noted in the hinterland areas of the port, urbanization might have brought general Zones and central business Zone. Thus the functional structure of a medieval commercial centre, a port city of Kerala, can be reconstructed. It is important to note that it is in this centre, the Portuguese settled and established a warehouse, church, street and fort complex in the latter half of the 15<sup>th</sup> century A D. So such influences can also be noted in this analysis. Lastly the present reconstruction would supply a model for similar studies examining the pattern of settlements on coastal and in interior areas of Kerala particularly and other places in general.

It is to be noted here that the names of places mentioned in the records of the *Grandhavaris* and land records and paimashi records, down from the early part of the 15<sup>th</sup> Century A D. is almost unaltered during the passage of times. These names, noted from the medieval records are seen in the settlement records of British Officials without any change. It helps us to identify the actual plots and fields where the early institutions and roads existed

Apart from these sources we have referred some medieval silpa texts such as *Samarankana Sutradhara* and *yukti kalpataru* of Bhoja, and many vastusastra texts written in Malayalam. These texts provide us with a model for formulating a conceptual framework for our study. They also give us some idea about the medieval city planning in at least Deccan and South India. Some information related to the early capitals of Cheras and Cholas, available, can also be compared with the newly identified city pattern of Calicut.

Identification of places in the NAGARAM complex (Present Calicut City) is in the first part of this discussion followed by the analysis of the areas as a commercial complex and a port city. The medieval structure of the city as a capital of the Zamorins and identification of historical places and the underlying architectural principles are discussed in the second part, patterns closely inter-woven in the area. We have already pointed out certain urban tendencies observed in the hinterland areas of CALICUT and in the port, in the previous discussions of this work, Here, we try to get a structural pattern of a medieval Port city.

Based on the available studies on various urban areas of the world, a few observations regarding the structure of the port, commercial centre, distribution of streets, locations of trade exchange-centres etc .are also made here. Calicut, being under the influence of foreign commercial contacts and indigenous city planning principles, this analysis is inevitable to understand the complexity of the commercial and administrative.

## SPECIALIZATIONS AND HISTORICAL GEOGRAPHY

NAGARAM complex (identified group of villages with urban situations ) consists of village Nos.28, 29, 30, 31, 32, 35, 36, 37, 38, 39, 50 and 68 of NAGARAM Revenue area prescribed in the Revenue records of 1892 Survey and settlement .

### **Distribution and density of settlements of commercial and artisan communities, distribution of administrative centres and streets**

Frequency, density and distribution of commercial and artisan groups indicated by the toponyms in the NAGARAM complex show higher values compared to all other complexes in the taluk . The density of settlements of commercial groups is 3.4 and artisans is 2.1 The settlements of other trade communities like gujarathis, paTTanis, muslims, viragis etc and settlements of foreigners are also to be taken into account. All these groups, highly interested in trade and commerce are seen concentrated in the NAGARAM area.

*ceTTis* and *caaliyas* are seen spread throughout the area and there are numerous *caaliya* and *ceTTi* streets. They have their own street system and worship centres. A few bathing tanks are also seen named after these communities. The importance of these two communities is reflected in some historical records also. The traditional belief is that a *ceTTy* from the east coast started the trade at Calicut port. Mahuan, the Chinese traveler says:

*caaliyas* are weavers, probably migrated from outside Kerala. They have their own street and village system. The houses of *caaliyas* are closely situated on both sides of the street and a Ganapati temple at the end of it. Early records mentions a number of *caaliya* streets in and around the NAGARAM complex. Even now, most of them exist. One of the biggest *caaliya* settlements is kannanceeri in 38 PANNIYANKARA. The specific panniyam means a weaver's loom. The street is mentioned in all records of royal visits down from 1696 A.D

*caaliya* streets on the northern side of *maaNaNciRa* and in the premises of varakkal temple are mentioned in the records dated 1762 A.D. There were two *caaliya* streets on the North West and north of *maaNaNciRa*. On the eastern side and the northern side of the varakkal temple, there were two streets, which are mentioned in records dated 1731 and 1783 A.D. .The streets on the *maaNaNciRa* area was close to another street by name *maNavikRamanteru* Another street by name *puttaNteru* was also near these *caaliya* streets. *kacceriteru* and *konnenattu teru* were also *caaliya* streets, since they are called *koonnenaTTu caaliyatteru* in the records of royal visit.

*puttaNteru* is on the northwestern part of the *maaNaNciRa*. There are a few field names around this street indicative of a paLLi and settlement of aaryaNs. These fields are the villages KALATHINKUNNU (37) and KARIYAKUNNU (36). *kammaNa*, *kinaacceeri*, *ceNamkanTi*, *cakkikuLannara*, *paLLippaaTom*, *ayyappaN kanTi*, *puttilampaRampu*, *manTapam*, *taLiyaar*, *caakkaRkuNi*, *aaryaNvaLappu*, *cuTukaaTu*, *palampalLi* and *vayyampalam* are the field names seen as a cluster .They are all on the north west of the fort area, the kulabhavana of the king. According to Vastusastra, north and North West of the Rajadhani is to be allotted for residences of recluses. From these circumstances, it seems to be possible that the area was occupied by the Jainas or Buddhists. *puttaN* is a Dravidianised form of Buddha.



There are two streets by name kalavaanibhatteeru. One of them is on the North West part of the fort area. Near the north eastern bazaar and the other is on the south west of the fort area. On the coast, near the *kaTal cumkam* or customs office. *kalam* means ocean vessel and hence the names may be indicative of streets where foreign goods were sold.

*teennaakkuTu teruvu*, *kanchavainTe teruvu* (opium street), *cakkaravaanibhateruvu* (Jaggery street) *vaalakka vaanibha tteru* and Fruit street are seen mentioned in the early records. *teennakkuTu teruvu* or street where coconuts warehouses existed is identified with the help of municipal map of 1946. This area is on the northern side of *maanaNciRa* near the *kacceri caaliya* streets. But at present a copra bazaar is seen situated at the centre of the city. Banana Street and fruit streets remain unidentified. *puuvanibhatteeru* (flower street) extends from the big bazaar or *valiyannaaTi* to the south. There are three parallel streets in this name. This street is parallel to the yama sutra of the Rajadhani and directly connects *valiyannaaTi* or the central zone of the port city to Rajadhani.

#### **CHINESE STREET AND OTHER STREETS OF FOREIGN SETTLERS AT CALICUT**

There are three parallel streets towards the north from the valiannaaTi bazaar, by name *ciiNatteru*. These streets are known as *paTTuteru*, *paTTusaalatteru* and silk street. The street is indicative of the trade relations with china. Early historical records and foreign notices pointed out these relations. Chinese knowledge of Calicut during 14<sup>th</sup> and 15<sup>th</sup> century A.D. gives ample evidences to these trade relations.

It is to be noted that Foreign travelers who visited the NAGARAM area and the port mention the presence of Chinese ships harboured near the port. Mahuan in his travelogue says:

There are some fields, north of *Nakaram annaati*, named as *paRankippally*, *paRankikooTTa*, *paRankikaLku koTutta nilam* and *paRanki smasaanam*. This cluster of names indicative of a fort, church, field and burial ground is to be assumed as the early Portuguese settlement in the coast. The situation of the market and its facilities are of important here. There were canals entering the *Nagaram* area to enable the transfer of goods to the market out of it. The *panTaarakkaTavu*, or the ferry of the royal family, which was the real port area, is seen located close to the *Nagaram* market. The residence of the *vancikanakkapiLLa* or Port Accountant and the office of the customs or *kaTal cumkam* are near this ferry. There are arrangements to load and unload goods from the boat. All these show that the Portuguese Fort on the bank of a river here indicate the Fort on the side of the canals close to the market place, *Nagaram* or port. In Kerala palama, Gundert describes a canal in between the pillars of the fort. The area by which we identify the fort is also indicative of the entrance of some canals to the fort area. On the northern side of the fort, a little interior *vaLappilkaTavu* with a canal from the sea is situated. Thus the Portuguese fort and the Portuguese settlement were in the present fields with field names indicative of the fort field Nos: 18 to 20 have to be assumed as the Portuguese settlement.

### Factors attracted the Foreign trade

Calicut had its natural facilities as a harbour and resources which supports trade and commerce. The political factor was the political stability and security of the harbour achieved during the advent of Zamorins in 15<sup>th</sup> century A.D. William Logan remarks: "This corroborates in a very remarkable way the tradition preserved in keralolpathi that it was owing to the security of trade which merchants found at Calicut that they were induced to settle there."

### DISTRIBUTION OF RESTING PLACES AND WAREHOUSES

Centres of *tanniiR pantal*, *satRam*, *kannippura*, *valiampalam* and *Brahmacaari madom* are to be noted here. These centres denote resting places where people from hinterland areas concentrate to reside for short periods. These places intended for the traders and travelers in general as well as for specified groups. The *inns* viz. *vairagi satRam*, *Brahmacaari madom*, *Gujaratti satRam* and *DharmasatRam* are of this kind. A palace with an inn viz. *satRamulla koovilakam* is located on the northern part of the complex. A resting resort or *valiyampalam*, is seen on the northern side of *maNanciRa*. In the port area a watershed or *tanniiRpantal* is located. Another water shed is on the southern side of the complex in 39-PANNIYANKARA. Inside the Fort area an *agrasaala* and a *kannippura* are seen.

*panTikasaalas* or warehouses and *cumkam* houses or Toll centres are spread in the Complex to facilitate trade. There are a number of warehouses and toll centres in the PUTHIYANGADI, VALAYANADU and KATALUNDI complexes which are around the NAGARAM complex.

### TOLLS AND TAX COLLECTION CENTRES

In the NAGARAM complex are also important. There are two major tol. Toll houses known as *palaya cumkam* and *kaTal cumkam*. The former is near the *valappikaTavu* where the foreigners had their residences and latter is on the southern side of the *valiyannaaTi*, near the warehouse street, close to the *panTaarakkaTavu*.

*taraku* is a term suggesting a type of brokerage or customary deduction. In trade centres, *taRakaN* means warehouse keeper. On the southern side of the NAGARAM complex near Kallai River, a *VaRRilattaRaku paRampu* is seen. It is significant because *Betal* leaves were exported from the Calicut port in early times. Another *taraku paRampu* is also noted in the complex.

There are three centres where the presence of port accountants had their offices or residences. *vancikanakkapiLLayuTe taamasa sthalam* in *paTTanikkaTavu*. and *panTaarakkaTavu*, and near the Portuguese settlement indicate that the port accountant collected tolls from the port. The specifics of the names point out that they are attached to the office where the cargoes by boats were accounted and tolls were collected.

### WHARFS AND FERRIES AROUND THE CALICUT PORT

Wharfs and ferries around the Calicut port also deserves mention here. One of the major centres of loading and unloading cargoes from ocean Vessels was *panTaarakkaTavu*, west of the *valiyannaaTi* bazaar. Facilities for such loading and

unloading are called paataaRs.. paataaram or paataaR means a pier. They are on the western part of the muutaakkara mosque. The place is very safe for ocean vessels and it is reflected in the names muutaakkara. It means a coast with surge, arising of waves smaller than tira (a wave billow) and larger than ooLam (a wave or surf) muuta or mootaa here indicate the nature of the sea. The pier and the port.

Landing places of cart and other conveyances by land are also seen distributed around the valiyanNaTi bazaar. Landing places are marked in the municipal map of 1946 in places near paTTani kaTavu, putiyapaalam kaTavu, putiyaRa, erannippalam and karapaRampa. vanTipettas are also seen mentioned.

### **BIG BAZAAR (VALIYANGAADI)**

Big bazaar or *valiyanNaTi* is the central port. The actual centre of big bazaar is at the point where the *paTTusaalattu* and *puuvaanibhatthu* respectively from north and south meet the *panTaarakkaTavu* area on the coast. The bazaar starts from the seacoast and extends towards east up to the southeastern corner of the early fortress.

### **REFLECTION OF THE STRUCTURAL PATTERN OF THE CITY, MARKET AND PORT AREA**

From the details given above, we can assume the commercial activities of the port town in the early times. There are a number of streets with specific indications of different commercial groups and commercial commodities. separate streets or localities were seen given to different group of traders and other settlers. There are warehouses indicative of different commodities and different ownership. The toll system also reflects the differentiation of commodities. From this general view itself, we can observe some kind of structural pattern in this commercial and trade centre. yet another centre, the noble part of the city mentioned by *Della Vella* was also there on the eastern part of the complex where administrative offices and the palace complex were situated.

The streets ware house centres, ferries or wharfs toll centres etc. discussed here are to be taken as the modal points or focal points of the structure of the city because commercial and trade activities at these points are comparatively high.

### **DISTRIBUTION PATTERN OF ADMINISTRATION UNITS AND THEIR FUNCTIONAL IMPORTANCE**

#### **Palace complex at the Kozhikkode Headquarters**

Zamorins had his old palace on the southern bank of *maaNaNciRa* inside a fortification. *ampaaTi koovilakam*, *paTinnaaRe koovilakam*, *kilakke koovilakam*, *putiya koovilakam*, *caalappuRattu koovilakam* and *eeRampiri koovilakam* were stood on the east and southeast part of the fortification. Thus all these palaces formed a residential complex of the Royal family. K.V. Krishna Iyyer remarks that as the family increased and the power of the Zamorins expanded, new palaces are constructed. First the built the *kizhekke koovilakam* Palaces at *mankaavu*, *tiruvannuR* and *kooTTakkal* might have constructed for this reason and they are far away from the Headquarters.

In the Rajadhani or Capital city at the centre the *kulabhavana* or ancestral house stood. It is encircled by *kalam*, *kalari* and fortification. Outside the fort there existed streets planned on the lines of Trade facilities.

### ***kovilakams* (Palaces) in the Complex**

First reference of the *kilakke koovilakam* in the palace records is dated A.D. 1849. It was located on the eastern side of the taLi tank and Zamorins major palace. Thus its name *kilakke koovilakam* or Eastern palace. It might have been constructed before A.D. 1761 because the name western palace is recorded in A.D. 1761. Even though the palace before that date. Thus, chronologically, the first palace was on the southern side of maNaaNciRa, then built the Eastern palace, then the *tekke koovilakam* and finally the *putiya koovilakam*.

Earliest reference of *ampaaTi koovilakam* is seen in the palace records dated 1666 A.D. It stood on the northern side of taLi temple. *AmpaaTi koovilakam* was not named as *vaTakke* (Northern) *koovilakam*. The palace locations in the rajadhani form a continuous settlement of the fortress area, towards the southeastern direction in the form of a complex and this situation is of great significance in the structural form of the Rajadhani according to Vastusastra.

### ***KaLari* and *kooTTa*: The protective measures**

The protective measures reflected in names and the distribution of them in the complex give a pattern in accordance with vastusastra and they are constructed functionally in strategic points. These clusters point out that *kaLam*, *kaLari*, and *kooTTa* co-existed in certain strategic points that they are distributed based on some medieval pattern. Distribution is such that they protect the Rajadhani in general and entrances of trade routes, location of granaries, toll centres, wharfs, ferries etc in particular. The centres of foreign settlements are particularly looked after by the ruler. The arrangements inside and close to the fortress are in the ownership of *mannaTTachan* and tamme panicker, who were the kings high officials.

### **Worshipping centres**

The temples and worshipping centres also deserve attention here. The need of different kinds of worshipping centres increases when different religions co exist. There are Hindus, muslims, christians, and different caste like *ceTTis*, *caaliyas*, *vairagis*, Brahmins etc. Most of them possess their own centres of worship and burial grounds. The worshipping centres reflect different kinds of deities also.

### **SECTOR WISE DISTRIBUTION OF DIFFERENT SETTLEMENTS - COMMERCIAL CENTRAL ZONE OF NAGARAM**

There are large number of settlements of commercial communities, artisans, foreign traders and migratory people from the main land in the complex. Each group shows their own settlement areas, with facilities needed for them. *caaliyaas*, *ceTTis*, *Gujarathis* and the like had separate streets, worshipping centres *choultrys* etc. These form a set of sector wise distribution. Local feudatories had their trade centres in the area. Aali Raja of Cannanore, Raja of *veTTattu* and *kavaLappaara Nayar* owned centres in the complex. *Aali* Raja and *veTTattu* Raja had warehouse centres

as indicated by *aali RajayuTe paanTika saaLa* and *veTTattu vaka paanTika saala* respectively. Traders from the main land owned private ware houses as reflected in the names of *cochiyil DhanikanTe paanTikasaala* (ware house belonged to Dhanika of cochin), *covvakkaaranTe paanTikasaala* (ware house belonged to a person from covva, near kannanore) and the like. Muslims and Arabis had their settlement zones specifically allotted for them on the port area. Foreigners had their warehouses, churches, streets and fortifications in the port area. Both these groups owned wharfs also. *paRanki paanTikasaala*, *inKirisu paanTikasaala*, *saamantara Koya kaTavu*, *Kappittaan kuLam*, temple *saayvinTe taamasa sthalam* etc. reflect the situation. All these are spread on the north and south of the *panTaara kkaTavu* and big bazaar. Exchange commodities are stored in warehouses of different structural patterns and exchanges took place in separate streets of each commodity. The situation is reflected in the names like *ciinNatteru*, *paTTuteru*, *puuvaaNibhatteru* etc.. All these factors related to the trade and commerce and the settlement sectors revolve round the Big bazaar, *tuRa* and *panTaarakkaTavu* area, in a well defined pattern. Thus it becomes the commercial CENTRAL ZONE of NAGARAM complex.

Hindus, the major portion of the settlers and the rulers of the territory had their settlements with all protective measures on the eastern part of the port city which was referred to by the visitors as the noble part. As the rulers, they possessed fortifications, palaces and large temples which are reflected in names like *kooTTappaRampukal*, *taLi sivaksteRam*, *tRivikRamapurattu tevaR*, and temples for Bhagavati and Ganapati. Their settlements are reflected in names with more details like *eLamkuuR paRampu*, *onnaamkuuR paRampu*, *ampaaTi koovilakam*, *palaya koovilakam*, *putiya koovilakam*, *kilakke koovilakam*, and *saamuutiri koovilakam*. All these settlements are in the central part of the Nagaram, away from the centres of commercial activities. The lands where these settlements are located show that the area was *cemmannaaTu* and *tooppukal* or land with red and fertile soil. Not a single palace is located in the commercially active centres near the Coast River or wharfs. But, these Royal settlers had their administrative locations in the commercially active centres to maintain law and order, to collect tolls and taxes, to protect the land from invasions etc. ownership of lands of the port and wharfs and ferries are vested in the Royal family of Zamorins, his family members or high officials in his administrative machinery. The name *panTaarakkaTavu* itself reflect the ownership of the Royal family. The land of *kannaNkaTavu* and *vaLappil kaTavu* belonged to *kilakke koovilakam*. The *muLamkaTavu* and *paTTanikkaTavu* belonged to *Dharmottu panicker* and *marakkaam kaTavu* to the *sahabantra koya*.

The settlement of high officials in the Royal administrative system also in the Fort area as reflected in names like *mannaaTTupaRampu* (residence of *mannattaccan*) *saRvaadikaaryakkaR paRampu* (Residence of *saRvaadi kaaryakkaR*).

Even though artisan communities are there, their settlements do not coincide with the sector wise distribution discussed here. *taTTaacceeri*, *aasaarikanTi* etc. are isolated settlements: But the distribution is based on caste wise allocations or based on other kind of functional peculiarities. It is significant that lower castes like *paRayas*, *pulayas* and the like had no settlement areas in the complex.

The resting places are distributed the centres which are of maximum utility to the incomers and residential population. Toll houses and landing places are also distributed in convenient places for checking the exchanges and of maximum conveyance facilities by roads and waterways. It is seen that all such areas are invariably protected by the king's administrative machinery to keep law and order and to protect the city from invasions.

The presence of protective measures and administrative units for collecting taxes etc. in the foreign settlements and in other parts in a widely distributed nature indicate that the king had the supreme control over the area. The administrative elements are the centers of specialized activities which control the whole area under law and order. They dictate the areas of settlements, provide streets, bazaars, ware houses, collect taxes and tolls, and protect the area from invasions. The supply of produces, raw materials, collection of produces and commodities from the hinterland areas are all to be done by the administrative system. This inevitably brings the need of a stable Government too.

The distribution of field names suggestive of palace, fortress area and other locations related to central administration reveals a well-defined administrative unit existed on the eastern half of the complex, with the fortress area as the central zone. A well-planned fort, residential zones for members of Royal family, distribution of religious centers and temples etc. on the eastern half clearly reflect this situation.

The specialisations of NAGARAM complex reveals a nature of highly urbanized settlement, which is not reflected in the centres in the hinterland area. The commercial central zone and administrative central zones are clearly defined and specially separated and their nits are spread out based on utilitarian aspect, considering the principles of vastusastra and urbanisation. The specializations of the area are larger in size, wider in activities.

### **Co-existence of two central zones**

There are two central zones in the NAGARAM complex:

- 1 The administrative central zone at the centre of the complex
- 2 commercial central zone on the coast.

They are spatially separated by 1 kilometer and connected by a straight and wide high way by name big bazaar. All the activities of administration are done at the administrative central zone, with fortress and kings palace as the nucleus.

The commercial central zone has two components. One of them is the structural component of the Administrative Central Zone, with Port, Bazaar, Fort and other units. Nuclear of this Commercial Central Zone in total is the *panTaarakkaTavu* or Port belonged to the king. A second component is the Foreign Zone situated a little north of the *tuRa*. This zone extends from the *tuRa* area where the Chinese streets and *ciiNakkooTTa* were situated, to the French Lodge area in ValiyakaTavu or *VaLappilkaTavu*. Thus the Zone may be identified with a Nucleus in *VaLappilkaTavu*, where the *kaTal* cumkam or customs centre is situated. The foreign nucleus is of much importance in the rise and fall of Calicut.

The units of the administrative central zone and commercial central zone are distributed such that all the activities are closely interwoven. During the 15<sup>th</sup> and 16<sup>th</sup> centuries, the administrative central zone had predominance in all activities. But later, the foreign nucleus grew larger, ultimately destroying the indigenous administrative central zone.

### **Evolution of the multiple nuclei**

Physical and functional structures of Calicut Port and Capital are related to the long distance trade with maritime traders and the advent of Zamorins to Calicut. Both reflect a common feature viz. the Centripetal force of the port area. The Portuguese and other *traders came and settled from Foreign countries. The Zamorins family migrated to Calicut* port from Nediyruppu, a village in the ERNAD taluk .This was the way of evolution of multiple nuclei.

### **Establishment of new capital**

The establishment of the city of Calicut, by Zamorins is also a traditional belief. Thus, it was the beginning of a stable administration and establishment of a capital at Calicut. This took place almost at the end of this 11<sup>th</sup> century A.D.(*taRa* is the basic land revenue unit *kaavuthattakam* is based on *taRas* In *keralolpathi* all naatus are measured on the basis of *Tarahs*.It seems that there were two types of *tarahs* 1.*tattakams*: they are settlements of KuTikal.They are counted as taras and the groups make a tattakam2the second one is *tarah* of Nair/Lokar groups Army .distributed or centralized - see *lokanar kaavu thattakam*)

The details of establishment of a new capital and administrative system by the Zamorins are discussed in the structural and functional analysis of the Rajadhani pattern existed in Calicut

### **Stable Government and use of a port**

Permanent settlement created a sense of stability in humankind. This marked the real evolution of history, which is a flow created through organized institutional framework. Among the different social organisms Government sthanas at the top of a Pyramidal structure. The centres of world civilization and cultures come up and gone with the development and disappearance of strong institutional systems where strong and wise Governments existed Golden ages of any society is marked along with the regime of strong benevolent administration. Periclean age in Greece, Darius in Persia, Guptas in India, Pharaohs in Egypt, Julius Caesar in Rome and such others are notable examples. Even though prosperity and growth of cultural, commercial and economic elements comes through professionals and experts, it is not possible without a strong machinery of administration. Simon Kuznets remarks:-

“The heart of the matter is that political power of the sovereign state is almost indispensable. It is used to mobilise energies within a country for the purpose of economic growth despite the risks and burdens, or to extend the sway of sovereignty into other areas in either case it helps spread the new system of economic production as it did in earlier eras. The dominant power organization of society must be involved in the extension of any new methods of economic production particularly if they

necessitate rapid and thorough going transformations such as those associated with the modern industrial system.”

While discussing the role of Government in the development of backward countries, W. Arthur Lewis states:

“In the first place, planning requires a strong, competent and incorrupt administration. It must be strong enough to be able to enforce its measures, such as to collect taxes from the peasantry, or to enforce a rationing system without black markets, measure which even so ancient a government as that of France has not found itself fully able to enforce. It must have a competent administrative service, with trained personnel, able to understand the large issues that are at state, and to act reasonably and rapidly. And it must be free of all charge of corruption since whereas men will bear many restrictions from a Government which they believe to be acting fairly and solely in the public interest (however mistakenly) without respect of persons they will sooner or later resist violently measures which are corruptly administered, however acceptable the measures themselves may be”.

Numerous examples can be cited to point out the abovementioned opinions. The importance of Indraprastha in early days and New Delhi at present is centred on stable Governments. Ujjain flourished under Guptas; Madura under Pandyas, Pataliputra under Mouryas and others, Mahodayapuram and Cranganore under Cheras. Most of the backward countries today are seen in Afro Asian, Latin American continents, once they had been under foreign rule for decades. It implies that the resultant backwardness has emanated from the absence of strong and stable Governments. France had better resource potential than England but industrial revolution took place in U.K. owing to the presence of a powerful Government for a long period. Political stability in the post war Japan is another example. These are ever blossoming examples to show commercial and economic prosperity when a stable Government provides sufficient opportunity and environment for the same. Venice flourished under Roman empire. Hongkong and Singapore flourished fast more than any other city in China or Malasia because these cities enjoy more freedom along with political stability. It connotes that stability with freedom is the atmosphere for growth and prosperity. We have to give due importance to the traditional belief that maNavikRama established the Commercial Capital at CALICUT.

### **CLASSIFICATION AND FUNCTIONS OF CALICUT PORT**

The cities are classified as functional units under the heads of manufacturing, retailing, diversified etc. by modern urban geographers<sup>188</sup> Calicut port mainly reflect commercial exchange and transportation functions Even though there manufacturing centers of salt, oil, clothes and iron they were not highly specialized, and methods of production were indigenous. Such centres had died out and at present no such functional categories like producers of Salt, Iron etc. are seen in the Port area. Even in early times, bulk of the items shipped from Calicut port were of natural productions, mainly agricultural produces, forest produces and products of natural resources.<sup>191</sup> These commodities were brought to the port by land routes and waterways. There were large number of warehouses and other storage facilities spread all over the coastal belt. Ocean vessel commodities imported also had storages. Thus, major function of the Calicut port was transportation and it was mainly are-export centre.



## ASPECTS OF HUMAN SETTLEMENTS.

Characteristics of urban settlements, their size, functions, spacing, layout and build vary regionally according to the physical environment, with the density of population and with the character of human economics and cultures which they serve and represent. It may vary in the different areas of the same stretch of lands and vast differences can be observed in areas located in different countries. Their scientific examination and elucidation of their regional variations both over wide areas and within the urban complex itself are essential problems of urban geography. Both the study of individual settlements and comparative study of different settlements come under the urban geography, in the wider perspective. Geographical study of human settlements has three aspects.

1. Physical structure of the settlement. The character and the mode of groupings of its buildings and streets.
2. The process which determines this structure-i.e. the social and economic character and the traditions of the community.
3. The stage in the historical development of the settlement.

The site and situation of the settlement and their characteristics are to be noted at first. The developments of town in early middle ages (Before 1200 A.D.) was favoured valleys and low land sites at the junction of valley routes because facilities for trade and for the organisation of the populated area and contacts with the civilised world were primary factors in their location and growth<sup>197</sup> In the later middle ages the great majority of towns grew as local centres of trade and administration and has only local "nodality". Their sites were dictated by need of defence rather than trade and either castle or town or both were placed on strongly defended natural sites as hill tops and river spurs<sup>198</sup> The term 'nodality' is used by Geographers to express the significance of a settlement as a node or focus of routes. But urban geographers are of view that nodality should be measured on the basis of the functions of the settlement as a focus<sup>199</sup>. We need a measure of the nodal functions in terms of the relations of the settlement with the country and with the other settlements around it. Here in the case of Calicut, as we have observed, the town reflects great local nodality. But in this study, the relation of Calicut with other settlements around it of the same nature is not analyzed. It is a fact that whatever be the origin of these small trade centres, Their growth before the modern era was depended entirely on their ability to function for a tributary area in competition with neighboring towns of similar status. We have noted three characters in the case of Calicut It had long distance trade, as reflected in field names which is corroborated by historical evidences. This was the primary factor in the development of the early medieval towns. It called into being many mercantile settlements on the main routes, the chief of these settlements clustered for protection and custom around existing strong holds that already served as seats of defence and administration for their surrounding territories.

Apart from the relation of long distance trade, the growth of handicrafts and local trade caused these settlements to develop closer associations with their surroundings. The important factor in the development of Calicut is seen reflected in the structure and distribution of the groups discussed. They are around the NAGARAM complex and

these are handicraft production centres in the city. The land routes and waterways from all the surrounding hinterland areas are all directed to this Port city. We observe even hexagonal pattern of trade centres extended to the complexes.

We notice a pressure of Foreign traders in Calicut only by the end of 14<sup>th</sup> century. There can be two reasons for it apart from the Geographical instability in the coast. The first and foremost of them is the instability of the political situations existed in the region<sup>201</sup> Porlatiri was only a petty chieftain according to the traditional history and the Zamorins defeated them and conquered his capital town. Secondly the moors settled in the Calicut Area were not in friendly with the other foreigners. Even though they had constituted much in the development of trade in Calicut, and helped much the growth of Zamorins reign, the later foreigners encountered considerable opposition from them But Portuguese succeeded in thwarting the endeavors of new arrivals to gain over the Zamorins to their side There was always a fierce struggle between Portuguese and the moors for ascendancy in Malabar trade and this reflects a tendency of the western mercantile guild system.

#### **CALICUT: CASTLE AND FORTRESS-NUCLEUS**

The route and the market place formed the nucleus of the early medieval towns which usually given up adjacent to a stronghold. It is pointed out that majority of towns grew gradually around a castle, a church or a monastery in the west of Rhine and in Germany they are founded near an existing stronghold.<sup>206</sup> .The origin of Calicut is also connected with the presence of the native rulers and their places at the port area as reflected in the traditional history. The story of *Ceraman Perumal*, his deeds and the origin of Zamorins are all elaborately discussed by historians based on *Keralolpathi*, the tradition history of Kerala.

It is significant that everything described revolve round the establishment of a new trade centre and capital at Calicut. According to the *Keralolpathi* the Zamorins came down to Panniyankara, and besieged the Porlatiri in his own capital. It is clear from the description that the area was *kolikkode Nagaram*. Zamorins with his army came near Perumpilakkil, where the Ganapati temple stood, and the fields were near the gateway of the fortress. The situation is clearly reflected even now in place names. *Gunapatitara* near the western gate of the early fortress and perumpilakkil on the south west of the fortress are still there. The *ganapathithara* reflect the position of the mint at Calicut. So as in the same of the origin of urban towns elsewhere, the origin of the city of Calicut was also related to a Capital and Fort. But, the prosperity of the city was due to the arrival of Zamorins and their administration. By that; it became the capital of an expanding Empire. It commanded the waterway that gave access to the pepper country.

#### **CENTRAL ZONE AND DISTRIBUTION FOCAL POINTS.**

The geographical situations of the site selected have been discussed in the earlier chapters. The city is situated on an upper table land, with river mouths on south and north and a river course on the east and the area is well protected by a cliff surrounding south, southeast and North. By this natural situation, the western side of the coast, the sea is calm and safe for the ocean vessels also Situation of the sea is

pointed out by Logan. Two gap formations in the cliff area on south east and North East, allows two trade routes to enter the city which connect the complex to the hinter lands or productive area. The highways from south and north also of the contact to hinterlands. Thus the land routes and river courses are all helpful as the important transportation Links. The area around the complex is highly productive for commercial crops too

Some aspects of the structural framework of “Central Zone System” of a city pointed out by the urban geographers are to be mentioned here. Cities are actually concentration points of specialized activities which serves the city as well as the hinterland. Many functions remain or gravitate in the Central Zone of the urban area because in that zone they can be carried on more conveniently than elsewhere. The central zone is the focal point not only for the main thoroughfares in the urban pattern but for all systems of rapid transit. The second functional convenience is the regional convenience. Thirdly the inter regional conveniences

The concentration of one function in a central zone operates as a powerful magnet attracting other functions. Thus the streets or points with storage facilities of large commodities of each items reflected in names are to be taken as focal points selected in promoting trade exchanges Convenience is an important consideration be it for customers, administrators or for employees. Business of like nature is found grouped for purposes of facilitating inter firm communications or transactions. The advantage of a location near competitors varies with the scope of the market and the nature of the commodity. In general proximity of dealers in the same line is desirable where the market is to be served regional or national, where shopping comparison and selection are important steps in buying process and where the function of price establishment is performed by a cluster of wholesalers. Thus we can observe the focal points with storage centres on the banks of rivers based on these disciplines.

Points of commercial activities are distributed in Calicut port in such a way that they help the traders to load and unload their commodities in the most convenient and less expensive manner. The landing places, wharfs and ferries form the important factor of the major focal points. These storage facilities like *paanTikasaalas* and *uppukuuTams* are close to such centres. Tollhouses and resting places are also distributed in such points. Thus these three units in co- existence form a type of focal point. The silk street and the like where same kinds of commodities are sold and places of commercial productions are also to be taken as types of focal points. A third type can be assumed in centers like *kizhekke bazaar*, *vaTakke bazaar* (Eastern and northern bazaars) and markets like *aalcavaTom*, *miiNcaappa* (fish curing yard) etc. All these can be termed under the general head “Focal points of the central zone”. A general review of such centres is given here.

There are five wharfs viz. *vaLappil kaTavu*, *ValiyakaTavu*, *kannan kaTavu*, *panTaarakkaTavu* and *marakkaam kaTavu* in the Complex. *VaLappil kaTavu* and *valiya kaTavu* are in a region set apart for the foreign settlers. *panTaarakkaTavu* is the wharf area under the direct control of the ruler of the land. The *maarakkam kaTavu* is situated in a place where the Muslim settlements are of high density and owned by *sahabantaR koya*. On the southern side, there are four wharfs namely *muLamkaTavu*, *panTaarakkaTavu*, *paTTaani kkaTavu* and *kuuLimaTukaTavu*. Here

also, a wharf belongs to the ruler of the land. On the eastern side along the banks of *ceRupula*, there are two wharfs by name *KallukuttikkaTavu* and *Putiyapalam kaTavu*.

The differentiation of them is also a notable character. *VaLappil kaTavu* indicate some kind of walls built around it and land transaction records indicate them. This may be because of the custom restrictions for the foreign goods arrived by ocean vessels. *panTaarakkaTavu* belonged to the king and it was under the direct control of the king. *marakkamkaTavu* has another name *saamantara koya kaTavu*, where the *kolikkoTTu koya* had some special control. *paTTanikkaTavu* indicate some kind of importance to the *paTTanis* in the wharf.

Later records attest many landing places and cart stands around the city area. Near *paTTanikkaTavu*, *kallukuttikaTavu* and *putiyapalam kaTavu* there were landing places. Other landing places were *maankaavu* in the *VaLayanaaTu* complex, *mooriyaaTu* near *kallukutti kkaTavu*, *putiyara* near *Putiyapaalam*, *eranjippaalam* and *karaparampa* on the north east of the city, and *Nadakkavu* on the north of the city. All these are along the side of the roads which enter the city. The cart stand by name *vanTippettah* near *Nadakkaavu*, *mooriyadu* and *paTTanikkaTavu* are also important. Thus, wharfs, ferries, cart stands and landing places are distributed around the port town in accordance with the transportation facilities by road, river or by ocean.

The commodities brought to the port were safely stored in warehouses which are indicated by names *uppukkuToms* and *paanTikasaalas*. These storages are also distributed in the city in convenient places. There is no manufacturing belt in the city complex: There are only trade exchange centres, loading, and unloading places. A trade centre needs easy conveyance of goods to the warehouses and to the retail places. The wholesale places and storages should be in such a way that it should help the rapid retailing and frequent deliveries should be done in such areas. Frequent shipments of materials also become essential. Therefore such warehouses are to be situated near the loading and unloading places called landing places, wharfs and ferries. This situation is clearly reflected in the distribution of storages in the Calicut city.

The major part of the *paanTikasaalas* is on the coast, near the *valiyakaTavu*, *panTaarakkaTavu* and *marakkaam kaTavu*. There are clusters of *paanTikasaalas* and *uppukuuToms*. *paanTikasaalas* are situated on the eastern side of the city near *putiyapalam kaTavu*, and on the bank of *cherupula*. All these are conveniently placed to help the loading and unloading and transfer of goods. The storage of salt or *uppukuuToms* are also distributed in the same manner. The field names reflect more than thirteen other ware houses, but the locations of them are unidentified

There are clear indications of zones of different commodities and grouping of business of like nature *uppukuuTom*, *pukalappanTikasaala*, *tennaakkuuTuteru*, *poNvaanibhatтеру*, *cakkara vaanibha tteru*, *ceTTitteru*, *caaliyatteru*, *paTTutteru*, *puuvaanibhatтеру*, *Verrilattaraku paRampu*, *kancaavinTe teru* and *kalavaanibhatтеру* are centres of like business, grouped. Salt, tobaacco, coconut, gold, jaggery, clothes, silk, opium, betel-leaf, commodities brought by ocean vessels and flowers etc. are reflected in the specifics of the field names. Apart from the already mentioned focal points storage centres and wharfs most of these centres of commodities of the same

nature are also focal centres. These focal centres are the retail centres of different commodities too.

Specifics of the names of warehouses suggest the ownership of them. *paRanki*, *imkirissu*, *suuryan cantu*, *Lakshmidasan*, *covvakkaran*, *kochiyil Dhanikan*, *veTTattu*, *aali Raja* and the like are important indications. The different structural peculiarities like *naalukeTTu*, *aRa* etc. are also indicated in the case of warehouses. *kuuTam*, *kuuTaaram*, *kaLam*, *pattaayara* are also storage centres of different commodities with different facilities. All these point out how the ruler made the improvement of trade and commerce in the port.

The Rest houses, watersheds and such other facilities intended for separate group of people and travellers are also seen situated mostly in the focal points. *saTramuLLa koovilakam* near the caaliya streets, *kannippura* and *agrasaala* in the palace complex near the western and northern bazaars, *tanniir pantal* in the foreigners zone, *vairagi satRam* on the side of big bazaar thorough fare, *Gujaraatti DharmasatRam* near Gujaraatti street, *Vayyampalam* near the northern *caaliya* street etc. are to be noted here *manTupams*, *uuTTupuras* and *madoms* are also to be included in this category. A few of them are not directly related to the trade and commerce. But they suggest the assemblage of people of different groups in the city area, where the pressure of the floating population is much. Functionally, lunch rooms, rest houses and food service centres locate conveniently at points where the economic groups whom they serve, located and hence functionally they are a kind of service centres. Such sites are normally based on analysis of pedestrian traffic and neighbouring occupants to provide an estimate of potential customers in modern times.

### **PRINCIPLES OF URBAN GEOGRAPHY**

The international structure of a city is closely related to the pattern of settlements. There are central business centres, the zones in the transition, the zone of the workers' houses, zone of better residences etc. Residential land use accounts for the major areas of all cities and there is a strong tendency for residential structures of similar type found in groupings. Such tendencies is dictated by the nature of function namely commercial or non-commercial. The commercial people and traders normally try to reside in the areas where such activities can be done easily and profitably. People related to administration usually select their residences in such zones. Foreign-born people in urban centres particularly, where they constitute sufficient numbers to be recognised as distinct social groups, have tended to clustering immigrant neighbourhoods. The local ruler according to their city planning may allot separate areas for them. Immigrants tend to segregate in areas populated by persons of the similar back ground of culture and economic status; birds of same feather flocks together. The residential zones of people who are not involved in commerce and trade usually select areas in the high land, will drained and away from nuisances such as noise, odors, smoke and traffic lines. Social inter action in the distribution of time and space is a major factor in settlements. Interaction by process of competition and selection of the physical and social mobility of persons. In consequence the city tends to become a sort of cultural and racial islands. These tendencies are clearly reflected in the structural and functional distribution of residential areas in the Calicut port.

### VASTUSASTRA BASIS OF CITY PLANNING OF CALICUT - PRIMARY NOTE

The Port city has adopted some kind of medieval city lying pattern existed in India. The pattern follows certain rules in the allotment of separate zones for functional, cultural and social groups. The geometric division of the town into four sectors is the first principle, southeast, southwest, and northeast and North West where the Reference Point is the location of the ruler's residence and fortification. One of the medieval texts gives the disposition of the residences of different classes and professional groups within a city as follows.

On the southeast are to be jewelers, blacksmiths and other artisans of this class. *taTTacceeri* - 42 is a name indicative of the residence of goldsmiths. *ceeri* is the separate zone allotted for a group of them. This location is the south east of the fortress and situated at the centre of the town. *AsaarikkanTi*-74 is the residence of the carpenter, which is also on the southeast part. The merchants, those given to gambling and dancers should stay on the south. The presence of *paTTanikkaTavu*, port accountants office namely *vanchikanakkappiLLa* and *verrilattaraku paRampu* in the south shows this situation. *caakiyaaR madom* is the residence of the *caakiyaR*, the dancer. *caakkiyars* are the dancer community. on the south west those who live by pigs, sheep, other animals and fishermen. The muslim community has their settlements in this area. *marakkaam kaTavu* on the south west reflect this. *kutirappanti*, *kaLari* and *kurukkal madom* on the west follows the rule that western part is for charioteers and wielders of weapons. North West is for all kinds of servants. In this area in Calicut town, all foreign groups were settled. The northern part is to be for places of recluses and Brahmins, *tirumannalam*, *puumadom*, *puRa madom* etc. on the north along with the *aaryan paRampu* cluster show this zone. The army chiefs and chief men of the king are to be resided on the eastern part. The *sarvadhikaryakkar* and *aaNappaTTaR* are residing in the eastern and south eastern part. According to the same text, a further distribution is also seen. The Army on the north east, chiefs of the merchant guild and leading men of the realm on the south, Treasury officers, ministers architects on the west, commanders of the army on the south west, priest and astrologers on the north. A few residences of officials like *mannaTaccan*, the kings minister, *Vanchi kanakkappilla* etc are seen obeying this principles. An indigenous text on the city-laying pattern says that, the functional groups like commercial categories should stay in the outer circle or in the peripheral area of the city. Merchants have to be their residences on the south.<sup>261</sup> Fishermen should stay on the North West, people who live by animals and meat should be on the west. oil sellers should stay on the north. The palace complex is to be located on the southeast. Some of these principles also are seen obeyed in the city lying plan of the Calicut port. The major palaces are on the southeast part. Fishermen have location in the North West part and Muslims on the southwest. Most of these suggestions are based on functional aspects. Merchants, doctors, chief men and forces may be all over the place as all these are people in constant need.

Caste wise distribution is also stated in some medieval texts. Brahmins on the north, Kshatriyas on the east, *Vaisyas* on the south and sudras on the west. The *Kshatriya* families or the king's family members had their residences in the east, south, and Brahmins on the north in Calicut Port town. Spatial distribution, related to the

king's fortress area is also discussed in some texts. One of them instructs that the professional classes should have their residences in the heart of the city and the foreigners the anti social elements and also the portion of the army at the out skirts. In the central part, where the king dwells, the Gopura, army chiefs and ministers should live; but not next door to the king. Those in the state departments should be spread over different parts of the city and these again should not be close to the ministers. Foreigners or those suffering from dire diseases should not be within the Royal Square, or institutions for dance or study; these could be used by enemies for espionage. These directions are also seen obeyed to some extent. The foreign settlements are clearly on the outskirts, the North West part of the city. The ministers and higher officials are staying at a distance from the Royal Square. Professional commercial groups have their zones in the heart of the city, in the central zone area. Certain parallels seen in the description of the Sanskrit texts and analysis of urban geographers.

Both the administration of the land and administration of the commercial activities are centred at the fortress area, which itself is at the central part of the city. The general nature of a medieval city was that it lay around a castle with fortress. The commercial centre zone is on the coast, which is known as the *Valiyannaati* in the Port area or *panTarakkaTavu*. Both are separated at a distance nearly of one kilometre. There are commercial, cultural and administrative centres, in the city complex, which also indicate the general pattern of early towns. It is believed that this palace and fortification were built by the Zamorins in 15<sup>th</sup> century A.D.

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# Cultural Heritage Management and Tourism: Some Thoughts

**Benny Kuriakose**

*Architect, Chennai*

*Email: bennykuriakose@gmail.com*

## INTRODUCTION

The built environment refers to the totality of all that humans have changed or rearranged within the natural environment (Bartuska and Young, 1994). It refers to the manmade surroundings that provide the setting for human activity, from the largest-scale civic surroundings to the smallest personal belonging. It includes buildings, streets, urban spaces, roads, highways, waste disposal sites and man-made water storage facilities.

Within the built environment, “we are here concerned with a quantitatively minor part of the built environment: that part which the contemporary generation resolves has ‘cultural values’, and accordingly merits special protection from the chances of erosion, in order that it can be better enjoyed by the current generation, and passed on to the future” (Lichfield *et al.*, 1993). “Cultural heritage management is the systematic care taken to maintain the cultural values of the cultural heritage assets for the enjoyment of present and future generations” (McKercher and Cros, 2002).

According to McKercher and Cros (2002), cultural tourism was regarded as a specialized, niche activity, but now it has superseded ecotourism as the trendy tourism buzzword. “Cultural Tourism is arguably the oldest of the ‘new’ tourism phenomena. People have been travelling for what we now call cultural tourism reasons since the days of the Romans; it is just that they were never recognized as being a discrete group of travelers before”. McKercher and Cros argued that the cultural tourism and cultural heritage sectors still operate in parallel, with little evidence being shown of true partnerships forming between them. They are of the opinion that “sustainability can occur only when the practice of trading off one set of values for another ceases and, instead, tourism and cultural heritage management interests work toward the achievement of common goals”.

It is important to see that there is a proper management plan for the cultural heritage assets since the high tourism pressures derived from tourist traffic, can cause many conflicts.



## **IMPACTS OF TOURISM**

There can be both positive and negative impacts based on the various actions by the tourists and the changes, which are taking place. Tourism can play a beneficial role for the conservation of the cultural heritage. Visitor fees, concessions and donations provide funds for conservation and presentation efforts. Tourism can also promote cultural values by supporting local handicrafts or by offering alternative economic activities.

There should be improved health and sanitary conditions with all the garbage being stopped from going into the public spaces and waste recycling happening. There should be greater educational opportunities – old and young alike will have an opportunity to learn about history, heritage, conservation and environment. Tourism should create employment and livelihood opportunities for the local community. In some cases, the tourists' interest in arts and crafts may foster a cultural renaissance, it should be ensured that these should not be guided by the products of commodification. People shall be made more aware of built and natural environmental issues.

The thrust should be to minimise the negative impacts of tourism. At the same time, "tourism may not attract sufficient visitors quickly enough to generate the quantities of revenue needed to meet the economic expectations of the community. This results from the competitive nature of tourism or the quality of resources in the communities" (Pederson, 2002).

On the downside, tourism spawns well-known problems. Literature on tourism is replete with stories portraying tourism as a destroyer of communities and culture (O'Grady, 1981 and D'Sa, 1999). Some tour operators exploit the local culture and the heritage assets, while providing little in return for the community or the continuing care of the assets. McKercher and Crus (2002) states that "increased visitation, overuse, inappropriate use, and the commodification of the same assets without regard for their cultural values posed a real threat to the integrity – and in extreme cases, to the very survival – of these assets".

### **Tourism and Local Community**

The community is likely to support tourism if the positive impacts outweigh the negative impacts or they stand to benefit through employment for themselves or family members. But most of the tourism projects do not benefit the local community and the tourism revenues often reach a different segment of the population who are outside the region. Big companies may deprive locals of anticipated economic benefits.

Dana (1999) stated that once the social costs of tourism are considered, then it may not be considered beneficial to the society. "One could argue that the island residents are wealthier in monetary terms, but I question whether they and their island remain as rich as they were before tourists arrive."

Social disruption caused by increased visitor traffic is another negative impact of tourism. There will be visitor traffic and it may disturb the people in and around the monuments/sites, but if systematically organized, visitor traffic can be easily and efficiently managed.

## **TOURISM AND AUTHENTICITY**

Tourism is a commercial activity and tourists look for fun and recreation. But tourists want authenticity, not necessarily reality. Heritage assets need to be converted into cultural tourism products, but commodification of culture should be avoided. As commodification takes place, “people begin to perform exclusively for the tourists’ benefit, and events may lose their value as a cultural and spiritual manifestation. As a defensive mechanism some communities try to limit tourists’ intrusion by keeping separate cultural manifestations closed to tourists, and offering “staged authenticity” performances to visitors, including appropriate interpretation and explanations” (Pederson, 2002).

Not all cultural tourists are alike. A small number of tourists really seek a deep learning experience. Affluent tourists sensitive to local culture will stay in local accommodations, have local food, have basic facilities. This represents a tiny portion of the traffic, but is on the increase.

As far as possible, the heritage should not be removed from its context or setting, to the extent that the authenticity is affected. The integrity of the cultural space plays a major role in presenting an authentic experience, although it may not be traditional. Highly commoditized attractions by the tourism sector for easy consumption are not desirable (Kuriakose, 2009).

## **DEVELOPMENT**

The new development should be appropriate to the historic and the architectural context. Modern designs and buildings are necessary for any society, but it should be ensured that the cultural values are conserved. They should not impact the authenticity, character and the values of the built environment. Proper cultural heritage management is required to sustain the values.

It is feasible to introduce contemporary architecture in historic areas of the city. The modern techniques and materials can also be used as long as they are sympathetic with the surrounding historic fabric. Regarding the introduction of contemporary architecture, the symposium at the 3<sup>rd</sup> General Assembly of ICOMOS (1972) arrived at certain conclusions, which are mentioned below;

1. Such contemporary architecture, making deliberate use of present-day techniques and materials, will fit itself into an ancient setting without affecting the structural and aesthetic qualities of the latter only in so far as due allowance is made for the appropriate use of mass, scale, rhythm and appearance.
2. The authenticity of historical monuments or groups of buildings must be taken as a basic criterion and there must be avoidance of any imitations, which would affect their artistic and historical value.
3. The revitalization of monuments and groups of buildings by the finding of new uses for them is legitimate and recommendable provided such uses affect, whether externally or internally, neither their structure nor their character as complete entities.

## **INTERPRETATION**

The conservation of historic buildings should provide an entirely new approach to interpretation and presentation of monuments. Interpretation is the means by which people can understand the values and significance of the heritage site, both as a whole and as individual elements. The built heritage should be made comprehensible to as wide a range of people as possible, and making the best use of the site for educational purposes, either for leisure, formal study or as a tool for raising awareness.

There have also been significant technological developments in interpretation since 1990s, particularly in such areas as GPS and computer generated imagery, touch screens, mobile phone technology and video and audio wands which could be applied to improve communication of the Site's values to the visitor.

The time spent by a visitor may vary depending upon each person's interest. Interpretation panels at various levels should be designed depending upon the amount of time to be spent by the visitor. They may include local residents and repeat visitors.

## **EDUCATION**

One of the major aims of the any heritage project should be to provide an environment, which educates the public at different levels. At the directly perceivable level, it educates about the conserved monuments and its various components. At the conceptual level, it deals with the macro issue of the conservation, the built environment, the heritage and sustainability.

“Developing the educational use of a heritage site fulfils the obligation under the 1972 World Heritage Convention to transmit the site to future generations. Educational activity in its broadest sense, encompassing formal and informal education, is essential to creating awareness of the values of the site and ensuring that these are cherished and enhanced in the future” (Austen, 2006).

The Interpretation and Education Strategy would provide a mechanism to help people to engage with the site, appreciate its significance and understand more of the way in which it is being managed and conserved.

## **PROTECTION OF NATURAL ENVIRONMENT**

Contemporary human society is in a transition, moving from the rural to the urban. There is, consequently, an urgent need for the urban community to re-establish and remain connected to such systems, so it does not forget its fundamental dependence on them.

The natural environment of a site may have great biodiversity. There may be sensitive areas such as rivers, forests, lakes etc in which the built environment is situated. The prevailing degradation of the natural environment due to reasons such as pollution, silting, deforestation etc. can be alarming and threatening to the built heritage as well. The garbage collection in the particular site may go up and more pollution may result due to the increase in tourist traffic. Environmentalists may have important concerns over the potential negative impacts of tourism development on the flora and fauna of the region.

The landscape of the natural environment is integral to the values of the built heritage as well. The management of the built heritage must take into account the values of the natural environment and its role as a wider setting; in particular when there are gaps in our detailed understanding of the relationship of the architecture and development. Inappropriate development in the region may impact negatively upon the built and natural heritage. "Trees, mangroves and other flora make a vital contribution to the setting of the Muziris Heritage Site, especially to its skyline. The bio-diversity of the Muziris Heritage Site is vulnerable and requires careful management to ensure its survival. The network of waterways is going to be used by a large number of new visitors for transport to the area once the Project Sites are open. It is critical that the importance of clean waterways, controlling mosquito menace, reducing pollution and such matters is stressed" (Kuriakose, 2009).

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# Evolution of Space Technology in India

## **P Radhakrishnan**

*Former Scientist, Vikram Sarabhai Space Centre, ISRO,  
Thiruvananthapuram*

***“The question is not whether a developing country like India can afford space technology ; the question is whether we can afford to ignore it.”***

--Vikram Sarabhai

## **INTRODUCTION**

In the evening twilight of November 21, 1963, a sounding rocket lifted off from TERLS (Thumba Equatorial Rocket Launching Station), about 14 km north of Thiruvananthapuram. It was the first ever rocket carrying a scientific experiment to leave the Indian soil. Until then, the atmosphere had been studied solely by instruments installed on the earth or carried aloft by balloons. For India, there was no turning back since. We are now among the handful of spacefaring nations. Actually during 1957-58, India had actively participated in IGY (International Geophysical Year), a globally co-ordinated scientific campaign focused on geophysical investigation of the earth.

IGY proposed to study diverse subjects such as aurora, air glow, cosmic rays, geomagnetism, glaciology, gravity, ionospheric physics, latitude and longitude determination, meteorology and oceanography. By the late 1950's, technology and tools had advanced so much that it opened up unprecedented scope for the research scientists. The most innovative of the new tools was the rocket, a post-World War II legacy that made space exploration possible. Both Soviet Union and the USA sent artificial satellites into orbit during that period.

What enabled India to play a meaningful role in IGY was the substantial research carried out in the 1940s in areas such as Upper Atmosphere, Geomagnetism and Cosmic Rays. The monumental book by Prof. S.K. Mitra, “The Upper Atmosphere”, was published in 1947. It was soon hailed internationally as an authentic reference document on the subject and continued to serve several generations of students in upper atmosphere, geomagnetism and space science. The atmospheric model given in this book was used by the Soviet Union to predict the orbital life of their satellites. The Physical Research Laboratory (PRL), Ahmedabad, deservedly acknowledged

as the home of space research in India was established in 1947 by Dr. Vikram A. Sarabhai. By the 1950s, intensive investigation of the ionosphere was being carried out by scientists at PRL, National Physical Laboratory and All India Radio, Delhi.

## MILESTONES

The then Prime Minister Jawaharlal Nehru was convinced that nothing could raise India from its backward state as effectively as Science and Technology. He was the force behind the *Scientific Policy Resolution*, passed by the Parliament in 1958. But for the providential confluence of Jawaharlal Nehru and scientists such as Dr. Homi Bhabha and Dr. Vikram Sarabhai in whom the Prime Minister reposed implicit faith, it is doubtful whether India would be where she is today in Science and Technology.

In 1961, Government of India entrusted the task of initiating space research and its peaceful uses with the Department of Atomic Energy headed then by Dr. Bhabha. It is remarkable that in 1962, barely within 5 years after the launch of the first manmade satellite, INCOSPAR (Indian National Committee on Space Research) was constituted, which was affiliated to the international body, COSPAR. India obtained approval from COSPAR for establishing a rocket launching station for investigating the upper atmosphere above the magnetic equator (Dip Zero) passing through southern Kerala. About 100 km above the magnetic equator, there is an electric current system known as *Equatorial Electrojet*, which hold a great interest to space scientists. A search for suitable site led eventually to Thumba and the decision to establish a rocket launching station there, was conveyed to the Parliament on January 21, 1963, by Smt. Lakshmi N Menon, the then Minister of State in the Ministry of External Affairs.

One week later, while inaugurating a seminar organized by INCOSPAR at PRL, Ahmedabad, Dr. Bhabha said, *"If we do not do so now, we will have to depend later on buying know-how from other countries at much greater cost... within a few years our present modest beginnings will grow appreciably and Indian scientists will be making important contributions in the field of space research."* He took a "now or never" posture on this issue. To Dr. Bhabha and Dr. Sarabhai, studying upper atmosphere with sounding rockets was merely the first small step towards bringing space technology to India.

The biggest problem faced while establishing any major installation usually is *the first mile*, namely, the acquisition of land. The Rocket Station required a large coastal area far from the thickly populated city of Thiruvananthapuram. The then Governor, Shri. V.V. Giri and Chief Minister, Shri. Pattom A. Thanu Pillai were both firm in their decision to quickly transfer the selected 800 acre-land to Government of India, and the decision was ably executed by a diligent District Collector, Shri. K. Madhavan Nair. Within a matter of months, a smooth transfer of land took place. The complexity behind this operation will go unappreciated if we forget the fact that Thumba was a fishing village, and right at the heart of the proposed site, there was the old Mary Magdalene Church ! A historic landmark in the entire process of land acquisition was the singular co-operation on the part of the Christian community at Thumba and Rt. Rev. Peter Bernard Pereira, the Bishop of Trivandrum. This is truly a standing example of religious tolerance and magnanimity displayed by the people who lived there. In a sense, the birthplace of Indian rocketry was consecrated by the good will

of the original inhabitants, who were resettled in a new colony not far away. This may well be a unique act of grace in history of laying a venerated place of worship on the altar of science ! The Church has ever since been maintained in its pristine solemnity; it is now a space museum attracting countless number of another kind of devotees.

The first sounding rocket, Nike-Apache, launched from Thumba was supplied by the US whereas it carried a French scientific payload, the Sodium Vapor Cloud Experiment. The launch was supported by a Soviet computer and an American radar. The convergence of these disparate political entities at Thumba at the height of Cold War amply demonstrates the astute diplomat in Dr. Sarabhai. TERLS was later dedicated to the UN by Prime Minister Indira Gandhi on February 8, 1968. ISRO (Indian Space Research Organization) was formed in 1969, which was subsequently brought under the newly formed DOS (Department of Space) in 1972.

The 1960s represents the infancy of our space activities. Rocketry is an intricate, multidisciplinary technology closely guarded by those who possess it. ISRO had, therefore, to master the technology through the usual learning curve fraught with trials and tribulations. Though a midget, the RH-75 (Rohini Sounding Rocket with diameter of 75 mm) is the first outcome of our agonizing struggle. In due course, ISRO developed a family of Rohini Sounding Rockets with different capabilities for various purposes, the biggest of them with a diameter of 560 mm, known as RH-560.

By 1970, ISRO was ready to take up certain bold experiments with satellites. Aryabhata was the first Indian satellite launched in 1975 from Soviet Union with one of their launch vehicles. Armed with the confidence gained from Aryabhata, we built two satellites, Bhaskara – 1 & 2 -- also launched by Soviet vehicle in 1979 and 1981 respectively, which marked our initial attempts in satellite-based Remote Sensing. However, there were aerial remote sensing experiments in the early 1970s pioneered by Prof. P.R. Pisharoty to investigate coconut root-wilt diseases using CIR (Color Infrared) photography. This was followed by other aerial missions such as ARISE (Agricultural Resources Inventory and Survey Experiments) in Andhra Pradesh and Punjab during 1974-76. Data from Landsat 1 & 2, launched in 1972 and 1975 respectively by the USA, was also used by ISRO as part of demonstration studies. Establishment of a data reception centre at Shadnagar, Andhra Pradesh by the NRSA (National Remote Sensing Agency, now renamed as National Remote Sensing Centre) in 1979 was a major step in operational use of RS (Remote Sensing) data by the State and Central Government agencies. JEP (Joint Experiments Program) was taken up in 1978 in association with Departments of Agriculture and Co-operation, ICAR, and Ministry of Steel and Mines in order to arrive at a definition of IRS (Indian Remote Sensing Satellite) program. Experience gained from Bhaskara and JEP laid the sound foundation of IRS program. The first satellite of the IRS series was launched in 1988 on a Soviet vehicle. The IRS constellation, among the best in the world today, has been serving our nation in providing valuable information on earth resources. We are also able to sell IRS images in the competitive international market.

In the mid-1970s, two satellite communication experiments were conducted using foreign satellites. The first, known as SITE (Satellite Instructional TV Experiment), made use of a US satellite. It was indeed a massive techno-social experiment to assess

the role of satellites in instructional/educational TV covering 5000 Indian villages. The other, STEP (Satellite Telecommunication Experiment Project) used a Franco-German satellite. Later in 1981, an indigenously built experimental communication satellite, APPLE, was launched using the Ariane Launch Vehicle of the ESA (European Space Agency). These successful experiments paved the way for the now operational INSAT (Indian National Satellite) System serving our TV and telecommunication needs.

The 1980s started with the successful launch of the SLV – 3, our first Satellite Launch Vehicle. Though capable of launching merely a 40-kg satellite, SLV gained us the 6<sup>th</sup> place in the exclusive club of spacefaring nations. It took over 25 years before another country acquired satellite launching capability, which speaks for the complexity of the technology. Development of ASLV (Augmented Satellite Launch Vehicle) with a capacity to carry 150 kg satellite was then taken up. ASLV achieved two successful missions in the first half of 1990s after two earlier failures, which really taught us valuable lessons in launch vehicle technology, particularly in transonic flight.

The establishment of NNRMS (National Natural Resource Management System) in 1983 by the Government of India with DOS as the nodal agency was a most important step in adopting a co-ordinated action combining conventional techniques as well as RS (Remote Sensing) technology. The efficacy of this approach had already been demonstrated successfully in certain end-to-end experiments in areas such as ground water targeting, mineral exploration and fisheries. The objective of NNRMS was to provide timely, regular, accurate and specific information to decision makers at various levels. Now there are five Regional Remote Sensing Service Centres affiliated to NNRMS as well Application Centres in most States.

The star of the 1990s is, no doubt, PSLV (Polar Satellite Launch Vehicle). Though its first launch attempt in 1993 failed, all the 23 subsequent missions from 1994 have been successful. PSLV has endowed us with self-sufficiency in our remote sensing program. It has also rightfully become our workhorse and it has carved a niche for 1500 kg class sun- synchronous RS satellites. It has carried a number of passenger satellites from other countries along with our own main spacecraft. Most remarkably, PSLV helped us achieve our first lunar mission, Chandrayaan - 1, in 2008. It will also serve in our forthcoming Mars Mission.

Backed by our experience with PSLV, ISRO undertook the ambitious GSLV-MkII (Geosynchronous Satellite Launch Vehicle) in order to acquire self-sufficiency in launching 2000 kg-class communication satellites. It required a cryogenic rocket in its upper stage to achieve the goal. Though the Soviet Union, in the original contract, had initially agreed to transfer the know-how along with three ready-to-use cryogenic stages, the political changes that led to the collapse of Soviet Union in 1990 forced them to retract from the clause dealing with transfer of technology. The contract was then revised to a mere purchase of a few finished cryogenic stages from Russia without technology transfer. Though we bought some cryogenic stages, we were left to our own resources as regards development of cryogenic technology. The first successful launch of GSLV-MkII took place in 2001 using a Russian cryogenic stage though the mission goal was somewhat underachieved. GSLV-MkII, however, has



had a chequered history in its seven missions. There is no doubt that ISRO will soon tide over these problems. Most contemporary communication satellites including many of ours weigh well over 3000 kg for which we are now depending on the Ariane vehicle of ESA. To acquire indigenous capability in launching heavier communication satellites, ISRO has undertaken the development of a more powerful version, the GSLV-MkIII, with a payload capacity 4000 kg. Its development is in its final stages and the first experimental launch can be expected before long. The development of RLV (Reusable Launch Vehicle) is also under way that will substantially cut the cost of launching satellites. Chandrayaan – 2 and Human Spaceflight are also under various stages of development.

### **APPLICATION AREAS**

The chief application areas ISRO has been vigorously pursuing from the beginning are Communication, Meteorology and Remote Sensing. This was later extended to other areas such as Search and Rescue, Tele-medicine, Tele-education and Navigation.

#### ***(i) Communication***

INSAT System has brought most of the Indian population under the TV coverage besides providing long distance telephone communication network. One unique feature of INSAT is that it combines communication with meteorology. Several hundred cyclone warning systems are deployed on the Indian coast, which help us take advance action in disaster management. The EDUSAT was a communication satellite exclusively for educational purposes to reap the benefits of country-wide classrooms. Yet another important use of our communication satellites is in the field of Telemedicine. That some of the communication transponders in our INSAT satellites had earlier been leased by the global communication agency, INTELSAT, bears testimony to their quality and reliability. There is, nevertheless, an appreciable gap between transponder supply and demand, which needs to be filled early.

#### ***(ii) Remote Sensing***

The Indian Remote Sensing (IRS) constellation has been steadily serving the nation in areas such as agriculture, wasteland mapping, forest cover mapping, monitoring water resources and ground water prospecting, study of glaciers, flood prediction and damage assessment, land use and urban planning, cartography, marine resource assessment, environmental studies, and many more. As part of Sustainable Development, Village Resource Centers have been operating for some years.

**Agriculture** accounts for 18 % of GDP as well as 70 % of rural employment. Though agricultural production has multiplied considerably during the past 60 years, there remain problems like stagnation of productivity in certain areas and low productivity in others. Besides, there are uncertainties in rain-dependent agriculture, soil erosion and water logging. Production requires to be increased by at least 50 % before 2025 if our demands are to be met. This points to the need for expansion of the area of cultivation by identifying cultivable wasteland, raising the cropping intensity by cultivating in Kharif/post-Kharif fallows, conservation of soil and moisture, and providing reliable crop production statistics and forecast. Some steps taken up in

this direction include crop production forecasting, crop intensification and rotation, and mapping wastelands and salt-affected soils.

**Crop Production Forecasting** calls for the estimation of the area used for a given crop and the yield per unit area. This is done by identifying and classifying pixels in an image based on the spectral signature of the crop. Combining this with other agro-meteorological parameters provides yield forecast. CAPE (Crop Acreage and Production Estimation) procedures, initiated in the 1980s, have undergone steady upgradation resulting in improvement in accuracy of crop estimates. The data provided by WiFS (Wide Field Sensor) in IRS helps forecast the harvest of various crops. Microwave radar data is useful for rice crop grown during kharif (monsoon) when there is heavy cloud cover. Besides, there is FASAL (Forecasting Agricultural output using Space, Agro-meteorology and Land-based observations) making use of econometric models before the crop season, agro-meteorological models in the beginning of crop growth, coarse and fine resolution RS data respectively in the middle and final stages for estimation. It is also possible to revise estimates based on episodic events after the harvest. In order to facilitate independent space-based agriculture-statistics system, the Mahalanobis National Crop Forecast Centre was established in New Delhi by the Ministry of Agriculture in 2012. Remote Sensing data is used also for inventory and monitoring of irrigated status over the seasons.

**Wasteland Mapping** on a nation wide basis was first carried out by NRSA in the 1980s creating the first, small scale baseline information on spatial distribution of wastelands. During the last decade, however, 1:50,000 scale wasteland maps have been prepared for all districts in the country. These surveys show that total wasteland area has decreased during this period from 63.85 Mha to 46.73 Mha indicating that some of the wasteland has been converted to productive area.

**Forest Cover Mapping** at a national level using RS data was undertaken in 1983, which established the urgent need for monitoring forest cover periodically and taking steps in forest conservation. Forest Survey of India has been carrying out forest cover mapping every two years from 1987 and submitting the findings to the Parliament. High resolution multispectral data has remarkably improved our capability to prepare forest type/ density maps. Combining RS data with ground-based information, we are able to conduct activities such as biodiversity assessment, monitoring landscape changes, carbon sequestration, hydrology, generic ecosystem patterns, Environmental Impact Assessment (EIA) studies and regional climate models.

**Water Resources** management demands inventory, monitoring of surface water bodies, irrigation performance, groundwater exploration, snow-melt run-off forecast, flood inundation mapping and forecasting, reservoir sedimentation. Space-based data has been in extensive operational use. The Water Resources Information System of India has been set up to serve as a source for comprehensive information on India's water resources in a GIS frame work.

**National Drinking Water Mission**, a high priority task undertakes to provide safe drinking water in hundred thousands of villages. Using RS and Ground Truth data, ground water prospect maps, in 1 : 50,000 scale, have been prepared. These maps

reveal regions with a high water-striking probability as well as the yield at different depths. This Mission has returned a success rate better than 90%.

**Integrated Mission for Sustainable Development (IMSD)** was instituted in 1992 after initial experiments in 21 districts. In due course, this was extended to 175 districts in the country covering 84 Mha. IMSD was, in fact, prompted by the widespread drought during 1987-88. That is when our attention was drawn to the concept of RS-based sustainable development on watershed basis. It required information on soil, slope, drainage, land cover, geomorphology, rainfall, demographic distribution, availability of drinking water and the like. Location-specific action plans concerning alternate land use practices, soil conservation, surface water harvesting and ground water exploration/recharge were formulated jointly with all concerned, including beneficiaries, and the post-implementation results regularly monitored.

**Snow and Glaciers** are significant sources of frozen fresh water. Himalayan snow and glaciers not only result in the perennial rivers of North India but they influence summer monsoon, and are sensitive indicators of climate change. Synoptic, repetitive RS data has been helping us prepare the seasonal snow cover maps and make snowmelt run-off forecasts.

Inventory of the Himalayan glaciers and monitoring their retreat/advance is important because it is related to global climate change and water security. Inventory of the glaciers in 1:50,000 scale has revealed that, there are thousands of glaciers in the Indus, Ganga and Brahmaputra basins spread over a total area of 70,000 sq. km, many of them monitored for 20 years for their retreat/ advance. A recent study has indicated an overall deglaciation of 20%. Monitoring the spread of glacial lakes is valuable in view of their flash flood damage potential.

**Wetland Inventory** involves regular mapping and monitoring wetlands that broadly denotes ecosystems governed by water. Wetlands provide habitat for a wide variety of aquatic life and, besides, have an appreciable influence on flood control, reducing sediments, recharging aquifers, regulating water flow and quality, and removing pollutants. Wetlands are often encroached for urbanisation and, also for agricultural and industrial purposes. In the early 1990s, wetlands larger than 0.5ha were mapped nationwide in 1:250,000 scale, indicating a total wetland area of 8 Mha. It has since been followed up with more detailed surveys and conservative measures.

**Geology and Mineral Exploration** began with the *Vasundhara* Project in 1994 for creating a database comprising both conventional and RS information on geological aspects for the southern part of India. Several studies have since been carried out for preparing maps showing geological structures and geomorphology. RS is increasingly in use for geo-environmental and geo-engineering applications.

**Coastal Zone** includes coastal water, tidal wetlands and adjacent shore-land influenced by marine water. India has a 7,500 km coastline inhabited by 25% of the population with a coastal strip 60km wide. The coastal zone is also home to diverse terrestrial ecosystems such as coral reefs and mangroves. RS data has helped us effectively to obtain information on coastal wetlands, land use/land cover, vital and critical habitats, shoreline changes, coastal processes and potential sites for brackish water aquaculture. CRZ (Coastal Regulation Zone) maps critically depend on RS data.

**Urban Mapping and Infrastructure Development** make extensive use of high resolution RS data for urban sprawl and broad level classification, for planning development and transport network. Preparation of a perspective plan for Ahmedabad urban development in 1996 was the first detailed study, which was followed by many other cities such as Mumbai, Kolkata, New Delhi, Bangaluru and Hyderabad. GIS and GPS together with high resolution RS data have facilitated several infrastructure development plans in urban areas, transport networks, road alignment and rural road connectivity.

**Fishery** derives substantial benefit from monitoring Ocean Colour and SST (Sea Surface Temperature) together help forecast PFZ (Potential Fishing Zone) 2-3 days in advance because aggregation of fish is influenced by physical, biological and environmental parameters such as sea surface temperature (SST), chlorophyll concentration and currents. PFZ forecast has been made with better than 90% success rate.

**Disaster Monitoring and Mitigation** are of great concern because of our vulnerability to natural disasters resulting in huge loss of life and property every year. DMSP (Disaster Management Support Program) has been in force since 2003. It combines data from a number of sources – indigenous and foreign – and a secure satellite communication network.

Landslide hazard zonation maps in 1:25000 scale have been prepared for pilgrimage routes in the Himalayas and north-east region using database on lithology, geological structures, slope, vegetation and land use. These maps also depict conservation measures to be taken up.

**Atmospheric and Oceanographic** studies have focussed on the retrieval of various geophysical parameters from satellite data and their validation, their assimilation in models, numerical weather prediction, and sea state forecasting. A tight ground network for in-situ data for use in weather models has been set up with AWS (Automatic Weather Stations), Agro-Met Towers and DWR (Doppler Weather Radars). IMDPS (INSAT Meteorological Data Processing System) has been established to receive and process data from INSAT spacecraft. The four instruments in Megha Tropiques have lately been furnishing additional data for the study of tropical hydrology. Mesoscale forecasting at 5km grid interval for the entire country is being done to provide 72-hour forecasts of temperature, humidity, winds and rainfall. Studies on cyclone genesis, its track and landfall point prediction and intensity estimation have been also carried out.

Global ocean wind vectors are derived from our Oceansat-2 satellite and disseminated within three hours of data acquisition. Applications in mixed layer depth, ship track routing, identification of sea mounts, and oil spills have been demonstrated. It has also been possible to locate off-shore hydrocarbon structures by the study of residual gravity anomalies using altimeter data.

The Geosphere-Biosphere program started in the 1990s to demonstrate usefulness of RS data in conjunction with ground data for studying the Earth System as a whole. This mission undertook the study of aerosols, atmospheric trace gases, boundary

layer network and characterisation, energy-mass exchange in vegetative systems, land use and impact of human activities.

### CONCLUSION

Both USA and USSR had adapted their military missiles for space exploration in the beginning. On the contrary, India did not have even her own aircraft technology, let alone missiles !The sole capital we had half a century ago, when we took our tottering steps in space technology, was a leadership powered by will and a band of committed, though novice, scientists.

Dr. Sarabhai was convinced, ***“India will not have to look abroad for its experts, but will find them ready at hand.”***As we take stock of our achievements in a remarkably short time, we clearly see that Dr.Vikram Sarabhai stands entirely vindicated!

***Subtheme V:  
Culture, Heritage and Knowledge Management***



# **The Future as Cultural Past: Ancient Maritime Exchanges and the Green Archaeology Project at Pattanam (Muziris)**

**Dr. P J Cherian**

*Director, Kerala Council for Historical Research, Thiruvananthapuram and Pattanam Excavations*

## **THE FUTURE AS CULTURAL PAST**

It is a matter of great appreciation that Kerala Environment Congress is deliberating on different aspects of cultural heritage and the advancement of healthy environment. In fact, it is an intricate and strenuous intellectual exercise to approach the themes of cultural legacy and sustainable environment - for various reasons. In times when the 'social' retreats and 'the social minus' gains silent approval, cultural legacies may become increasingly irrelevant and the environment falls a victim to the indulgence of the present. Further, to address the complexity of cultural heritage and threat to healthy environment, we might need a science perspective sans the limitations of the hitherto 'scientific perspectives'. It might demand more rigorous, comprehensive and collaborative efforts. In this context, the multi - inter and trans-disciplinary approaches towards knowledge generation can be pertinent and their employment might help to address issues relevant not only to the realms of cultural heritage and environment but also to the wellbeing of life on earth.

## **CULTURAL POVERTY (?)**

In his preface to the "Malabar Manual" William Logan had written on the travails of tracing the Malayali cultural heritage, "...The Malayali race has produced no historians simply because there was little or no history in one sense to record" (7<sup>th</sup> January 1887). However, he adds that, if one were to search the length and breadth of peninsular India, there would not be another region richer in cultural resources."

Even after twelve decades - a not so short period in the history of any society, Kerala cuts a sorry figure when it comes to the attitude towards cultural heritage.

A critical introspection into our definitions of life and attitudes might help us understand probably the cultural poverty (?) of our socio-cultural and intellectual life. How many in Kerala can trace back their cultural ancestry to the larger social canvas of a pre-Brahmanic, pre-Christian, pre-Islamic, pre-Dalit, pre-Ezhava or pre-Nair past? Isn't it a disgrace for an 'educated and enlightened society' to be unconditionally accepting 'imposed' identities as absolute and remain prisoners



of an 'eternal' present? The attitude to cultural heritage and environment needs to undergo a test of fire deep within and engaging in blame- games might only keep the issue underplayed and out of bounds of our immediate concerns.

To think beyond the present and contemplate the role of an updated science perspective would be essential to realize the impact of cultural heritage in the present and future of humanity. This sort of platforms can be potential spaces for such interrogations. I am thankful to the organizers for extending me an invitation and insisting on my participation. I am hopeful that this association will further grow in the best traditions of trans-disciplinary academic collaborations between the Kerala Council for Historical Research (KCHR) and the Centre for Environment and Development (CED).

The 'Future as Cultural Past' was used in the title to imply the phenomenal influence of the cultural realm in the contemporary life and its probable wider and deeper impact on future. The effort is also to bring to the attention how the educated and modern Malayali evaded the engagement with the tangible heritage and relied heavily on the written sources and their interpretations to understand our cultural past. Finally the effort is to introduce the archaeological site of Pattanam (N. Lat. 10° 09.434'; E Long 76° 12.587') and sketch how it should be studied and conserved employing rigorous scientific methods and civil society participation.

### ARCHAEOLOGY IN KERALA

Kerala could be the only Indian state where archaeology as an academic discipline failed to find a place in the University system till the 21<sup>st</sup> century. We had archaeology departments in the Travancore state as early as the 19<sup>th</sup> century, but its enquiries were mostly confined to the epigraphy records. Kerala society passively presumed that Kerala is archaeologically barren. The official agencies, academic institutions and history research mostly focused on the post-eighth century history for which written evidences are available. All these made archaeological studies- the major means to understand the pre and early history of this region- the inadvertent causality.

Naturally, legends were relished as 'reliable' history of the pre -eighth century Kerala. In addition to the popular legends like Parasurama, St. Thomas, Kanai Thoma and Cheraman Perumal, we have myths like *Parayipetta panthirukulam* (on the origins of tribes/castes) and on sacred spaces, rituals and festivals. In due course, many of the myths became the ideological tool to confuse if not obliterate the pre- eighth century cultural past of Kerala.

The Kerala society seems obsessed with the 'immortality' and authenticity of written words, failing to realize that 99.9 % of the human past, whether here or elsewhere, is not in written documents but in mute objects that survive the ordeals of time. Dismissing and marginalizing the archaeological data eventually made the historical research in Kerala a verbal discourse sans the merits of rigorous scientific inputs. To probe for evidence for the pre-8<sup>th</sup> century history was not therefore a priority, leaving the history of that period to subjective guess and myths.

The earliest archaeological assets of Kerala, in terms of tangible artifacts, are mostly the megalithic burial monuments and associated grave goods of the first millennium BCE. The first recorded exploration in this region was by British explorers (J.

Babington, 1819) who seems to have located as many as 335 burial sites in the Malabar district of the Madras province. The sporadic searches for Kerala antiquity in the succeeding two centuries were not very impressive. The pre-historic past continued to be confined to Iron Age burial monuments and associated finds, with few exceptions like Edakkal caves (Fawcett, 1899), Palaeolithic tools and rock paintings in the Western Ghats (P. Rajendran, 1977 and S. Padmanabhan Thampi, 1983 respectively).

Field explorations, excavations and salvage archaeology operations of recent times by the Archaeological Survey of India (ASI), the state archaeology department, various universities, colleges and individual researchers, had brought out an amazing variety of burial monuments like stone circles, menhirs, dolmens, cist graves, umbrella stones, hood stones, rock-cut chambers and sites with a wide range of urn burials (*Nannangadikal*) across the state. The associated grave goods included iron weapons like daggers, swords, spears, barbed arrowheads, knives; tools like hoes, plough shares, spades, shovels, sickles; artefacts like lamps and tripods; organic remains like bone fragments, charred bones and charcoal; pottery types like black and red ware, coarse and slip wares, variety of glass and semi-precious stone beads; and in rare cases, copper, bronze and gold objects/ornaments. These finds very rarely underwent scientific analysis, nor were properly documented or conserved, or displayed and naturally many were lost in due course. Further, the complex material assemblage of Kerala's "archaeology of death" somehow failed to lead us to the "archaeology of life" - i.e. to habitation contexts.

Other than the Greek-Latin and Tamil sources, the coin hoards were the datable evidence on our early historic past. Gold and silver Roman coin hoards of the early historic period were recovered from Eyyal, Kottayathunadu, Panangadu, Puthenchira and Valluvaly. A great handicap of this evidence is that they were not found in stratigraphy contexts, but as hoards; limiting their archaeological value to a great extent. There are few Buddhist and Jain vestiges of the early historic period in different parts of the state, yet to be integrated into the socio-cultural life of the past and present Kerala. A review of Kerala museums, (Do you remember coming across one?) the condition of the artifacts, their analytical studies, conservation, display strategies, labelling etc might reveal how much respect, resources- intellectual and financial- are spent on the tangible cultural heritage of Kerala.

#### **PATTANAM RESEARCH BY THE KCHR**

Pattanam research began in the 1990s, when the archaeological significance of the site was identified through surface finds and field surveys (C.K Vimalkumar, 1996, K P Shajan, 1998, P J Cherian, 1998) and by a trial excavation (Selvakumar et al 2004). The KCHR came into the picture in Dec. 2006, with a field survey at Kodungallur followed by full-fledged multi-disciplinary excavation in 2007 and underwater explorations by the Southern Command of the Indian Navy. KCHR has now completed seven consecutive seasons of excavations and explorations at Pattanam. (P J Cherian et al 2007 to 2013)

Pattanam has produced a plethora of artifacts belonging to the Mediterranean, Red Sea and the Indian Ocean littoral, indicating a very extensive transoceanic, regional

and hinterland network in antiquity. Pattanam seems to have been the nucleus port of the Indian Ocean maritime web of the Old World. (Table 1 & 2).

**Table 1**  
**Consolidated data of pottery belonging to Mediterranean, Red Sea and Indian Ocean rims excavated over the seven seasons of Pattanam excavations**

Sl. No.	Pottery type	2007	2008	2009	2010	2011	2012	2013	Grand Total
1	Amphora	267	310	542	2515	2779	734	283	<b>7430</b>
2	Terra sigillata	2	7	1	5	104	15	26	<b>160</b>
3	Torpedo	59	284	160	767	1983	264	167	<b>3684</b>
4	Turquoise glazed pottery (TGP)	64	121	66	382	861	189	53	<b>1736</b>
5	Rouletted ware	1041	1285	442	3320	3410	958	264	<b>10720</b>
6	Black and red ware	2	4	12	50	124	18	22	<b>232</b>
7	Chinese ceramics	51	47	28	106	62	55	26	<b>375</b>
8	Unidentified/ distinct pottery	-	10218	11047	35351	38657	4983	3019	<b>103275</b>
9	Pattanam ware	-	-	-	---	188	97	146	<b>431</b>
10	Others (Black ware, Fine ware, RCP, Type 10AKM, South East Asian)	-	8	-	-	84	-	20	<b>112</b>
11	Local Ceramics (including body sherds)	517877	356863	275461	1436469	894213	381383	109793	<b>3972059</b>

**Table 2**  
**Consolidated details of Pattanam antiquity excavated over the seven seasons of excavations**

Sl. No.	Antiquity – object type	Total	Sl. No.	Antiquity – object type	Total
1	Cameo blanks	55	17	Inlays	17
2	Copper antimony rod	4	18	Lead coins	3
3	Copper coins	122	19	Lead fragments	219
4	Copper slag	8	20	Spindle whorl	57
5	Copper fragments / other objects	285	21	Stone beads	988
6	Crucible fragments	244	22	Stone debitage	1584
7	Glass Bead	71467	23	Stone rough outs/ bead blanks	219
8	Glass bead fragment	6866	24	Stone raw materials	138
9	Glass bangle fragment	32	25	Stone mould	4
10	Glass fragment	1694	26	Stone bead fragment	149

11	Glass waster	119	27	Terracotta ball	31
12	Gold Objects	107	28	Terracotta stopper	16
13	Iron nails	6412	29	Terracotta bead	47
14	Iron slag	250	30	Terracotta lamp	75
15	Iron objects	2571	31	Terracotta disc/Hopscotch	253
16	Iron Knife	41	32	Others (Miscellaneous and unidentified)	1136
<b>Total count of antiquities</b>					<b>95213</b>

Pattanam site was inhabited from the Iron Age period onwards as can be inferred from the stratigraphy, chronometry and artifactual evidences. AMS C14 dating of the charcoal samples from the Iron Age layers estimates the antiquity of the site as well as the habitation to around 1000 BCE. (P J Cherian, et al 2009) The finds -Iron objects, ceramics (Black and Red Ware and coarse and slip wares) indicate that the earliest humans at the site led rather a simple life and the site gradually evolved into a commercial site and emerged as a hub of the Indian Ocean exchanges in the early historic period. The other cultural periods for which Pattanam gives evidence are the medieval and modern periods with gaps and probably desertions and re-occupations. This paper would briefly discuss the archaeological record related to the five main features of the Pattanam port site with focus on the maritime conduits that intersected at Pattanam.

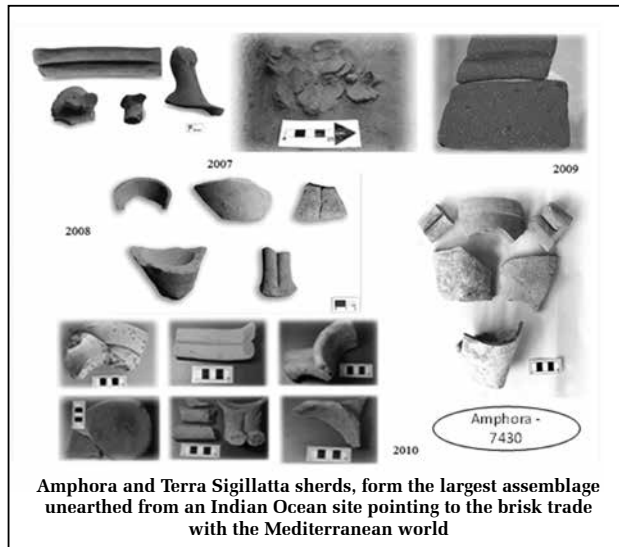
These are the main features of Pattanam (For details see the Interim reports of Pattanam excavations from 2007 to 2013)

- commercial features
- maritime features
- urban features
- industrial contexts
- poly-ethnic features

### **Commercial features**

Pattanam is the first site on the south- west coast of India to produce Indian Rouletted Ware (IRW), a fine pottery from the Gangetic region, which was considered as Roman ceramic during colonial period since it was a fine-ware type. This discovery has the potential to illuminate the trade dynamics within India, especially the Buddhist/Jain trading trails which could have laid the foundations for the famed long-distance maritime traffic from peninsular India to the Mediterranean in the early historic phase. The stratigraphic distribution of this Indian Ocean pottery - IRW- in the Pattanam trenches suggests that the site could have been commercially active before and after the West Asian and Roman commercial contacts in the early historic period.

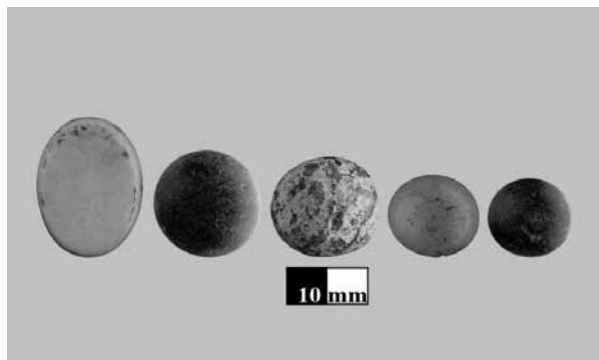
Two types of West Asian pottery – the glazed pottery of the Mesopotamian region of the Parthian and Sassanian periods and the bitumen coated torpedo jar fragments probably from the South Arabian regions, were excavated in substantial quantity. These ceramics might warrant the rewriting of ancient maritime exchanges from Alexandria to Tamralipti (Tamluk), since we had been so far unaware of West Asian



cultural/commercial contacts with the peninsular India, which, it has to be presumed now, preceded the celebrated Roman trade on the Malabar Coast. (Kennet, 2008).

Pattanam produced substantial evidence for the legendary links of the Malabar Coast with the Roman Empire. The site has yielded a large number of Mediterranean amphora sherds (7430) more than any other Indian Ocean archaeological site (amphora is the jar used for transportation of wine, olive oil and fish sauce). Amphora specialist has identified them as from various regions in the Mediterranean- Koan (Greek Island), Campanian (Southern Italy and Bay of Naples), Catalan (Spain), Gaulish (France), Rhodian (Greece), Aqaba (Jordan), Cilician (Turkey), Berenike, Myos Hormos and Alexandrian (Egypt). Pattanam also happens to be the first site on the West Coast of India to produce Terra Sigillata, a fine pottery from South Italy. (Tomber, 2008).

Among other evidences for the Roman connections are the banded agate and the carnelian cameo- blanks, meant for engraving cameos- a status symbol which was in vogue during the Roman Empire period. They seem to have been exported from Pattanam to the lapidary workshops in the Mediterranean region. Many other contemporary port sites with Roman connections had yielded finished cameos but it is for the first time that blanks



Glass gaming counters associated with the Roman board game, Ludus Latruncularum excavated at Pattanam



**Pattanam wharf complex with a dugout canoe (anjili) and seven bollards (teak) were carbon dated to 36 BCE - 24 CE period**

(raw material) were found from an Indian Ocean site.

Glass gaming counters used in the Roman board game, *Ludus Latruncolorum* is yet another significant find with a explicit Roman stamp. *Ludus* was a popular Roman board game - a simplified mix of chess and draughts. Perhaps this is the first time that Roman gaming counters have been unearthed at an archaeological site beyond the bounds of the ancient Roman Empire. The Mediterranean

seamen or traders would have brought them to Pattanam.

The ring-stones excavated from Pattanam, one intaglio with a leaping lion image and other plain ones are strikingly similar to those retrieved from the drains of a 2<sup>nd</sup> c CE Roman Legionary Fortress Bath at Caerleon in Wales in UK. The curator of the National Museum of Wales, where they are displayed, told this author that those ring-stones are probably from North India since one of them has the image of a North Indian (?) parrot. In the wake of almost identical finds from Pattanam, who knows, those in the Wales museum could have been from the lapidary workshops of Pattanam or one of its satellite sites.

### **Maritime features**

An important feature unearthed at Pattanam was the well-built wharf context in which a dugout canoe made of *anjili* and seven bollards made of Malabar teak were found. The University of Georgia, USA, has precisely dated the age of the canoe and bollard to be between 36 BCE and 24 CE, probably marking the wharf as one of the oldest maritime contexts excavated in South Asia.

### **Urban features**

Early urban features like well-laid out structures, high quality burnt bricks, triple grooved tiles, burned clay floors, ring wells, features resembling toilets and huge storage jars were excavated at Pattanam. They indicate residential or warehouse characteristics attributable to a commercial port site. Well-made burnt bricks of different sizes were found and the biggest measured 38x19x7 cm. The Flemish and Old English bonding styles in brick construction seem to have been in vogue at Pattanam 2000 years back. The brickbats and fragments of roof tiles run into thousands. The meticulous brick building style and the layout of structural features are indications of planned living at the site.

For the first time in the history of Kerala epigraphy, the Early Historic layers of Pattanam have produced terracotta sherds with *Brahmi* letters. A local rim sherd of a large terracotta pot with *Brahmi* inscription 'a ma na' meaning Jain or Buddhist monk, suggests the presence of Jaina/Buddha traditions at Pattanam. This happens

to be the only indication so far regarding the belief systems of the people lived there.

Pattanam also produced for the first time from stratigraphically discernable contexts, coins –125 early Chera coins. They would significantly help in the study of the state and polity in ancient Tamilakam. Interestingly, the state symbol on them was elephant, which still remains to be the symbol of modern Kerala state.



**Meticulous brick building styles and the layout features are indications of planned living at Pattanam**

### **Industrial contexts**

Pattanam is also the first site in Kerala with evidence for the early historic industrial activity. The major activities seem to have been related to metals, lapidary, cotton weaving and terracotta. It may be assumed that the expertise in metallurgy was not confined to iron, though it was the foundational to the material culture of Pattanam as well as peninsular India. The artisans of Pattanam seem to have extended their skill, dexterity and technology to produce copper, gold and lead items as well. Presence of metal workshops are suggested by the charred blackened soil, soot, parts of kilns, crucibles, fragments of ornaments and cosmetic tools like antimony rods. Lapidary items like stone beads, cameo blanks, ring-stone intaglios, pendants, ring-stones, glass beads and semi-precious stone debitage are found in substantial quantity and variety. From the last seven seasons, over 70,000 beads were excavated. The artisans seem to have been abreast with advanced stone-cutting technology. Cotton weaving or value addition through *jeri* work are suggested by the spindle whorls and the thin *jeri* (gold and silver filaments) recovered from the early historic layers.

Terracotta items dominated by pottery are the major cultural artifacts from the site. Probably there would not be any other archaeological site in South Asia with such a high pottery density. Seven seasons of excavation in approximately 800 sq m meter area have yielded nearly four million local pottery sherds.

### **Poly-ethnic features**

Admixture of people from distant geographical regions was a logical possibility considering the presence of various artifacts from trans-oceanic regions. This was confirmed by the mitochondrial DNA (mtDNA) studies by the CCMB, Hyderabad on 12 bone samples from the early historic layers. Three of



**Seven seasons of excavations have yielded nearly four million local pottery sherds – with imprints of local culture**

them matched with genetic markers (Haplogroup) of West Eurasians, one with native Europeans concentrated in the Eastern Baltic Sea. Four were common to people in India or South Asia. Two matched with Turkmenistan and Eastern Europe. One matched Jew Haplogroup and one sample did not have any mutation. (Cherian et al, 2013)

### **The Pattanam research design**

The Pattanam research design by the KCHR is a comprehensive proposal towards developing Pattanam into a model heritage site.

The main components of this proposal which adopts multi-inter and trans-disciplinary collaborative approaches include

- Full scale excavation
- Archaeo-science studies
- Explorations to identify contemporary sites of Pattanam
- Comparative studies on contemporary sites within and outside the country
- Building up a multi-inter-trans disciplinary team
- Collaborative research at national and international levels
- Field archaeology school and internship opportunities
- Creating digital database and digital archiving
- Publication of excavation reports, handbooks and research articles
- ‘Green Archaeology Project’ to ensure site conservation
- Interpretation centres (site museums)
- Multi-purpose archaeo-science laboratory complex
- Participation of the civil society in heritage management



**The Pattanam research design is a comprehensive proposal towards developing Pattanam into a model heritage site**

### **The Green Archaeology Project**

The Green Archaeology Project aims to convert the thickly populated Pattanam village into an organic garden of spices, medicinal and flowering plants. The objective is to ensure the protection of the area of 100 acre archaeologically sensitive land in the Pattanam village and develop Pattanam into a model eco-friendly, community friendly heritage site.

Of the four meter thick cultural deposit at Pattanam, the gardening might require only the top one meter of soil so that the archaeological evidences deep beneath remain undisturbed. Since deep running tree roots are severely damaging the fragile archaeological asset of Pattanam, the removal of such trees is pertinent in saving the cultural wealth of the site. Being an organic farming initiative, there would not be the risk of corrosion and other chemical damage to the artifacts.



Apart from preserving the priceless archaeological wealth, the spices, medicinal and flowering plants would obviously enhance the ambience of the area. Ultimately, the hues and fragrance of leaves and flowers, not walls and fences should demarcate the Pattanam archaeological mound.

The local people have been supporting Pattanam research in various ways from catering of food, site maintenance to labor support for the excavations. A unique strength of this thickly populated village is its women, who may be empowered as the caretakers. The men folk can be trained to manage the marketing obligations to sustain the Green Archaeology initiative.



**Green Archaeology' initiative promotes the use of bicycles in the village and villagers are gifted bicycles on a merit cum need basis**

Scientific landscaping, floriculture etc would require technical expertise from the planning stage to harvesting and marketing of the produces. The expertise and involvement of the Spices Board, CED, KFRI, Agricultural and Veterinary Universities, LSGIs, Kudumbasree and NGOs working in ecological projects can provide necessary inputs.

'Green Archaeology' initiative also promotes the use of bicycles in the village, as an attempt to reduce the carbon foot print by minimizing the use of polluting vehicles. KCHR appealed the civil society to donate bicycles for this initiative and the response was encouraging. The Pattanam research team uses bicycles in the village and villagers are also gifted bicycles on a merit cum need basis. Leading bicycle companies are also being approached to patronize the initiative.

Pattanam is probably one of the earliest human habitation sites from where goods, ideas and technologies were exchanged globally. Pattanam provides a great moment of realization for the state, the region and the country that we were active partners in the trans-oceanic crossings as early as 2000 years back. This site where the seeds of cultural pluralism and acculturation were sowed in antiquity may be developed into the "Viswa Bharathi" of the 21<sup>st</sup> century. Invoking Rabindranatha Tagore's vision for Viswa Bharathi, Pattanam also may demonstrate the richness and rigour of mind to nurture nature, to care for the cultural heritage and "...to offer to others the hospitality of her best culture and India's right to accept from others their best."

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# Heritage Conservation: Stewarding with Geographic Information System (GIS)

**Dr. T R Vinod<sup>1</sup>, G Magesh<sup>2</sup> and Dr. K P Thrivikramji<sup>3</sup>**

*<sup>1</sup>Program Director, <sup>2</sup>Research Associate, <sup>3</sup>Professor Emeritus*

*Centre for Environment and Development, Vattiyoorkavu, Trivandrum 695 013*

*E-mail:vinodtr@cedindia.org*

## INTRODUCTION

Heritage Conservation is the process of identification, recordation, analysis to afford protection and management of natural and cultural heritages special to a region or a community/society. Once limited to monuments, archeological sites, and movable heritage collections, by definition heritage now includes historic urban areas, vernacular heritage, cultural landscapes, natural sites, and even living dimensions of heritage and all aspects of the physical and spiritual relationships between human societies and their environment. The World Bank defined physical cultural resources as 'Movable or immovable objects, sites, structures, groups of structures, and natural features and landscapes that have archeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance' (World Bank, 2006). Indisputably, heritages of a community or of a nation are treasures needing safe guarding and conservation for the sake of posterity. Sadly, steadily rising demands for more land and natural resources of a region, state or nation, go contrary to the efforts of activists, advocacy groups or even the authority's public policy for protecting, sustaining and conserving the natural heritage.

The constitution of India has ample safeguards to protect and improve the environment, (i.e., largely related to natural heritage) and to safeguard the forests and wildlife of the country'. It is a duty of every Indian citizen 'to protect and improve the natural environment like forests, lakes, rivers, and wildlife'. Reference to the environment also exists in the Directive Principles of State Policy as well as the Fundamental Rights. In 1980, the Department of Environment was established specifically to ensure a healthy environment for the countrymen, which was later, in 1985, upgraded as the Ministry of Environment and Forests. A number of laws - acts, rules, and notifications- have been issued to enforce the constitutional provisions. Immediately after the Bhopal Gas Tragedy - the Environmental Protection Act (1986) - an umbrella legislation was enacted, which unequivocally, bridged many gaps in the existing laws? Since then, several other laws came in order to meet the new problems that cropped up later, like for e.g., Handling and Management of Hazardous Waste Rules in 1989.

Enactment of new laws by State Legislatures and the national parliament have ensured sustenance of the heritages of sorts by conservation and protection. The rules formulated based on these acts are the essential initial steps ensuring the protection and conservation of natural and cultural heritages or indirectly the quality of life of the citizens as well as securing the legacy to our own children. This ensured increasing public access to nature (like natural landscape, clean water and air, biodiversity, as well as natural resources) and objects and symbols of ancient culture (e.g., places of worship of the dominant religions of India and of differing antiquities, historic monuments, memorials, and places).

### **HERITAGE: AN OVERVIEW**

All nations and states or regions are very proud of their own heritages, viz., cultural and natural. But in what follows spotlight is on the cultural heritages(CH) and how to protect, conserve and maintain these for posterity with a new technology like the GIS. The cultural heritage of a province or nation is a record of the past glories (in the form of engravings or inscriptions, carvings, buildings, small objects and artifacts etc.), of a community or society preserving the humble beginnings and transition through centuries to their current state. Historians, cultural anthropologists, archaeologists as well as hobbyists and advocacy groups have worked hard to enlighten the leaders of the society and the administration on the need to protect, conserve and maintain these past legacies or heritages, most of which otherwise are deteriorating either due to age and/or vandalism or sheer neglect. Majority of the nations have stepped up their efforts through legislation and rules to provide for even community policing of such treasured sites and objects.

The UNESCO (Box, 1999) on its part, have been continuously assisting and encouraging the member nations to identify, demarcate, document, protect, research and communicate to the public on heritages special to the nations and regions, so that follow up like protection, conservation and maintenance of such legacies are ensured as national treasure and as global heritage wealth, for education and pleasure of the posterity. For this UNESCO created a framework, technology and process or a system as well as training for documentation of heritages whether these are smaller artifacts (e.g., a Paleolithic tool), a large field sites (e.g., ruins of Hampi) or monuments (e.g., the Tajmahal).

### **TYPES OF HERITAGES**

Though this paper spotlights the Cultural Heritage (CH) in a GIS environment, a glance at the natural heritage will be in order. Fishing, cross country walking (e.g., via Erumeli to Sabarimala on foot), ancient landscapes, drinking tasty and healthy water, enjoying the shades of large trees, breeze, viewing animals in wild, praying, meditation and participating in site specific rituals etc are some examples of natural heritage. CH falls under two categories, viz., tangible and intangible. Examples of tangible CH are buildings (palaces, places of worship, forts, monasteries, etc), monuments, landscapes (i.e., battle fields), books, works of art and artifacts, while the chief intangibles are folklore, ethnic medicines or medical practices, martial arts, traditions and language.

In fact, current practices of preservation of CH in most nations and regions are nothing but classical. For instance, smaller artifacts and copies and scale models of others are arranged for display in national or regional museums. Field sites are generally identified with special signs, fenced off and watched by dedicated staff. Cataloging is one of the classical paths or methods. With the result, the chances for public exposure of these invaluable treasure sites are nearly non-existent, unless the novice and motivated make a trip to such field sites and/or museums. A moment of introspection will quickly reveal that our CH and data thereof are spatial in character. Currently the GIS technology is the best vehicle for input of spatial data, classification, analysis, as well as display and retrieval regionally, nationally or even worldwide. In what follows, we present a model wedded to a modern technology very much appropriate to the globalised world, for making available the cultural heritage or legacy of Kerala or India for use by novice, enthusiast as well as researchers.

### HERITAGE AND KERALA

Kerala state, despite its relatively smaller size (area = 38863 km<sup>2</sup>) when compared to the other states of the union of India, is unique in many ways in that it is endowed with a relatively vast treasure of both natural and cultural heritages (CH). For this research, as the spotlight is on the CH, in spite of the discovery and documentation of a variety of elements of heritage in general (see Table 1), we address only one pervasive aspect of the CH, viz., places of worship of the dominant religions of Kerala, viz., Hinduism (variety temples), Christianity (churches) and Islam (mosques).

**Table 1**  
**Partial list of various elements of Cultural Heritage, Kerala**

<p>Kovilakam, Agraharam, Nalukettu , Cowshed ,..</p> <p>Place of Worship, Kudumba kovil, sacred grooves, Wayside cutstone shelters. ..</p> <p>Mosques, Churches, Schools, Colleges, Hospitals</p> <p>Royal Residences, Palaces, Jails</p> <p>Rubbles of playgrounds, festival grounds, Burial site/grave headstones/monuments, Ruins of Battle grounds &amp; memorials...</p> <p>Remains of Settlements, pathways etc</p> <p>Rock cut temples, Caves, Rock shelters, springs</p> <p>Architectural ruins, artifacts of roof materials, walls, Basement &amp; foundation (cut stones, dimension stones, Timber, Metal; Concrete, etc.)</p>
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Artifacts, figurines, miniature icons, idols

Any other

### **STEWARDSHIP CULTURAL HERITAGE WITH GIS**

Geographic Information System (GIS) is a relatively modern technology which is steadily evolving in tandem with growing computational power, user friendly software and high speed World Wide Web connectivity that is most appropriate for storing, analyzing, visualizing and displaying spatial data. Elsewhere, technologies like GIS greatly facilitated the inventory, evaluation, conservation and preservation of heritage sites and thereby added a significant newer dimension in conservation of both natural and cultural heritages.

Giardino (2011), Pappu et al. (2010), Tennant (2007) and Mohan (2004) demonstrated the unique advantages of integration of GIS, Remote Sensing (RS) and modeling technologies in management and decision making in respect of CH. For e.g., High resolution Satellite images along with ground-based data aggregated and spatially referenced using Global Positioning System (GPS) significantly increased the precision in mapping of heritage sites.

Moreover, a formal GIS record of sites, archaeological finds, archaeological deposits and events, legally protected areas etc, mapped on satellite and topographic base is indeed a powerful tool for Cultural Resource Management. Such a geographic database, created in GIS with all the spatial data dedicated to the heritage sites, comes in handy for future analyzes and planning of research and conservation. Further, the increasing resolution, precision and free access to serial images of generic *Google Earth* scenes enable and sharpen the potential to improve the visualization and dissemination of scientific data in respect of CH.

### **GIS AND CONSERVATION OF CH**

Recent advances in Geoinformatics, offer appropriate and powerful tools for data capture and populating a heritage information system (HIS) and nearly 25 nations, worldwide, use geoinformatics in CH conservation and management. Though like elsewhere, architecture and ruins are a substantial part of our CH, many architectural monuments are widely used or abused and endangered by long term influences of the environment. From the point of view of conservation and protection, documentation of the actual or current state of such monuments, is of utmost urgency and importance, and more so if the latter is implemented in GIS environment.

Application of GIS and RS technologies in CH management plans, viz., research (historical and physical site documentation), analysis (assessment of physical condition, cultural significance and the social and administrative context), response (preparing conservation and management strategies) and implementation (carrying out, monitoring and evaluating management policies) have proved to be of immense value.

Further, 3D models/views of the ancient monuments help us to better understand the

spatial objects, even if they are not accessible. Use of models created from existing objects can enormously ease the understanding of complex spatial structures and help propose the required interventions of the monuments.

### SATELLITE DATA FOR HERITAGE SERVICES

In recent years, remote sensing has received considerable attention in heritage research and blending of satellite remote sensing techniques with GIS, the monitoring process of heritage sites can be efficiently supported in a reliable, iterative, non-invasive, rapid and cost-effective manner. Table 2 is a list of the orbiting satellites (year of launch and resolution in meters), useful for cultural heritage site identification, data collection and management. Some among these offer data products directly importable into the GIS environment, whereas certain others need conversion. Moreover, satellites like Quickbird, IKONOS, WorldView and GeoEye have spatial resolution up to 0.5 m, and hence can quickly and easily facilitate detection of archaeological or CH sites.

**Table 2**  
**Satellites, Sensors, year of launch and Resolutions**

No.	Satellite	Sensor	Launch Year	Resolution, m
1	Advanced Land Observing Satellite (ALOS), Japan	PRISM	2006	2.5
2	China-Brazil Earth Resources Satellite (CBERS - 2)	HRCC	2003	20.0
3	Earth Observing (EO-1), USA	ALI	2000	10.0
4	FORMOSAT-2, Taiwan		2004	2.0
5	GeoEye-1, USA		2008	0.41
6	IKONOS, USA		1999	1.0
7	IRS Cartosat-1, India	IRS-P5	2005	2.5
8	IRS Cartosat-2, India	IRS-P7	2007	1.0
9	IRS Resourcesat-1, India	IRS-P6	2003	5.8
10	IRS Resourcesat-2, India	IRS P6	2011	5.8
11	IRS P3, India	1C / 1D	1996/97	5.8
12	Korea Multi Purpose Satellite (KOMP-SAT-2), S. Korea		2006	1.0
13	Landsat 5, USA	TM	1984	15.0
14	Landsat 7, USA	ETM+	1999	15.0
15	Orbview-3		2003	1.0
16	Pleiades-1		2011	0.5
17	Proba	CHIRS	2001	17.0-34.0
18	QuickBird, USA		2001	0.60
19	RapidEye		2008	5.0
20	SPOT-4	HRVIR	1998	10.0
21	SPOT-5	HRG	2002	5.0



22	Terra	ASTER	1999	15.0
23	WorldView-1, USA		2007	0.5
24	WorldView-2, USA		2009	0.5

### MONITORING HERITAGE SITES USING GIS AND RS TECHNOLOGIES

In many regions of the world, cultural heritage sites and visible monuments are monitored generally with onsite observations, including data collection, periodic visit/inspection of archaeological sites and multi analysis risk assessments. Onsite observations are time consuming and not cost-effective. From the 1990's, GIS and RS technologies were used systematically for archaeological research. Hadjimitsis et al., (2011) highlighted the benefits of integrated use of satellite remote sensing with GIS for exploring the natural and anthropogenic hazard risk of the most significant cultural heritage sites in Cyprus. Lasaponara and Masini (2007) highlighted the potential benefits of high resolution satellite images in order to detect subsurface monuments through the use of vegetation indices and edge detection techniques. Cavalli et al., (2007) introduced the use of airborne hyper-spectral scanner Multispectral Infrared Visible Imaging Spectrometer (MIVIS) for the detection of subsurface monuments based on spectral anomalies. Aqduş et al., (2008) used the combination of hyperspectral data and several remote sensing processing techniques (Principal Component Analysis, vegetation indices, etc.) for the detection of subsurface monuments in eastern Scotland. In the ancient city *Sagalassos*, Laet et al., (2007) applied object-oriented techniques and several satellite images (ASTER, SPOT, IKONOS) in order to identify archaeological remains. Lasaponara et al., (2011) investigated the Piramide Naranjada in Cahuachi (Peru), using high resolution satellite imagery, geomagnetic surveys and Ground Probing Radar.

### HERITAGE STUDIES USING GIS AND RS TECHNOLOGIES IN INDIA

In the late 1980's, India launched the IRS 1A, 1B, 1C, 1D and IRS P2 sensors (Tripathi 2005a). Although these data have been used for archaeological purposes in India, such as the identification of the mythic site *Dvaraka* (Tripathi 2005b) and the observation of *Hampi* site (Raj et al., 2005), their use is very limited in other regions. Natural Resources Data Management System (NRDMS), Department of Science and Technology (DST), Government of India initiated the Indian Digital Heritage (IDH) Research Project. The basic goal of IDH project was to bring the power of GeoICT (a fine synergy of Geospatial technologies with Information Communication Technologies and development of technology tools), to help preserve, use and experience of India's vast heritage in digital form.

### SUMMARY

The cultural heritage, CH, or the heritage of a nation or region in general, is unequivocally an important add on to the quality of life or happiness of the respective societies as well as to the international pleasure travelers, research workers like cultural anthropologists, analysts, cinematographers and so on.

The heritage sites and the various unique elements of the site like ancient monuments, excavated and restored sites or excavated but only exposed ruins,

figurines, coins, other icons like wall or stone face engravings, remains of buildings with unique architectural styles and such others are in various states of natural deterioration. Alongside, these sites/objects of heritage are systematically vandalized and clandestinely plundered for trading internationally with a profit motive.

The laudable the efforts of the UNESCO in enlightening the national governments and local advocacy or activist groups, on the compelling need and urgency for protection, conservation and maintenance have largely been responsible for the slowdown of the robbing or misuse of elements/objects of heritage in the member nations.

However, the UNESCO on its part though, is mandated to help identify and advise or offer expert scientific service on the preservation techniques or technologies, but not render any financial assistance in the restoration and preservation tasks. In fact, UNESCO has come out with a manual on using modern computer assisted methods like GIS, in archiving the details of spatial heritage data and item or site attributes for better management of such treasures in the member nations.

A synergy of GPS, Total station data and the high resolution satellite remote sensing images, will unquestionably and distinctly enhance the precision and easy transport/adaptability of CH data in a GIS platform. GIS based CH information system is a very powerful and 'real time' tool for all efforts focusing at conservation, dissemination, global presence and research.

We hope that the model template developed by us for a GIS environment and proposed in this paper specifically on places of worship in Kerala – only one category of Kerala's CH - will quickly earn the attention of the concerned, such that a new mission or effort in this direction for documentation and conservation could be considered for implementation and launch. If required/requested, we the CED will gladly participate in this mission in any manner that the authorities deem fit and appropriate.

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# Performances, Art, Folk Narratives in Kerala and Sustainable Environment Management

**Dr. C R Rajagopalan**

*Hon. Director, International Centre for Kerala Studies, University of Kerala, Kariavattom P.O., Thiruvananthapuram, Kerala 695581, Phone:09446987766, Email: rajgopalcr@gmail.com*

## INTRODUCTION

Kerala, a region of inhabitants with ancient cultural imprints the 'First peoples' in the mountainous regions of Western Ghats, numbering about forty groups of natives, the rural agriculture people and craft communities have the tangible and intangible traditions, revealing the rich eco-heritage. A small strip of land in the southwest corner of the Indian subcontinent has been much fabled over the centuries for its incredibly high diversity, be it spices or plant wealth or cultural expressions.

Each community has distinct bio-cultural features, eco-history and ethno aesthetics. The natives living in tune with nature have a very strong living oral narratives, craft culture, epistemology and traditional ritual performances encoded with a number of concepts for the conservation and enrichment of biodiversity. Their indigenous knowledge systems and culture impart a lot of information about their contributions for preserving the ethno science and sustainable environmental management; and this forest and agricultural lore about their landscapes was handed over from generation to generation. Their knowledge about the medicinal plants, tuberous roots, honey and rice varieties is rich and scientific. Animism, anthropomorphism, totemism and nature worship was a strong concept and also a practice; hence they had a devotional feeling towards land, animals, plants and the whole forest landscape. They worshipped trees, animals, hills and rivers; and their myths, legends and songs are indicators of their intuitive knowledge about Mother Nature. Indigenous people have acquired knowledge about their surroundings through hundreds of centuries of experience and observations. This paper reveals the strong ecological and cultural legacy of Kerala.

## TRADITIONAL ENVIRONMENTAL KNOWLEDGE

Indigenous Knowledge is the traditional knowledge of the indigenous people of a region. Every folk group collectively expresses itself and the signs of sustainable environmental wisdom through it. Mainly the group uses its performances and oral traditions as mediums to communicate from one generation to another. Ethno

music, performances, mythology, games, handicrafts and rituals represent the whole cultural scenario of the society.

The earliest inhabitants of the pristine rainforests of Western Ghats were the Australoid, Negroid and Pre Dravidian people. They represent a rich cultural diversity from the hill tribes that were hunter gatherers or nomadic, to people that cultivated land shifting cultivation. The Kuruchiyar, Adiyar, Muduvan, Malayan, Irular, Kani and Paniyar are such tribes, to name only a few. The Western Ghats is inhabited by over forty with their diverse oral learning systems, art and ritualistic performances still preserved. In forests like Parambikkulam, Nilambur, Muthanga and Thenmala they nurture the totemic belief system where in animals and trees are seen as related in blood to the human being. The traditional knowledge of the forest and environment that they possess is perhaps the reflection of such beliefs in respect of Mother Nature. The 'Sahyadri' forest is a hotspot of diverse flora and fauna. The ethnic people living in these forests have an intricate knowledge of animal distribution and animal behaviour. Natives in forest have bisons, elephants, bear as their totems. They believe that these animals were all friends and family to their tribe: the bison got them rice, elephant got them fruits, bear got them honey; and that it is the growing greed of man disappointed and alienated these creatures.

The natives have a unique worldview of the forest and its ecology, which is part of the eco-history of the landscape. Indigenous forest communities consider 'vayals' in the forest as the 'watershed of the forest' and revere them as a sacred element. These habitats help to retain the alluvial soil and water level of the area, providing ecological balance. They also observe the behavioural system and internal signalling method and the communication net work of the animals in the forest. These swamps are left untouched and protected by forest communities which are the like herbaria of the forest. The non-intrusive 'observation method' can be used to understand native perception and epistemology. Appropriate usage of the method has the potential for improving forest management practices.

### **Historical aspects of the Heritage of Kerala**

#### ***Rock carvings***

The rock carvings, engravings in Edakkal cave in the verdant northern region of Kerala called Waynad, were the first specimens of drawings from India. "Edakkal" meaning "a stone in between" describes how this cave is formed by a heavy boulder straddling a fissure in the rock. Discovered by Fawcett, the Superintendent of Police of Malabar district in 1890 during a hunting trip. Edakkal is located near Ambalavayal in Ambukutthi Hill. The prehistoric rock etchings found on the walls of the cave date back to over 5000 years, suggesting that the cave has been inhabited in various stages in history. Motifs in the cave have depictions of the sun, animal figures, Brahmi inscriptions, a cart, a bow and mask dancers. Today the cave is still sacred for tribal people and is a sign of primitive art and ritual.

#### ***Sacred Groves***

In the ecological heritage of Kerala, sacred groves and mangroves have a vital role in the preservation and conservation of biodiversity. All the villages have semi-evergreen groves as land part of few chief houses a quarter of the area should be

set apart, preferably near the pond and under shady trees to the south west of the main house where the snake deities would be enshrined. The members of all communities would engage snake charmers to conduct the snake worship according to the indigenous practices. It has one or more idols consecrated on a chithrakoodam (a laterite permanent pedestal) by a Pulluvan. The idols of kavus could assume the representations of Nagaraja, Naga Yakshi and their descendents. They should be represented by stone images showing hooded cobras installed under preferably Ungu trees (*Pongania glabra*).

These sacred groves are a habitat for diverse groups of unique and rare living trees (Pala - *Alstonia scholaris*, Arali - *Nerium*, Sindooram - *Vermilion*, Kanjiram - *Nux vomica*, Al-*Ficus religiosa*) including endemic and endangered medicinal plants and numerous shrubs and creepers. They are the home for myriads of insects, birds, reptiles, animals and treasure houses of diverse natural wealth. There are taboos and rituals connected with these groves. These wild groves help to retain the alluvial soil and water level of the area providing ecological balance for the villagers. These groves are left untouched and protected by local communities are reluctant even to break a dead wood in the grove, which are like herbariums of the village. Such strict taboos indirectly preserved these groves in their virgin form and such customs reflect the worldview of the local community. It accorded with the wisdom of indigenous peoples who had developed life styles and expertise that enabled them to co-exist with snakes. It also led to the accumulation of great wealth of snake lore and fertility cult which become an integral part of the ecological heritage of Kerala.

### ***Ayurveda***

Ayurveda is a way of life and qualitative. It offers a framework of how we can modify our lifestyles to optimise our bodily functions. The philosophy of Ayurveda is based on the theory of the five elements (Panchabhoota). From this theory emerges the theory of controlling the forces or doshas, i.e vaata (motion), pitta (energy), and kapha (inertia) that act on the tissues (dhatus). Classical Ayurveda depends on three books in Sanskrit –the Charaka Samhita, Susrutha Samhita and Ashtangahrudayam. Palm leaf manuscripts contain several of our healing systems. Dashapushpam (the ten flowers), food customs in the Karkidakam month and Marunnukanji (herbal porridge) are some of the ways how rural families preserved the knowledge of medicinally valuable plants. Among the diverse plants of the wilderness in Kerala, medicinal plants constitute an important source, the use of which for human and veterinary health care has continued in an unbroken folk tradition – both written or codified and oral folk and tribal, home remedies.

During 1678 – 1703, an important treatise compiled and printed by Hendrik Van Rheede, the Dutch Governor of Cochin, was published. It was called Hortus Malabaricus (Garden of Malabar) and had descriptions and illustrations of 742 plants with Sanskrit and Malayalam names. The ethno medical information presented in the work was extracted from palm leaf manuscripts by a famous Ezhava Vaidya named Itty Achutan. All the country around was diligently searched by the natives best acquired with the habitats of plants; and fresh specimens were brought to Cochin where the Mathaeus sketched them with striking accuracy. Malayalam script was first seen printed in Hortus Malabaricus.

### ***Ship Building Technology, Bepur***

The Malabar wooden vessels referred to in Arab history are an important geographical indicator. The mode of transport for the sea trade with Malabar needed boats, catamarans and ships. We had trees like Jack, teak, mango and also had the best available technology needed to build ships. Ship building units were scattered along the coast and they worked mostly on orders from Arab and Kuchh traders. A boat was recently excavated at the sleepy hamlet of Kadakkarapalli near Thykkal in Alappuzha and has been protected ever since. 'Odaayi', a specific ship making community in Chaliyam Kadavu at Bepur near Kozhicode could be seen as a remnant of the ship building industry that was alive in the past centuries.

### ***Martial Arts***

Ballads of Thacholi and Putthooram heroes that were sung in the 'Vadakkan Paattukal' and several Theyyam Thottam songs of north Malabar may be familiar. Called Chekkonmaar, these two heroic families were experts of Kalari Payattu, an age old institution and martial art of Kerala. 'Kalari' the space where the martial art is performed, symbolises the universe. A Kalari student applies gingerly oil or herbal oil before entering the Kalari, as a way to render coolness and flexibility to the body. They use a variety of weapons—dagger, spear, and sword; It is said that the eye becomes the body for a Kalari performer, meaning how sharp the eye needs to be.

### **SUSTAINABLE TRIBAL WISDOM: A CASE STUDY**

Ancient tribes had practiced a number of magic performances under the priesthood of the leader to ward off evil spirits considered to be responsible for various diseases. This practice accompanied by the administration of medicines extracted from plants can be termed as relief Magic. Adiyar, Kanikkar, Malayan, Kadar are the main tribes having medicine-magic practice combined. Gaddika, Chattu pattu, Muram kilukkipattu are the prominent relief performances. Muramkilukkipattu is a magic ritual of song by shaking the bamboo basket for instance, is a shamanistic performance of Malayan. The person who governs the tribe is called Elumooppan and the one who does the medical practice is known as Poojari Mooppan whose qualifications for such high positions in the settlement are heredity, knowledge of biodiversity and also the respect the tribal members have for them. There will be an auspicious sacred grove in each settlement where Malayar worship their forest God. Sometimes this site may be a small raised base around a pala (*Alstonia scholaris*) or Arali tree, or a stone conceived as Malamkurathy, the forest Goddess. Along with the magic practices they have some performances such as Kavarakali (kavara dance a animal mimicking dance), Anakali (elephant dance), Polikali (circle dance) and Koorankali (a animal mimicking dance). These tribals who preserved the concept of biodiversity in their myths and world view worshipped the natural forces like the sun and plants. The never drying water sources in forest are called Pazhavelom (old water) which they won't pollute even by touch because they believe that the springs will disappear if not respected.

Malayan tribe traditionally worships Malamkurathy and 'Muram kilukkipattu' is an attempt of the shaman to find out the details of and reasons for the disease. The shaman will be keenly observing and searching the winnow basket shaking his head

while singing. The iron chain that is shaken in the winnow basket falls down in the process. If the chain is seen entangled the shaman decides that the spirit is a very powerful one. The chain is a sign of the generations. This treatment is a combination of belief and medicines. The shaman has an intuitive power to know how the patient fell victim to the evil spirit and also to prescribe the proper medicine.

Using rhythm, music, breath control and body movements the shaman invokes the spirits and controls them to make them reveal the secrets to him. Great confidence is obvious in the magical performance and also in his statements such as "I can see the forest spirits. I shall question them." The confidence is derived from the ethno music which is one of the sources of inspiration and intuition for the tribes who have acquired the forest knowledge for generations. The forest lore is a composite form of ethno botany, ethno zoology and ecology. The triangular shallow winnow basket is made of bamboo available in the forest. Since it is used only for this performance and not for any other purpose such as sieving this winnow basket is specially made by the person assigned to it by observing a devoted penance for seven days.

### **ECO- HISTORY**

Indigenous aesthetics is the sum of all the cultural expressions traditionally attained in every field of art by the indigenous people in each place. Eco-aesthetics have views different from the conventional Western aesthetics. Its strategies are totally eco-centric and objective as well as intuitive and they are derived from practical and innovative life of the generations. The images, motifs and cultural codes in the local myths and performances are imprints of their life and primitive landscape. Their songs and myths are the diachronic documentation of eco-history. Performing arts are the visual language of the landscape they live in, and all of them invariably are the register of the biodiversity. The natives have a unique world view of the landscape and its ecology, which is part of the eco-history of the landscape. The midland culture of Kerala is mostly agrarian. Small groups working in the land collectively perform various rituals and most of them are connected with Mother Goddess concept of fertility ecology. Protection and preservation of the different types of fields and seeds is part of their performances and rites.

The ethno-aesthetics cannot be defined as a universal formula for everything and everywhere, but it sprouts from the logic of the local artists and specific art and culture of a landscape. The subtle categorisation of aspects related to conservation eco- art, indigenous agri-culture, etc. at micro levels, is done by acquiring creative knowledge from local people intricately and is supported with the message of sustainable harvesting of biological resources. The methodology of acquiring knowledge, used by traditional people, is through 'seeing, hearing and doing' and is connected with the diachronic nature of myths, proverbs, ancient sayings, etc

### **Cultural Landscape in Sangham Literature Eco- aesthetics**

The early South Indian literature is popularly known as Sangam Age. The classical Sangam literature dates from the 1st to 4th Centuries AD and consists of a collection of poems and a number of literary works dealing with eco culture. In these texts the poets describe the ancient concept of classifying the physio geographic features of landscape into five divisions from forests in the mountains to the sea shore.



The main themes of the Sangam literature are love and heroic element. In 'Akam' (inscape) love-poetry, 'the life of a couple of lovers is given its setting in time and place (mudal), its natural background (karu), and then the details of their conduct (uri) are worked out.' Uri in Tamil means appropriate human feelings.

The word 'thinai' represents the primitive eco-zones. The five-fold categorisation of the landscape is called Aintinai. Kurinji(hilly forests), Palai (parched dry zone), Mullai (forests and pastoral land), Marutam (wet agriculture land) and Neital (sea shore). Each eco-zone has its own flora and fauna and cultural semiotics. This poetical description of the landscape is intricately woven to the environment and sustainable. In Sangam literature poets describe the totality of eco culture of time, space and human experience. Akam poems are filled with the cultural expressions and descriptions of natural, genetic resources, the expressions of inner feelings of the outer sacred landscape. The word like 'kurinji' used in 'thinai' stands for the endemic flowers of the landscape. This description is on the micro level sustainable life pattern of the villagers in primitive period about nature and wilderness. Each thinai has its own ethnic cultural motifs like musical instruments, the vegetation, animals, ethnographic details and social life etc. It represents the development of history from hunting and gathering, fishing and plundering and craft production, animal husbandry, shifting cultivation and agriculture etc. The basics of the environmental aesthetics is the geographical concept

### **Oral narratives**

Before the invention of script and written language, ideas and thoughts were communicated orally. The basic elements of culture can be found in oral narration, which has diverse patterns of presentation. Proverbs, myths, legends, songs of hero worship and riddles, ancient ballads are some of them. Males and females have different songs connected with ceremonial functions and dance performances. For children the songs are educative and connected with games and fun. Songs are the main branch of verbal art and among them, those connected with agriculture and heroic personalities are prominent along with Thottam pattu, Koothu pattu and Chattupattu.

The diversity of a society can be understood by the process, methods and rituals connected with agriculture. The songs of agriculture are encoded with the concept of food security, traditional technology, climatic change and the worldview of the people. Most of the songs are connected with soil, water, seed, climate, local food habits, fertility and collective farming. A song in Attappady shows the relation of humans with soil and nature.

'The tree exists believing the soil  
 And the soil stays believing the tree,  
 The branches are intact believing the tree,  
 The smaller ones believing the bigger branches,  
 The leaves live believing the tiny branches,  
 And the flowers blossom believing the leaves,  
 The seeds ripen believing the flowers,

And we live believing the flowers,  
The land lives believing us.'

The web of life is so woven in this song that we get the outlook of life and also the co-existence of each and every aspect connect with humans, land vegetation and everything. Here, one thing to be noted is that the humans are given 8th place in the hierarchy of natural existence of life showing the attitude of the tribe giving importance to the nature centered being of all the creations.

Another fertility song:

'Hail, hail, hail the luxuriant growth,  
Hail the hill and hail the pond,  
Hail the cattle and hail the land,  
Hail the seed and hail the grove,  
Hail, hail, hail the luxuriant growth'

It is a wish song for the luxuriant growth of everything in nature that clearly depicts the landscape and waterscape of Kerala. The ethno music tradition of marginalised community in Kerala, basically agricultural society worshipping Mother Goddess, the fertility deity, doing dance and beating drums in post harvest rituals. Music, dance and rhythms are combined in the performance. Most of the songs in the vibrant rituals are on agricultural life circle, indigenous environmental knowledge of the traditional community. It narrates the local legends and tales connected with the ethno history and biosphere. The wind instrument, 'Kuzhal' accompany with the beating instrument, 'Maram'. 'Mudiyattam' is the main performance, done by women folks, waving the hair for both sides. During the performance the dancers become in a trance-transformation situation.

Kerala has at least three traditions of ballads-Southern, Northern and middle land. Thekkan pattu is performed as part of bow-song from Kollam to Kanyakumari. These songs, ritualistic in nature, glorify the heroes and heroines who have sacrificed themselves for society in heroic actions. Vadakkan pattu in the northern parts of Kerala the women folks in the farm, those who operate the wheel to irrigate the field, cook while preparing food for feasts used to, sing the heroic deeds of legendary characters. These songs narrating the diversity of the culture can give information about the values, beliefs and agricultural practices. These songs are woven according to the oral formulaic theory.

Sacred 'thottam pattu' is sung as part of Theyyam, Padayani, Mudiyettu and also in connection with the worship of serpent, Kali, Kannaki and others. Thottam is derived from the root 'thondruka' meaning 'to create'. The myth of the deity sung with the accompaniment of instrument is thottam pattu. The aim is to make appear the deity by the help of floor diagram or by making up one's body in the form of that deity. This ritual song is something that sprouts from the mind of the singer.

### **Eco-aesthetics of visual anthropology**

Folk aesthetics are different in form and spirit from the conventional ones academically accepted by the elite class and scholars. Most of the conventional aesthetic discourses are derived from and controlled by the Greek, Sanskrit and

the Western 'Modern' doctrines. The Euro-centered white myths and texts with the stamp of authority are studied by using the methodology of the customary academic discipline. By subjugating centuries- 'primitive aesthetics' of the oral tradition the history itself could cleverly be distorted.

During the 20th Century a number of tribal and aboriginal narratives, performances and sculptures were collected by ethnographers and folklorists with great curiosity. Not being able to enter into the essence of the folk art forms, some scholars qualified them as simple, unfinished, crude, inferior and without artistic inspiration. These perspectives, derived from the western and phallogocentric thoughts, are now already questioned and ethno aesthetic is studied in a differently contextualized space. In tune with nature, life has been one with the art forms for centuries for folks who expressed their worldviews through their body language of communication, the aesthetics of which could not be read by the dogmas propagated by the modern cultural thought. Each folklore is connected with the myth, ritual, magical aspects of the life of the people. These forms encode the history and ethnic tradition; their cultural expression has a diachronic aesthetic, with a long- time series of information on art at one locality. They memorise in mythical and proverbial language the history of sustainable ecology.

The indigenous communities are masters of Kalamezhuthu, the floor paintings. The five basic colours used are organic, yellow from turmeric, black from burnt husk, green from leaves, red from lime and turmeric and white from rice flour. For performances such as Mudi yettu, Theyattu it is ritualistic to draw a Kalam on the floor. The songs of praise for Kali is sung while the picture is drawn. When the picture is complete, the final step is to draw the eyes of the Devi. In these Kalams, the scene is usually of Kali wearing the expression of 'raudra bhangi' after slaying Darika and blessing her people. Different communities across Kerala engage in this folk art – the Pulluva, Paraya, Kuruppu, Mannan and Marar are some. There is an incredible variety of these paintings-Pathirakkalam, Kolam, Mantravadakkalam, Kuttichathankalam, Sarpakkalam and Devikkalam. A Sarpakkalam is usually drawn in sacred groves.

In temples of northern Kerala, wooden carvings on pillars, ceilings, panels and walls were painted with basic natural colours – red, black, yellow and green coated with lac. Artists belonging to the Kdaran community have been involved in painting the wooden carvings. The Veeralipattu with typical geometrical patterns is an example of the wood carvings they made to decorate temple interiors. Wall paintings or frescos in temples and palaces are with their vivid colours. Common colours used in mural paintings are red ochre, yellow ochre, green, indigo blue, yellow, and lamp black. The roots of the Kerala mural art can be traced to the ancient Dravidian art of Kalamezhuthu. The murals in the Kanthaloor and Trivikramapuram temples in Trivandrum and the Parthivapuram temple are the oldest temple frescoes.

In all the popular visual and movement art forms of Kerala there are extensive use of face paintings, is it Koodiyattam, Krishnanattam, Kathakali, Theyyam, Thira and Mudi yettu. The Vannan and Malayan community specialise in the art of face painting and there exist at least forty kinds of face paintings. Prakk ezhutthu, Nari kurichu ezhutthu, Vairadalam and Vattakkannittu ezhutthu are some that give a sense of richness. The face paintings could take three hours to complete and are an essential

element of the entire costume. They commonly use chayillyam, manayola and other natural colours from turmeric, lime and coal and bring on the face the expression of the characters in a myth. Come September and the town of Thrissur comes alive with sounds of 'tigers.' Hundreds of men and young boys spend hours getting their body painted from head to toe to resemble a tiger.

### **Ethnomusicology**

The music of Kerala is as old as people and their culture and have a rich diversity in ethno - music tradition. Folk and classical instruments of immense diversity are used by musicians. We have in our heritage a possession of about eighty instruments - wind instruments, string instruments, percussion instruments and metallic instruments. Nanthuni is used for Devi's Thottam Paattu; Mizhavu is a percussion instrument made of copper pot used in Koodiyattam. Other instruments are Tamberu, Udukku, Chenda, Maram and Thudi. The Villu is the used for the performance of Villupaattu.

### **Krishigeetha and Agricultural Heritage**

Agriculture was an important livelihood in Kerala. Among the folk texts on agricultural practices before the colonial period, 'Krishigeeta' may be the most important one. Paddy is almost synonymous to the landscape. Pokkaali and Navara are our native traditional varieties of rice with exceptional qualities and have got the attention of global agriculturists. Illamnira, Putthari and folk performances are some of the fertility rituals that continue to be practiced. The indigenous knowledge of the farmers could be used to find solutions to the current food security problems. Paddy fields are disappearing from our landscape due to the growing consumerist culture and it is crucial that we understand the importance of reviving traditional farming. The indigenous calendar of Kerala has an intuitive knowledge and takes into account microclimatic variations in rain patterns.

The rhythm of seasons was apprehended by the local people who watching the path of the sun, waxing and waning of the moon, rising and setting of the stars articulated their lives in tune with the nature. Collecting and compiling the local knowledge of the people Krishigeeta an oral text was composed in the 17th Century. This text elaborately describes the rain lore of the folk along with the detailed account of the seeds, paddy cultivation and other things connected with agrarian life. Krishigeeta was included in the curriculum of school education in Malabar and other places later. Till recently the farmers in Kerala followed the practices described in the text Krishigeeta. As this was a compilation of the local knowledge of agricultural practices, the farmers without any difficulty could continue these orally transmitted instructions for centuries. Keeping a strong scientific view this narrative is not just a text on agricultural practices of, but is rather a chronicle of the culture and attitude of the society towards farming. The description in the text ranges from the mythological dimensions of the narration of the pattern of rain to the scientific way of preparing fields and even agriculture markets.

### **ECO-PERFORMANCES: CULT OF MOTHER GODDESS**

Kerala is rich in folk performing arts; most of which are connected with rituals and faith. Mother goddess cult, fertility rituals, concepts connected with agriculture, the story of Chilappathikaram and local myths are the underlying spirit of them.

The performing arts can be defined as art forms presented in the open space by articulating the body language in connection with their concepts of rituals, magic healing and entertainment. Each of the art forms is born out of the necessity of the society during some specific contexts. The social interaction of the humans is today received as performance, and, hence, these can be termed as social drama. Some of the main performing folk arts of Kerala are Kothamoory, Theyyam, Thira, Poothan kali, Mudiyyettu, Padayani and Porattunatakam.

One of the myths of Kannaki Devi has it that she was installed and consecrated in Kodungallur. In the month of April, on days of Aswathi, Bharani and Kartika star thousands of pilgrims come with swords, anklets and flags singing Bhagavati songs reach the temple to touch the Kodungallur kaavu and make it 'impure' (Kaavuteendal). A large number of these pilgrims are women oracles robed in red; they throw turmeric, pepper and even hens in a trance and offer themselves to Mother Goddess. The fire element of the feminine spirit finds expression in this ritual.

### **Mudiyyettu / Intangible Cultural Heritage of Humanity**

The word 'Mudiyyettu' literally means that the encrowning of Kali, the Mother Goddess. The performance used to be performed in sacred groves where Kali was worshiped by local communities who are the custodians of biodiversity. This is a divination ritual performance to propitiate Bhadrakali in the Kavu temples during a post harvest festival. This folk ritual performance is very much related to fertility cult, ritual symbolism and mother goddess myth is connected with the indigenous agricultural landscape. One of the oldest ritualistic performances of Kerala, Mudiyyettu is popular in the rural area. This is performed even today in about two hundred sacred groves, Kali temples which are open - air theatres. Those belonging to the castes of Marar and Kurup are the performers. This folk drama, which is a combination of dance, music and rhythm is performed before the believers in an open arena theatre starting at midnight. In olden days the villagers patronized this performance, to ward off the fear of contagious diseases especially the much dreaded small-pox. The belief was that Mudiyyettu performance done in devotion would prevent the spread of disease. In this indigenous performance there is live audience participation.

The myth behind Mudiyyettu is the victory of Mother Goddess in the fight between the Kali and the male demon Darika and the annihilation of Darika by her. After the fight between Gods and those opposed to them, the Asuras were almost wiped out. But when the Asura mothers –Darumathi and Danavathi- wanted to have progeny the Gods blessed them with two sons Darika and Danavendra. These two Asuras become cruel kings. Darika obtained two boons from Lord Brahma, one is that no woman can kill him; second one is if one drop of his blood falls on the ground a thousand Darika like him will emerge. This made him extremely haughty and he became a torment to the world. Lord Siva was informed by the Sage Narada the menace faced by the people. To annihilate the two demons Lord Siva created a female force, sakthi, character called Kali from the third eye. The ferocious Kali finally chopped off Darikas head, killed the demon saved the world and blessed the people at large.

Kooli is the companion of Kali, but humorous unlike Kali who is ferocious. This comic relief character has ridiculous face make - up and exaggerated stomach and breasts. The first appearance of Kooli also has its own peculiarities. Kooli's

performance has a number of chances of improvisation. During the dialogue Kooli shows very humorous gestures, combing the hair, adjusting the dress etc. The crowd also encourages her; the crowd also join in the dialogue.

First a floral diagram, Kalam of Kali is drawn in the 'Klappura' with natural powders of five colours. After the invocation song the first act, the dialogue between Lord Siva and sage Narada will be enacted. After that we see the tumultuous entrance of Darika to the 'stage'. The typical stylised theatrical appearance of a performer and the establishment of the feature of a character through 'Chaturvidhabhinaya' in the performance is called 'Purappadu'. He enacts several pieces of dance, movement and sounds and retires. After the dramatic atmosphere created by Darika that Kali also makes her biostrous entrance to the open arena space with devotees. Then the next, the narrating or story telling character Koipata Nair makes his entry. The drummer takes on the role of an interrogator and asks the warrior character many questions which he replies in a funny way. Then enters Kooli, the comic character companion of Kali, she performs a lot of funny antics which provides a much needed comic relief from the intensity of the war atmosphere. This character goes to the opposite extreme of the serious performance of Kali. The actions and the body language of Kooli are filled with 'playfulness' having an effect of 'unofficial culture'. During the performance Kooli even carries grown up people from the audience and fondles him as a mother does a child. She enacts feeding the child her oversized and pointed breasts.

Then again there is confrontation between Kali and Darika. During this war performance there are many dramatic and trance induction elements in the performance. Kali sometimes get possessed. The ritualistic active participation of the audience and the constant rhythm of the musical instruments lift the psyche of the Kali performer and gradually elate him into a trance. In Mudi yettu performance we can see the first type of trance rhythms, the shamanic trances. During the dramatic performance Kali comes to an alter state of other consciousness situation-trance transformation before killing Darika, the demon.

### **Other intangible performances**

Confined to the Kannur and Kasargod districts of north Kerala, the annual season for Kaliyattam is a time of resplendence. Performances can be witnessed in Kavu spaces from the October to the end of mid May. They are held during nights and are in fact socio-religious ceremonies with ancient Dravidian roots; they are based on beliefs and concepts of tree worship, serpent worship, hero worship and Kali worship. The chenda, elathalam and kuzhal are the accompanying instruments in Theyyam. The performers with elaborate heavy head gears, colorful costumes and facial make-ups of nearly forty kinds, represent the local deities and during the performance they can often be seen reaching a trance. Theyyam usually begins with the 'thottam paattu' narrating the myth of Gods and is an invocation of the spirit and faith of the entire village. Before that there is a ritual of seeing the 'appearance' of Theyyam on mirror in the green room.

Thira is performed mainly in Kozhikode and Malappuram districts. In kavu and houses, this is done by Mannan, Panan, and Velan casts. This is mostly connected with hero-worship, animal worship, Siva worship. etc. and participation of public is

prominent. Vellattu and Anchati thottam are the main ritual aspects; it has got very complex face painting, attractive headgear, rhythmic steps and different styles of dance movements. The characters are ferocious who are propitiated for the benefit of agriculture, domestic animals and also to beget children and ward of the evil.

In the districts of Palakkad and Malappuram Poothan and Thira are performed in Kavu in connection with velavaravu. Poothan is a companion Bhutha of Kali, and Thira is a character carrying the semi-round headgear of kali; and both thira and poothan have very elaborate body movements and have the instruments thudi and para to accompany the performance. The performance begins from Thravattambalam and reach kavu after a long process of visiting many houses.

Padayani is a ritual art form performed in the Devi temples of Pathanamthitta.. It is a form of folk theatre dedicated to the primal Goddess. The performance that begins after harvest lasts 28 days that uses evocative language. The story most commonly dramatised in a Padayani is the scene after the annihilation of Darika, when the Kali sets out on her Kailasa journey. Figures are drawn in natural colours in which the enlarged shape of eyes in the night light glitter and seem to project up. The performance has got environmental acting and the people who prepare the pictures of the Kolams are expert folk painters.

Porattunatakam seen in Palakkad and Thrissur districts, this folk theatre is also called 'Manoranjam'. This may be a play of the 'outsiders' or the marginalized communities; and this is performed independently and also in connection with Kanyarkali and Vela festival. The everyday life and rift of the people and solution to the family problems are the main themes of this performance. Accompanied by songs, dialogue and drums Porattunatakam contains a lot of information about local history, local festivals, circus, zoo, different professions, etc.

Kothamoory folk theatre is performed in the Kasarkod district for the protection and safety of the cattle and agriculture. During the month of December the Malayar community of Kolathunadu performs Kothamoory from door to door of the houses in the village. Godavari cow is believed to be the mythical Kamadhenu and legend says that Kothamoory and Paniyans descend to the earth for the prosperity of village and agriculture.

During the festival season of Onam in Thrissur, children and youngsters participate in a masked semi ritualistic performance called Kummatti. They believe that the Kummattis are the bhootaganas of Lord Shiva of Vadakkunnathan temple. The Kummattis performed at Kezhakkumpattukara, Villatam and Oorakam are the most famous. The characters in the dance are Kaattalan, Hanuman, Sivan, Kiraatan, Bali, Sugreevan, and Sri Raman; Thalla (grandma) leads the troupe. Wooden masks sculpted by wood carvers are from trees such as Kumizhu and Jack fruit tree. Parpadaka pullu a kind of native grass is worn as costume. Kummatti songs are sung with the folk instrument Onavillu.

### **Koodiyattam Register**

Kerala is a hot spot of folk and classical intangible performances. Recently, UNESCO recognised Koodiyattom – a traditional classical theatre form, as an oral and intangible heritage of Kerala. Performers of Koodiyattom belong to the Chakkari community.

Of the eighteen Chakkial families who were traditional performers of Koodiyattom, about five including the Kidangoor, Painkulam, Mani and Ammannur families are active today. There is a reference to Parayur kootha Chakkial in the ancient Tamil epic of Chilappatikaram. Koodiyattom saw a revival under the guidance of Kulashekharan in the 10<sup>th</sup> Century. His composition Subhadra Dhananjayam, Tapati samvaranam, Vichinnabhishekam are performed till date. Bhasan's compositions form the main texts for actors of Koodiyattom. The Mizhavu, Edakka (percussion) and Kuzhitalam (cymbals) are the musical instruments used in this classical dance form.

The female aspect of the Koodiyattom tradition, Nangiarkkuthu, is the sole domain of female artistes belonging to the Nambiar community known as Nangiars. The actress dressed in elaborate costume uses complex hand gestures, facial expression –Rasabhinaya-and body movements. Story in Nangiarkkuthu is based on the epics of Krishna – Sri Krishna Charitam being the most popular. Nangiarkkuthu is performed in the Ekāharya Abhinaya or the single character style. In temples of ancient Kerala, a classical theatre –Koothambalam- was built for staging the Koodiyattom, Chakiarkoothu, Nangiarkkuthu performances. Wooden pillars, a green room, a square to store the mizhavu -percussion instrument, a stage and an audience space – these are the elements of a theatre and the architecture is such that the acoustics are of great perfection. The position of Koothambalam in a temple is the front right side of the principal deity. Kalamandalam, Vadakkunathan Temple in Thrissur and the Koodalmanikkam Temple in Irinjalakuda have the most architecturally famous Koothambalam.

Kathakali, one of the oldest theatre forms in the Kerala is a highly codified and refined dance drama – nritya- that combines devotion and stylised with symbolic story telling. The themes are often from the epics Ramayana and Mahabharata. A traditional Kathakali performance is dusk to dawn in the kalippanthal or any theatre. The technique of Kathakali is rather powerful with a highly symbolic language of gesture, through which the performer can convey whole sentences and stories (Vakyarthabhinaya and Padarthabhinaya). The face, eye and hand movements reveal skill and emotions. To attain the high degree of flexibility and muscle control, a Kathakali actor undergoes a strenuous course of training methods up to ten years, and special periods of body massage-Chavitti uzichal. The costume is composed of an elaborate make-up and large head dresses. The music style of Kathakali is Sopaanam and the rhythm of the Chenda, Madhalam and other musical instruments fill the audience with a sense of nostalgic memories.

### **Serpent divination performance**

The serpent lore of Kerala is a primordial form of animal worship. In sacred groves of Kerala, an annual ritual to invoke snake spirits is practised from December to May. The ritual involves a variety of performances such as floral painting in five natural colours, female serpent divination movement, and fire dance and ethno folk music. With their underlying belief in conserving the pristine and biodiversity in sacred groves, people practice these rituals even in modern times. In the eco history of Kerala, sacred groves have a vital place. All the villages have groves as land part of few chief houses. These groves are a habitat for diverse groups of plants including medicinal plants. The key musical instrument is called pulluva veena, the



strings of which are made using a climbing plant that grows in the sacred groves. A medicinal plant 'Naagachittamrtu' is used for the strings. There are taboos and rituals connected with these groves. All these groves have icons of serpents, and the singers sing prayers before the serpent Gods.

The Pulluva community performs serpent songs in sacred groves. They are the main custodians of the rituals. They are also community healers who handle common diseases in children. After the agricultural harvest the bards wander around in the villages and sing songs of prosperity. Three core musical instruments are used in the performance. Pulluva veena is called a 'veena kunjju' (baby fiddle). There is a primitive manner of making the strings. The ritual is performed in the front yard of the house or in the kavu. Temporary structures called 'naattupandal' are built and are decorated with flowers, leaves and fruits symbolising the fertile landscape. Inside the pandal floor, pulluvars decorate the snake figures in natural powders of various colours in folk style. The knots formed in the intertwined serpents are of great relevance. An Ashtanagakkalam is composed of 8 intertwined serpents, drawn with great skill and precision. Karinagam, Anjanamaninagam are varieties of Sarpakkalam. A Pulluva couple plays the Pulluva veena and the Pulluvakkudam and sings invocations to the serpent gods. The five colours used in kalam symbolise the growth of life in nature. Visual anthropologists split them as two cool colours, two warm colours and one neutral white. The dancers smear the kalam with tender arecanut flowers. During the process of transformation, they declare what snakes are inside their bodies and the wishes that would be fulfilled for the prosperity of the community and the family.

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# Museums as Centres of Education

## **Dr. B Venugopal**

*Director, National Museum of Natural History (Ministry of Environment & Forests, Government of India), New Delhi. Email: dirnmnh@gmail.com*

### **INTRODUCTION**

Museums are public service institutions for the benefit of community. They collect, conserve and exhibit tangible and intangible evidence of mankind for the purpose of study, education and enjoyment. In countries like India, museums have special role to play. The presence of objects that do not know the boundaries of language and literacy helps museums to be on an advantageous position, compared to other public service agencies, to serve as a socially relevant agency for the education and development of the community. But it is an accepted fact that museums in India generally do not fulfill its educational and other social roles effectively.

### **EDUCATIONAL FUNCTION OF MUSEUMS**

The earlier museums were scholarship-oriented, with objects of curiosity opened only to the learned and royalty. Common people did not have access to it. The two notable political events in modern human history, viz., the American Declaration of independence in 1776 and the French Revolution's Declaration of Human and Civil Rights of 1789, allowed considerable social reforms, including opening up of new opportunities for the development of education and culture. This new development further intensified the collection of objects of art and culture and a gradual increase in public access to museum collections. Education was put as one of the major functions of museums.

As a democratic country, the importance of museums in the society need not be over-emphasized. 'In the days of the old, the temples and all other places of worship were the rallying points of the society and they served as cultural and social institutions. They also served as centres of education. In course of time, this role has been considerably diluted, and the museums in recent times have come to their own to serve as educational and social institutions to serve the community. But enough advantage is not being taken by the prevailing education system or the society at large to make adequate use of the facilities and materials available at the museums' (Banerjee, 1990).

In spite of the fact that education is a major function of museums, there is ambiguity in the minds of the public as well as Museologists with reference to its educational role. The challenge of dealing with museum education is emphasized in the following quotation: 'As this commission first began to consider the matter of museum learning for a new century, we knew we faced a particular challenge. Educational responsibility is firmly imbedded in the philosophical foundation of museums, but there is no clear understanding of how people can learn best in the museum environment- a situation that is ironic when one considers the quantity and quality of educational programming in museums today. Confusion on the learning function of museums stems in part from the failure of museum professionals to articulate, to the satisfaction of all involved, the nature of learning experience. Although museums are plainly institutions of object-centered learning and there is interest among educators and administrators alike in formulating museum learning theory more clearly, there is no accepted philosophical framework. Discussions invariably focus on the nuts and bolts of programming on specific activities, materials and methods. These practical matters are important, but not as important as explaining issues that define learning in the museum context' (American Association of Museums, 1984).

### **THEORIES OF MUSEUM EDUCATION**

Education is defined as the process of experience, generally called learning, which brings in desirable changes in human behaviour with respect to knowledge, understanding, skill and attitude. Education, as per modern context, is meant to bring in desirable changes in human behaviour. The changes in behaviour that represent basic features of education are knowledge, understanding, skill and attitude. These changes that constitute one's behaviour are brought about by experience commonly called as 'learning'. Thus the term 'learning' stands for all those changes and modifications in the behaviour of an individual, which he or she undergoes from his or her birth till death.

Hooper-Greenhill (1988) considers museums, in the context of education, as an institution that can offer an educational experience across a wide range of variables and in relation to a wide range of institutions and organizations. The meaning of museum education is that museums provide a learning situation in which the visitors experience learning. A learning situation is a condition or environment in which all the elements necessary for promoting learning are present. Learning experience is the mental and/or physical reaction one makes through seeing, hearing, or doing the things to be learnt and through which one gains meanings and understanding of the materials to be learnt.

As mentioned above, museum education essentially involves learning experience by visitors in a learning situation provided by the museum. John Falk and Lynn Dierking (1992), who had extensively studied museum education in the USA, India, UK and many other countries, describe learning in museums: 'Learning in museums generally involves a visitor or a group of visitors attending to an object, a display, label, person, element or some mental construct of these. Normally, visitors attend to objects they are interested in rather than those they are less interested. Interest in such cases is based on prior experience, but can also be elicited as a short-term by

something unusual capturing the visitors' attention. This facet of museum learning has long been examined in relation to attracting power and holding power of exhibits in museums. The information thus collected by the visitor is stored in the brain and remains there over a period. Some of these memories are reinforced by previous and future experiences, and become a permanent part of memory, while others do not persist. At some future time, the memories that persist are available for the individual for retrieval. The information a visitor perceives during a museum visit tends to bear a 'contextual map'. The museum visit represents a collection of experiences rather than a single unitary phenomenon. Any information obtained during the museum visit is likely to include social-related, attitude-related, cognitive-related, and sensory-related associations. These associations will become embedded in memory altogether with the result that any one facet of these experiences can facilitate the recall of the entire experience.

The importance of objects in museums can be assessed by the International Council of Museum's (ICOM) definition on museums mentioned earlier. The word 'material' indicates something that is tangible while the word 'evidence' guarantees its authenticity as the real thing. Thus the basic thing that every museum has in common is the collection of material evidence. Museum objects are an important part of the cultural and natural heritage. They act as important means of work and represent the basis of work as objects of research for various technical, social, and natural science branches such as botany, zoology, palaeontology, minerology, geology, history, history of art, archaeology, ethnography etc. Objects can make a unique contribution to our understanding of the working of individuals and societies; in short, it can tell us more about ourselves. Hence, we collect objects to show illustrative examples of society and individuals. 'There is no one constant meaning for objects. The reader-text relationship, which suggests that people find their own ways of interpreting written texts through an interactive process, is also true of the interpretation of objects. The meaning of an object cannot be reduced either to the materiality of the object, or to the subjectivity of the viewer, but exists somewhere between the two. It follows from this that each object means something different for each viewer.'

Recently ICOM changed its definition of Museums to incorporate the intangible aspects of collections/objects. This combination of tangibility and intangibility of Museum collections/ objects adds to the educational value of Museums and helps it to serve as centres for the safeguarding of Intangible heritage as well. The NMNH has organised a large number of workshops and exhibitions in this regard. The Kalady workshop on "Museums and Intangible Natural Heritage" (2011) is an example.

Learning in museums may be compared with that in schools (Table 1). Museums provide learning situations quite different from those provided by formal educational institutions like schools:

- Museums provide free-choice learning situations devoid of verbal instructions, assessment, and other types of controls that exist in schools,
- Learning in museums is a spontaneous process, a personal experience not imposed on the visitor,
- Museums provide open communication of ideas, concepts and information involving exploration and discovery, and

- Classrooms in schools are home for 3 R's: reading, -riting, and -rithmetic, whereas museums are home for 3 A's: the authentic, the aesthetic and the accessible. The authenticity, as revealed by real objects and phenomena exhibited in museums, communicates with a powerful clarity to visitors. Museums are compelling aesthetic environments: they engage the senses, stimulate, inspire and sometimes even overwhelm. Museums make the whole world, the past, the present and the imagined, accessible to the visitor (Voris, H.H., Sedzielarz, M. and Blackmon, C.P. 1986).

**Table 1**  
**Comparison of learning in Schools and Museums**

	<b>Criteria</b>	<b>Schools</b>	<b>Museums</b>
1	Free-choice	No	Yes
2	Instruction based on	Text	Object
3	Senses most used	Oral	Visual
4	Formal assessment	Yes	No
5	Syllabus-oriented	Yes	No
6	Time schedule	Yes	No
7	Learning	Linear, Non-spontaneous	Multi-faceted, Spontaneous

The concept of discovery learning (DL) was a major contribution to the learning process of children in museums, especially the natural history museums. Here visitors, especially children are free to handle, play with, manipulate and interact with objects. Here learning is fun and unlimited. Discovery Learning means acquiring the skills necessary to make discoveries by one. Museums employ Discovery Learning when they set up open-ended, relatively unguided experiences that encourage inductive reasoning. The main proponent of the theory of Discovery Learning is Jerome Bruner.

The basic philosophy of Discovery Learning involves the following aspects:

- Learning through objects,
- Importance of various senses in learning, and
- Importance of interactivity in learning.

Here it is pertinent to quote the famous Chinese proverb:

- 'What I hear, I forget,
- What I see, I remember,
- What I do, I know.'

The proverb may be extended further as 'What I discover, I use.'

Discovery Learning theory is being extensively used in museums and other similar informal learning settings. Such Discovery Learning settings (DLS) are now becoming more popular with museums, zoos, aquariums, sanctuaries and other institutions involved in nature education.

Museums are also increasingly considered as centres of life-long learning and education. This may be due to the following reasons:

- People of all ages such as children, teenagers, youth, adult and the old visit museums.
- There is an increasing need for non-formal education such as open schools, open universities, adult education centres, and out-of-school centres, and
- People learn throughout their lives and not only as students, such as for example, through experience.

Museums are an exceptionally useful resource for special education, that is, education to the specially needed people like the disabled (differentially-abled). Education to them is becoming increasingly felt by socially committed museums. Communication and learning in museums is based on real objects that do not know the boundaries of language and literacy. Objects may be seen, touched, smelled, even tasted, and information about them heard in museums. In addition, museums utilise many supplementary media such as audio-visuals and the service of interpreters/guides to enhance the communication potential of objects. Since many disability conditions are based on the variations, often impairment, of various senses such as vision, hearing, touch etc, museum settings, which use multi-sensory techniques, have got the potential to become unique educational resource centres for the differentially-abled.

The National Innovation Council of the Government of India has initiated efforts to bring in innovation in Science Museums and have involved Museums like the NMNH (National Museum of Natural History) and NCSM (National Council of Science Museums) in a series of discussions leading to the decision to establish seven pilot projects. The NMNH's Khojkaksh Discovery Centre has been selected as one of these projects. It is a resource centre based on modified version of 'guided discovery learning'. It means acquiring the knowledge and skills necessary to make discoveries by oneself with the guidance of learning setting and museum guides.

## **THE INDIAN SITUATION**

### **History**

There are parallel evolutionary stories of museums in Europe and India, which are related to museum education. The English term 'Museum' owes its origin to the Greek word which means the seat of Museion (Muses). The term 'Museion' also denotes 'inspiration' as well as 'a place where men's mind could attain a mood of aloofness above everyday affair.' The Greek mythology refers to nine muses who are daughters of Zeus (Roman Jupiter) and Mnemosyne (Memory personified): Calliope, Clio, Euterpe, Thalia, Melpomen, Terpsichore, Erato, Polymnia and Urania. These nine Muses were initially nine rivers and originated in the Pieria spring in Thessaly at the foot of the mount Olympus. In course of time, these were personified and they sang and danced under the direction of Apollo. It was believed that these Muses helped Muses to forget their sorrow and anxiety by their performance of songs and dances. These nine Muses presided over nine different sections of fine and liberal arts and sciences. Thus the temples of Muses were temples of learning from the very inception of their evolution. Like Muses, goddess Saraswati, the goddess of learning in India, was originally a river with seven streams. She was considered as a celestial river, 'descended from the sky'. The seven streams of river were regarded

as seven sisters. The Aryan sages nourished in its water and inspired by the river, they composed Vedic hymns. Subsequently, this celestial river with her varied potentialities identified as one with Vac, the goddess of speech. The combined form came to be known as Vag-devi and was taken as the personification of wisdom and eloquence and was praised as Muse. Paramar King Bhoja is credited as the first Indian king to build a temple of Muse in the 11<sup>th</sup> century AD. He installed an image of Saraswati within a temple of Dhara and thereby, he turned the temple as a temple of learning- 'Saraswati Mandir'. Thus, it is evident from the very beginning that a museum had intimate relation with education. This association never ceased to exist and even today, a few museums in Rajasthan and Gujarat are called 'Saraswati Bhandar'. The terms 'Yadu-ghar' (the house of magic) and 'Ajayab-ghar' (the house of wonder) denoted museums in the 19<sup>th</sup> and early 20<sup>th</sup> century in India. These terms have now been considered outdated, obsolete and are totally discarded and museums are recognised as centres of education (Biswas, T.K. 1996).

### **Language**

In a vast multi-lingual society like India where there are many languages and hundreds of dialects, museum education becomes a difficult task. Labeling of objects and exhibits become a challenging task for the Indian Museologists. It is not practically possible to give labels in all Indian languages. A commonly accepted practice in Indian museums is to follow the three-language formula: local, national (Hindi) and international (English). Two-language formula is practiced where the local and national languages are the same, as in many states in North India.

### **Illiteracy**

The most challenging task of a museum educator in India is the question of how to deal with illiterates. Generally it could be said that about half of Indian population are illiterate. If the vast majority of the population is illiterate, it follows that museums may be visited mostly by illiterates. If museums are to be used as educational institutions for the vast majority of Indian population, no amount of labeling will reach them. Provision of guides may not solve this problem. However, a large population of school students, who are literate, also visits museums. Because of this reason, museum education in India is generally restricted to serve the local schools to supplement the curriculum as well as the literate general public. The vast majority of Indians, the illiterates, are generally neglected.

### **MUSEUMS AS CENTRES FOR HERITAGE EDUCATION**

Museums are excellent resource centres for heritage education. This may include tangible heritage which are artifacts collected in Museums as well as intangible heritage which may include documentation/ digitization projects. In this regard two projects, in which the National Museum of Natural History New Delhi is involved, may be mentioned. The first one includes the portal on Heritage education of the CBSE targeting schools. The NMNH contributed to the natural heritage section in collaboration with Sahapedia an organisation involved in Heritage projects. The second involves a large number of workshops and an exhibition on INH. The NMNH's efforts on INH are listed below:

- 2002: NMNH organised a Workshop on 'Hornbill and Tribal Empowerment' for Niyashi tribes at Itanagar, Arunachal Pradesh.
- 2002: NMNH represented India in the 7<sup>th</sup> Regional Assembly of the Asia Pacific Organisation of the ICOM held in Shanghai (China) in October 2002, on the subject "Museums, Intangible Heritage and Globalisation".



Competition for Children

- 2007: NMNH organised a National Conference on "Museums and Intangible Natural Heritage" in Calicut during 18-20 April 2007.
- 2008. NMNH represented India in the ICOM South Asia Workshop on TK, INH and Museums in February in Hyderabad
- 2008: NMNH organised a national Workshop on 'INH and Hortus Malabaricus' in March 2008 in Kochi.
- 2009: The NMNH established a Museum Gallery, "Such Treasure and Rich Merchandize: Early Plant Heritage of India" in its Southern RMNH at Mysore in January 2009. The Gallery essentially chronicles the documentation of plant heritage of India by European explorers.
- 2010: NMNH organised a National Meeting on "DR. E.K. Janaki Ammal and her contribution to Indian Science" in her native place (Thalasseri) on 4<sup>th</sup> November (her date of birth). Dr EKJ, the first Indian woman to get a PhD in Science, is considered as the pioneer in Ethno-botany in India
- 2011: NMNH organised a "Festival of Museums and Intangible Natural Heritage" during 22-27 June, 2011 in Kalady
- 2011. NMNH organised a National Seminar on 'Intangible Natural Heritage and Traditional Knowledge on Biodiversity' in Sept 28, 2011 in Jodhpur.
- 2012: NMNH contributed a Chapter to the first book on INH, "Intangible Natural Heritage: New Perspectives on Natural Objects" edited by Eric Dorfman and published by Routledge as part of its "Studies in Heritage".
- Charters on Intangible Heritage: The NMNH was actively involved in the preparation of two Charters on IH. During the 7th Asia Pacific Regional Assembly of the International Council of Museums convened between 20-24 October 2002 ICOM-ASPAC in Shanghai, China in 2002, NMNH proposed an Indian model on IH based on the ABS (Access Benefit Sharing) example of Kani tribes. NMNH has released the "Calicut Charter on Intangible Heritage and Museums" in the National Conference on "Intangible Natural Heritage and Museums" organised by it in Calicut during 18-20 April 2007.



## CONCLUSION

While accepting that Museums are centres of learning and education, it is essential for these institutions to rise to the occasion and develop innovative techniques to become socially inclusive institutions. Museums are excellent resource centres for heritage education involving both tangible and intangible aspects.

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## **Contextualizing Education around Culture, Knowledge, Practice and Environment of Ethnic and Local Communities**

**Dr. K H Amitha Bachan<sup>1</sup>, G Swetha<sup>2</sup> and Maya Mohan<sup>3</sup>**

*<sup>1</sup>Research Director, <sup>2&3</sup>Trustees Western Ghats Hornbill Foundation <sup>2</sup>Teacher, Poorna Learning Centre, Jalahobli-Bangalore, , <sup>3</sup>Asst. Professor Dept. of Sociology, Christ University Bangalore.*

‘Why are you being educated?’; ‘By Whom?’; ‘About What?’; ‘and How?’ - are the few fundamental/ critical questions we are grappling with ever since we had been introduced to schooling. It is obvious that your/our consciousness may not agree with this statement completely because most of the elders from the mainstream population reading this article (those who know to read, access, have time and consciousness) has been supporting the education system prevailing in our society today. But there will be some sort of agreement to this also. You will completely agree when you think rationally about the reason behind your achievements in life. Was it the education you have come across or was it your own personal enthusiasm, experiences, experiments and struggles that resulted in your success. You must have struggled to de-school yourself (get away from what you learned) most of the time and learned new things from practice and experience.

At the time of your initial introduction to the schooling system you would have been attracted by a lot of fascinating stories, materials or artifacts from your parents or society. The first simple question “why are you being educated?” would arise on the first day itself within you even if you also wanted to with parents to join school or if you are a kid struggled your own to learn or go to school to get educated. May be for the first time You feel angry towards your parents and society for being ‘orphaned’ and ‘isolated’ from your own world. And we are sure that the question remains in your mind at every stage of your education, jobs, life and until the end of your life. You will agree to this only if you are still conscious or not so conditioned by the linear ways of the life.

At the same time all the remaining three questions ‘by whom?’, ‘about what?’ and ‘how?’ would be your consistent companion during the course of the education while listening to a teacher to whom you don’t agree, while learning by heart a theme that you never owned up and the processes that you don’t have freedom to chose. The agreement with the statement will become complete when you think about the real goal of education. The idea of education is not merely to impart knowledge to the people in certain subjects but to develop in him/her those habits and attitudes

with which they may successfully face the future and at the same time preserve the traditional values which will safeguard future further.

Kerala is a land of religious, ethnic, cultural and geographical diversities. There are 35 tribal communities among which 5 are primitive tribes, 51 Scheduled caste communities and 81 backward communities. With such a heterogeneous geographic and demographic nature of the state, can the present educational curriculum addresses the need of all? Is it flexible enough to accommodate the differences? All these heterogenic communities and people from different geographical regions are following same syllabus and curriculum.

A primitive 'Kadar' tribal child born in a temporary hut made of bamboo and reeds, near a streamside in the rainforest of Anamalais in the Western Ghats, child from the fisher folk community born near the seashore in a small shelter thatched with coconut palm leaves and a child living in the slum of urban metropolitan city have to depend on a single syllabus and more over they have to use the same curriculum material. What is the result? Most often those who have cultural independence and courage to be honest to our basic instincts will opt to go out of the system first, definitely the tribal child and sooner or later the other two go out of the so called 'education' system and in our terms we identify them as 'drop outs'. Or otherwise they will lose their inner spirit and become ready to end up as an employee in the Govt. sector, or at maximum they will learn some technical skills and opt to export their skills and life to earn more money.

There were lot of efforts and reforms happened in Kerala starting from early 1990s following national policies to ensure 'Rights of Education'. National Education Policy of 1986, its Programme of Action (1992), the Minimum Learning Level programme and the Operation Blackboard scheme etc. were the initial ones followed by the District Primary Education Programme (DPEP) 1994, and Sarva Shiksha Abhiyan SSA (2001). Despite of some achievements made like enrollment of more students, grade systems, decentralized planning and child centered thoughts etc., we are far away from the real 'inclusive', right based and locally contextualized education.

This has been recognized as one of the shortfall in the current education system, where the individuals' different concepts, understanding of a particular thing or subjects and the objects or symbols they are dealing with i.e. 'worldview' has not been considered. Here we like to have a reflection of this shortfall of present education and its implication on education, learning, language diversity, culture, knowledge and environmental consciousness especially of the marginalized communities. In this paper, for our arguments, we use experiences from a decade long conservation oriented education with various group of people, interaction with 'Kadar' tribal communities and experiments based on a locally contextualized education material prepared for 'Kadar' and other rural children by Western Ghats Hornbill Foundation (WGHF).

### **Contextualisation of curriculum**

Contextualising the curriculum for the learner is always considered as a good concept. But practically, that has never been the case.. It is of utmost importance in this day and age and forever from now that one is cognizant about the environmental changes

that occur in one's premises and be able to be actively participating in the process of conserving what is left over. Contextualisation can be understood as "the activity of making a concept meaningful in a given context" (Weelie & Wals, 2002). The concept of "World view" can help to have a basic understanding of the requirements of 'contextualisation'. It means the conceptions of the world that a student holds "prior to formal instruction may, in part, be a result of traditional practices and beliefs that exist in their communities and to which the students are committed" (George, 1999). The term 'Worldview' refers to the culturally-dependant, generally subconscious, fundamental organisation of the mind. This organisation manifests itself as a set of presuppositions or assumptions, which predispose one to feel, think, and act in predictable patterns (Cobern, 1991). Worldviews help people "to conceptualize what reality should be like and to understand and interpret all that happen day by day in this framework" (Kraft, 1974).

There have not been many curriculum materials that address the regional or local language, symbols or materials that we come across in daily life representing our tradition, practice and culture in Kerala. When we take the case of the marginalized communities, although our National Curriculum Framework (NCERT, 2005) emphasizes on contextualization of curriculum for those 'marginalized from the mainstream' it is far away from reality. It demands for contextualisation of curriculum, the need for specific syllabus and textbooks by incorporating the diversities in each region and that NCF is a guiding document to set general standards of education. DPEP and SSA also oriented towards developing contextualized education materials. Primary education materials in Irula, Mudhuga and Kurumba languages by KIRTADS (Mini, 2013) and preprimary education packages prepared by Western Ghats Hornbill Foundation under CEPF-ATREE Western Ghats Small Grants programme including Kadar and Muthuvan languages (The Hindu, 2012; Bachan *et al.* 2012) are the few experiments in this regard.

It is very necessary to discuss what is missing in all these universal to contextualized, exclusive to inclusive, centralized to decentralized experiments? What is the real purpose of education? Does the formal education account for the consciousness or comprehension of an individual or community? Does the locally contextualized curriculum push the education away from understanding the universal syllabus and requirement of the modern society? And so on.

### **Role of teachers**

Role of teachers in education is very crucial as they have a chance to mould the curriculum, whatever it is towards the real goal of education. Personnel experiments of many teachers are the key for better performance of many 'Anganwadi' in Kerala, especially in tribal and rural areas. Most of them will have their own dictionary of the local dialect, objects and examples as a 'locally contextualized curriculum' developed through their own personnel experiences. A non-tribal Anganwadi teacher in Vazhachal area speaks of the kind of acceptance she has amongst the new children when she speaks to them in their language (Kadar) which she has picked up over the years. She differentiates the Kadars and Malayar by saying that the Malayar understand the "nāṭubhāsha" (Malayalam) better but the Kadars don't.

We have repeatedly asked a question to teachers of various grades from Anganwadi to higher secondary during various interactions and classes i.e. “which letter would you prefer to start with while teaching letter to the children?”. More than 90% of the teachers reply that ‘we should start with ‘A’ for English or ‘Aa’ for Malayalam. It was like a great realization for them to know that we can start from any letter familiar to the children and the ultimate aim is to understand the full set of letters. Most of the preprimary and primary teachers are doing or have to do more experiments to deal with the curious young chaps in the classrooms.

Many of the recent interventions in the learning and teaching such as DPEP and SSA have resulted in redefining the role of a teacher as a guide and facilitator rather than a universal encyclopedia. One with a comprehensive knowledge of the symbols and objects of the local environment to use to communicate can make the listeners better understand what he speaks. But still most of the teachers find it difficult to find suitable materials for local contextualisation. The universal nature of the curriculum, question and answer keys without much flexibility, lack of opportunity for a multilingual approach and tight schedules bound them back to traditional way of teaching.

### **Content: known to unknown through comprehension**

The actual process of learning and education is a voyage from known to unknown. The ‘known’ to start with, vary from person to person, region to region, race to race. So the local objects, plays important roles as the symbols or indicators as good as local language do. Also every enthusiasm or experimentation is a result of imagination; sometimes it is far beyond limited boundaries of arithmetic and logic. A person wandering within the limited boundaries can only become a good manager of the known things. But a ‘childish’ thought to experiment and go beyond boundaries is another key to the unknown. Does our class room teaching curriculum have enough flexibility and diversity to accommodate local objects, symbols and languages including various dialects? Do they provide degree of freedom for students to choose what he/she requires for a particular process of learning? Is it possible for a class room to provide diverse objects and interactive tolls better than we have outside in the ‘Nature’?

Comprehension instruction is often disregarded in primary education, where the focus is on learning how to decode (Pearson & Duke, 2002). Out of 100 students of Class-II, all were able to spellout orally A to Z alphabet, narrate to 1 to 20 numbers completely whereas to narrate alphabet of local language, 44 (44.0%) were able to completely narrate. In case of ability test of English language of class-II students, only 7 students out of 100 students were able to read correctly 5 words of English language. 17 (17.0%) students able to write correctly 5 words out of 5 whereas 83(83.0%) students were not able to write correctly these words. In case of class-VI students, ability test of English para, about 30% of the students were found able to read and write the para of English completely while the rest 70% were not able to read and write the English para. (GOH, 2009)

### **Inclusion of language**

Individuals are marked by many identities. Language and ethnicity constitutes an important one. It is desirable for any culture to survive to keep its language alive for that is the only way to pass on the knowledge gained over centuries. So, acknowledging language as a medium of worldly engagement rather than a mere tool of communication would help us be more sensitive to the demands of the linguistic minorities that are ever increasingly marginalised and furiously neglected by the policies and policy makers. This view should then take note of the marginalised languages and work towards empowering them through meaningful education that not only respects their language but also give them the other languages – in this case Malayalam and English - so that they can speak for themselves in demanding their rights and the means to access them.

Not all languages in India enjoy the same status. English rules the place with Hindi coming in next and the regional languages with its Sanskritised version taking prominence over other slangs, the other less spoken languages can be forgotten. In this case it is not surprising that the children of the Kadar tribe were taken by surprise when asked to name different plants and animals in their language. This being the appeal to having a more inclusive system, it is just as important to take note of the classroom practices that have been shaped by various forces into becoming a monolingual space. The survey conducted by NCERT shows that there has been a steady drop in the number of languages used in schools. In 1970 there were 81 different languages used at the primary level and it stood at 41 in 1995, and stands at 33 according to the survey in 1998.

The incorporation of poems from the Kadar folk culture has resulted in a certain acceptance amongst the students where they can “recognize songs as having heard from their grandmothers”. And there is a tone of satisfaction when the teacher says, “when it used to be the Malayalam poems they used to merely recite it for the sake of it, but now this is a language that they understand and so they are more excited to sing the songs from the new books”. The text has in a way sensitized the teacher to be indiscriminate towards languages.

Also issues like language endangerment and survival, unilingual to multilingual education, the real nature of conservation education and practice effectiveness of a multilingual geographically, culturally contextualized curriculum material for a real ‘inclusive/ and ‘right based’ education has to be discussed contrary to the education reforms its implications and effectiveness happened so far has to be discussed in details.

### **Conclusion**

Education reforms in India has undergone revolutionary changes in the policy level from exclusive to inclusive and right based. But the inadequacies in the planning and implementation have to be evolved to reach a really inclusive education system. Contextualization of education in an inclusive manner is the need of the hour and inclusion of language and content of all the ethnic, marginalized and local communities is the major key.

The recent experiment in the educational sector in Kerala did little advancement in 'mainstreaming' the culture of education into little more inclusive 'integrated' approach. Children studying in class four under the DPEP performed remarkably better than those in the non-DPEP sector. The former's standard of efficacy showed that they were equal to the eighth standard conventional class (The Time of India, 2001). Change in the education system (SSA) to strengthen teachers to think, work collectively and develop innovative programs in a decentralized manner did progressed in the learning process. Our experience shows that marginalised children are capable of learning and achieving results if the right conditions are created for their engagement in learning. Trusting the teachers and giving them decision-making freedom opens the way for professional development. It is interesting to note that the participation of the collectives strengthened and sustained quality education initiatives through decentralised decision-making (Baby, 2008). Evaluation of SSA by Planning Commission (GOI, 2010) indicates that the quality of education imparted to children is a major concern under SSA. But many of the cited achievements do not relate to the quality and drawbacks point towards the real needs. According to the report, "there has been moderate improvement in Pupil-Teacher Ratio (PTR), availability of infrastructure facilities and awareness among parents regarding SSA, there are still some outstanding issues, which need to be addressed such as shortage of upper primary schools in both rural and urban areas, mainstreaming of 'out of school children' and 'dropouts', seasonal migration, weak monitoring and supervision linkages and quality of education imparted".

Economic marginalization, poverty and early entry in work for children are realities that impinge on their schooling. However there needs to have a sociological approach to education based on an understanding of the tribal context and how it mediate pedagogic, curricular and institutional processes (Nambeesan 2007). About 110 million children remain out of the schooling system, and about 60% of those who enroll in school drop out by class VIII (Wadwa 2001). Issue of inclusion of language is one of the big challenges in education. Securing livelihood along with right to education is another challenge. Students in a natural science class room are most mischievously behaved (Popova, 2013). Striking the right balance between formal and informal science education will never be easy, but the answer is not to focus exclusively on the small fraction of people's lives spent in school. Policy-makers need to start looking at alternative models (Nature 2010).

The gap between real inclusion and right based education appears to be perishing even after many experiments like DPEP, SSA and the RTE act. Even after changes in to child centered education system, redefining the role of teachers to a particular extant the present education system is far away from real contextualization and comprehension. It has resulted in the marginalization and drop out of ethnic and local communities from education and the cultural/traditional institution and the state runs parallel resulting in social exclusion and endangerment of language and culture. Exclusive and mainstreaming nature of education and learning narrows down the scope for development and progress of regional languages and immense knowledge associated with great diversity of culture and traditions in our country.

Examination of multilingual pedagogy developed by incorporating 'Kadar' ethnic community language, Malayalam and English points out 59 odd words out of 148 not related to 'Malayalam' or Tamil; about 44 are related to Malayalam and remaining very few are real Malayalam words. Many of the words names are really organic, e.g. "Kootupambu" meaning the "Snake which make nest" for King Cobra, where as its Malayalam is 'Raja Vembala' meaning King Cobra. But it is the only nest making snake in our region (Bachan et. al. 2012). The basic instinct to conserve their own knowledge and language of ethnic communities are inherent in every aspect of their life and that is why such languages have not become extinct in this world of 'mainstreaming'. Naming 'Giraffe' an animal the Kadars see only in pictures as 'Gopura Kazhutha' (Gopuram = tower, Kazhutha = donkey) where there is no name in "Malayalam" is one of the example where the 'Kadar' language shows progress and growth through developing new words. Then what could be the results of inclusion of all the tongs and languages of the indigenous and local communities in education, planning and development.

So inclusion of diverse languages and dialects, materials native to diverse indigenous and other marginalized communities, diverse pedagogy providing great freedom for the students and such an inclusive diverse curriculum connecting to the universal syllabus is still a dream. Many of the innovations of the NGOs based on 'community participation' are accepted or neglected by the Government systems without clear analysis of what it is these models offer and what insight they provide into develop localized education strategies based on community ownership (Subramanian 2003).

A study evaluating SSA in Haryana, point out the lack of an appropriate, qualitative and effective teaching learning material and teacher training as major drawbacks (GOH, 2009). Vigilance against the imposition of narrowly refined conceptions of education can only be maintained and strengthened through the opening up of the spaces for the citizens, particularly those who are outside the education system, to express their views and perspectives on the nature and shape that education should take to realize their fullest aspirations and freedoms (Subramanian 2003).

Any attempt to contextualize education to the needs of the marginalized communities must look into the failures in the major experiments to bridge the gap in the extent of contextualisation. Contextualisation of education should be more into - (i) Content to start from known to unknown- diverse enough to accommodate everyone's world view. (ii) Language to be indigenous; flexible to accommodate multilingual ranging from indigenous, local, regional to universal (iii) Should result in effective decentralized and inclusive pedagogy; flexible enough to provide high degree of freedom to choose (iv) Method of teaching and evaluation should be comprehensive rather than prescriptive and (v) The role of the teachers should be as facilitators to enable pupil to comprehension, travel from known to unknown through dreaming, problem solving using information around rather than act as a knowledge centre or information provider.

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# **Protection, Conservation and Management of Ancient Natural Monuments and Archaeological Remains; The Constitutional and Legal Mandate**

**Dr. A Suhruthkumar**

*Associate Professor of Law, Government Law College, Trissur*

## **INTRODUCTION**

The present socio- legal system survives in a globalised market set up in which everything has been converted in to the status of commodity having higher rate of liquidity and transferability. Our natural, cultural and historic monuments also have commoditized as part of these new policy. The archaeological remains and sites have achieved such a market value to utilize them for profit making. On this social change and evolution of values, the legal and administrative policies and measures also have changed respectively. There we can see the transformation of the constitutional and legal mandate on the protection conservation and management of ancient natural monuments and archeological sites and remains in our country. With respect to the changing formulations the parliament evolved new law in this regard by 2010. Hence it is very relevant to examine this socio-economic cultural impact of those constitutional and legal reforms in the present scenario.

## **THE RULE OF LAW MANDATE**

In different range of responsibilities, the founder of our constitution, established the need of protection of ancient, natural and cultural monuments

This perspective was incorporated in the directive principle of state policies by which the rule of law establishes an obligation on the state to protect every monument- a place or object of artistic or historic value. The state is entrusted to declare such national importance, introduce measures to control and regulate any kind of spoilation, disfiguration, destruction, removal, disposal of export of such objects or materials. (Article 49 of the Constitution of India) But in actual practice several questions may be raised in this regard such as who will decide the protection value, how will the value is to be fixed, who is responsible to improve the protection measures, what shall be the measures against law breakers have etc.

The Constitution imposes a duty on the Indian citizen in order to protect and preserve the rich heritage of our composite culture. (Article 51 (A) (f) of the constitution of India) In the absence of judiciability and enforceability, how far this duty can be

performed by the people. Up to what extent the law makers and law givers can ensure the practice of this legal duty rather than a letter of principle. The existing legislations and allied legal materials miserably failed to achieve the above said goal. There is the relevance and scope of a comprehensive legislation towards the validation, conservation, protection and management of ancient monuments and archaeological sites in our country. In that sense, an analysis on the Amendment Act of 2010 became more important. (The Ancient Monuments and Archaeological Sites and Remains (Amendment and Validation) Act 2010).

### **POWER CONCENTRATION WITH NATIONAL GOVERNMENT**

By this Act, the National Government became more powerful to regulate any construction, re-construction and repair work within the modified sites or monuments through the designated authorities and officials. The central government has been empowered to prescribe categories of ancient monuments and archaeological sites and remains with national importance in concern to their historical, archaeological, architectural value and other relevant factors. (Section 4 A (1) of the Amendment Act 2010). The central government is also empowered to classify all such sites, monuments and remains so as to provide public access, information, exhibition and other manner deems fit. (Section 4 A (2) of the Amendment Act 2010)

The construction, re-construction and renovation or repair activities mentioned here includes erection of any structure or buildings including addition, extension either vertical or horizontal except such activities for public water supply, electrical distribution or such public facilities.

The central government is empowered to declare notified prohibited area or regulated areas in which it can prohibit or regulate above said activities of human being. (Section 2 (ha) (1) and Section 20 A and 20 B of the said Act 2010). All persons shall consider these changes in law with maximum concern because it will affect the federal structure of the nation, role of the state governments and mandate of local public to conserve and protect any such monuments or sites under their capacity. This will become the sole authority of the central government. The validation of such properties may lead to gradual alienation and privatization of those sites and remains for commercial and business purposes. Power to grant permission and license only with assent of the president shall consolidate unscrupulous authority in the central government and which will adversely affect the individualistic freedom right to life and livelihood in every respects. Such a conflict of powers and authorities in between different levels of government and in light of rights between different stakeholders will defeat the object and aim of the legislation itself.

### **POWER OF COMPETENT AUTHORITY**

Apart from the prohibited areas and in the regulated areas, the power to grant permission is vested with the competent authorities. They shall intimate the impact of the project on the heritage sites, monuments or remains, to the concerned authority as the case may be, according to the prescription of the central government. Hence, the recommendations of the competent authority, shall be final. If the permission is refused by the authority it shall be a speaking order in writing with adequate

reasons. The authority has power to withdraw a permission on sufficient reasons as the case may be. Here also considerable discretionary powers are concentrated to certain authorities with larger finality in the exercise of such powers. It can be pointed out that the principles of administrative law and process there under have been violated here. (Section 7 of the Amendment Act 2010 (Section 20 D and 20 E of the Original Act)

#### **HERITAGE BYELAWS AND ENFORCEMENT**

Once again the criticism of concentration of power may be established here so that the Act prescribe the formulations of heritage byelaws in respect of the consultations with the Indian National Trust for Arts and Cultural Heritage; which is a registered body under the Indian Trusts Act 1882 and such other experts as notified by the central government. Both the powers to constitute the National Trust and notify the designated experts are vested with central government. Once again the provincial or local governments are exhausted from their power (Section 8 of the Amendment Act 2010 (Section 20 E of the Original Act) . Community ownership and public trust concepts also will be negated here.

#### **NATIONAL MONUMENT AND HERITAGE AUTHORITY**

The proposed authority on historical monuments and archaeological heritage consists of an appointed chair person and not more than 5 full time members according to the recommendations of the selection committee. Appointing authorities and selection powers are vested with the central government. The ex- officio members of the selection committee are the officials under the central government and expert members of the selection committee are nominated by the central government. The state government shall not have any voice in this process. Whereas such national authority shall have their jurisdiction over the states territories. In addition to that the authority is vested with quasi judicial powers and its decision can be questioned only before the apex court of the land. This situation may lead to considerable hardship to the local people in related subject matters. (Section 20 F, 20 G, 20 H, 20 I and 20 K of the Original Legislation)

#### **ABSOLUTE POWER OF THE CENTRAL GOVERNMENT**

The said legislation endorses absolute and exhaustive powers to the Government of India,so that the government attains power to issue directions to the national authority and the competent authorities in the concerned matters. The central government achieves a power to supersede this said authorities in the relevant areas. The Act entrust the central government to issue final decisions in concerned matters, apart from a question of policy or other matter. The exclusion of judicial review capacity may cause hardship to the enforcement of the provisions of this enactment in actual practice of law. In legality such a finality provision cannot be justified under Administration Law and its jurisprudence. (Section 20 L and N of the Original Act)

#### **PENAL PROVISIONS UNDER THE LAW**

The recent amendment has been used for enhancing the penalties such as imprisonment and fine.Maximum 2 years period for imprisonment and one lakh

rupee for fine was incorporated within the penal provisions. Offences committed by officials shall be punished with increased penalties such as 3 years imprisonment and fine or both as the case may be. The Director General shall be vested with the power to conduct surveys and inspections in prohibited and regulated areas, and their result shall be submitted to the central government. The integration power, the evidencing value and the admissibility of information etc also depends on the central government and officials there under.

Hence absolute exclusion of the local communities, the local governments and state governments from the allied sections may result in great blockade to the real performance and practical enforcement of the concerned legislations . There is a larger scope for reform and revision to laws concerned here. Indepth discussion and restructuring is essential in the enactment in order to protect the federal policy, social control and community ownership on our rich cultural, historical and archaeological monuments, sites and remains in further course of time. People collectives, their initiatives supported with legal authorities shall be entrusted with the functions of conservation, protection and management of such properties with respect to the public trust precautionary and defaulters liability principle.



***Young Scientist Award Presentations***





# Rejuvenating Traditional Modan Rice Cultivation In Kerala

**C Biji<sup>1</sup>, A V Mathew<sup>2</sup> and N K Sasidharan<sup>3</sup>**

<sup>1</sup>Senior Research Fellow, <sup>2</sup>Associate Director, <sup>3</sup>Professor,  
Regional Agricultural Research Station, Kumarakom, Kottayam, Kerala 686 566.  
E-mail: bijijose82@gmail.com

## INTRODUCTION

Keralites can boast of a rich tradition of producing one's own food in their homesteads; a practice that prevailed till recent past. The cafeteria of crops in the homestead reflecting a rich biodiversity enriched our food basket and Upland or aerobic rice (also known as *modan*) was one among these. Others are tuber crops, fruit crops, vegetables, spices and medicinal plants. *Modan* had specified varieties/ land races like *kattamodan*, *karutha modan*, *chuvanna modan* etc.

The cultural practices of aerobic rice production process primarily aimed to impart drought tolerance to the plants by enhancing root activity. In *modan* cultivation, season and agricultural practices are joined to efficiently utilize the seasonal rainfall to enable crop sans any supplementary irrigation. Alternate rice cultivation methods such as system of rice intensification (Uphoff, 2004) or SRI and alternate wetting /drying management and irrigation (AWD) are reported to have higher water productivity than conventional rice systems (Singh and Chinnuswamy, 2006). The water productivity is much larger for *modan*. Though the yield from *modan* rice is generally less than that of wetland, it is a means of (supplementing) production for one's own needs. Since, as *modan* is totally rain fed, the vagaries of monsoon could upset the yield and income. Any technology exploiting the residual soil moisture for crop-use can ensure reasonable yields from upland rice.

It is a well developed root system in rice that taps moisture and nutrients from a relatively larger area of root activity. Unlike wetlands where the rhizosphere is always flooded through the crop period, in respect of upland rice as the rhizosphere is aerated, biocontrol agents like VAM and biofertilizers can stimulate root growth and solubilise soil nutrients (Purakayastha and Chhonkar, 2001). Considering such advantages, the effect of bio-inoculants and method of application on root development and yield of *modan* rice were evaluated at the Regional Agricultural Research Station, Kumarakom.

## MATERIALS AND METHODS

The field experiment was conducted at Regional Agricultural Research Station, Kumarakom (N.Lat 90 30' and E. Long. 76° 30; Elv.= 0.6 m a.m.s.l), where the experiment was laid out in RBD during the virippu season (May-sep) 2011 and 2012 with seven treatments and three replications. The treatments were:

T0-Control (Package of practices recommendation for crops, Kerala Agricultural University)

T1-Soil application of VAM, *Azospirillum*, *Pseudomonas fluorescence*, *Biopotash* and *Phosphobacteria* (@ 400g/ha), spraying with *Pseudomonas fluorescence* at 25- 40 DAS.

T2-Soil application of *Azospirillum*, *Biopotash*, *Pseudomonas*, and *Phosphobacteria*, sowing VAM coated seeds, spraying with *Pseudomonas*.

T3-Sowing VAM coated seeds

T4-Soil application of VAM

T5-Soil application of all five bio-inoculants, sowing treated seeds with VAM, *Azospirillum* and *Pseudomonas*.

T6-Soil application of VAM at double dose (800g/ha)

Three healthy seeds of Uma rice variety were dibbled at a spacing of 20x20cm. The plot size was 20 m<sup>2</sup>. The crop was raised as per the POP recommendations for rice by KAU (2007). Observations were taken at tillering, panicle initiation and at maturity stages. Observations on root length, root volume, root shoot ratio, vegetative tillers, dry matter production, panicle characters, grain and straw yield were recorded as per standard methods. The data were analysed for respective seasons and subjected to pooled analysis (Gomez and Gomez 1984).

## Results and Discussion

Significant variation was observed between different treatments on all the parameters under investigation (Table 1, 2&3). Higher plant height and better root development was found in both seed and soil treatment of all the five bio-inoculants (T5).

### Effect on root development

The data showed that T5 was significantly superior to the other treatments in its effect on root length, root volume and root shoot ratio. The study showed that increased root length, root volume, and root shoot ratio was noticed in T5 during all the stages of the crop growth rather than soil application/seed application alone (Table 1). This might be due to the enhanced root proliferation which resulted in more root volume leading absorption of more nutrients and water. Purkayastha and Chhonkar (2001) also reported enhanced root length and root volume in VAM inoculated rice plants.

### Effect on growth characters of rice

The crop growth parameters viz., plant height, vegetative tillers and dry matter production at various growth stages were found to be very much responsive to different methods of treatments. Data on plant height, vegetative tiller count and dry matter production revealed that T5 was significantly superior to other treatments

(Table 2). Greater accumulation of dry matter production under this treatment could be due to favourable growth components as would be seen from increased plant height and more tiller production. Similar increase in dry matter production was reported by Sanbagavalli *et al.* (1999) and Subbulakshmi (2001).

**Table 1**  
Effect of bio-inoculants on root characters on upland rice, Kumarakom 2011-2012

Treatment	Root length,cm	Root volume,cm <sup>3</sup>	Root shoot ratio
T0	21.66 c*	200.815 e	0.55 d
T1	27.96 ab	241.65 cb	0.715 c
T2	28.8 ab	277.48 b	0.811 ab
T3	30 a	256.665 c	0.801 ab
T4	28.8 ab	227.98 d	0.816 ab
T5	31 a	329.15 a	0.848 a
T6	26.63 b	187.165 e	0.756 bc
CD	31.2	18.84	0.078

\*values super-scribed by identical letters are not significantly different

**Table 2**  
Effect of bio-inoculants on growth characters on upland rice, Kumarakom 2011-2012

Treatment	Plant height, cm	No. of vegetative tillers/m <sup>2</sup>	Dry matter production (kg ha <sup>-1</sup> )
T0	100 d*	591.68 <sup>d</sup>	19703 d
T1	116.9 bc	896 abc	24646.65 c
T2	120 b	844.96 bc	25329.3 c
T3	114.16 c	826.4 bc	28783.3 bc
T4	116.81 bc	951.68 ab	32580 ab
T5	127.65 a	996.8 a	34513.3 a
T6	114.96 b	807.68 c	28856.65 bc
CD	4.17	143.68	48531.1

\*values super scribed by identical alphabets are not significantly different

### Effect on Yield attributing characters and yield

Significant variation was found in yield attributes like panicle/m<sup>2</sup> and number of filled grains/panicle. Number of panicles was higher in T5 and was superior to other treatments. VAM application alone on Soil (T4) gave higher number of filled grain panicle<sup>-1</sup>(Table 3).Increased uptake of water, nutrients and enhanced translocation of metabolites might have contributed to increased yield-attributing characters in rice. Sanbagavalli *et al* (1999) also reported similar results. Grain and straw yield were higher in T5 and was significantly superior to other treatments (Table 3).Increased grain yield was due to improved yield attributes viz., panicle m<sup>-2</sup> and number of filled grains/ panicle. Higher straw yield was due to increased plant height, production of more tiller and more dry matter accumulation.

The economics of application of bio inoculants also favoured, T5 which received both soil and seed treatment with VAM, *Azospirillum*, *Biopotash* and *Pseudomonas*(Table 4).

Although the production cost is slightly higher, the accrued benefits are significantly on the higher side as revealed by the highest BC ratio of 1.84. The beneficial effect of T5 on plant growth, yield, and yield attributes and on benefit- cost, indicating overall superiority of both seed and soil treatment with VAM and bio fertilizers.

**Table 3**  
Effect on Yield attributing characters and yield, Kumarakom 2011-2012

Treatment	Panicle m <sup>-2</sup>	Filled grains Panicle <sup>-1</sup>	Grain yield (kg ha <sup>-1</sup> )	Straw yield (kg ha <sup>-1</sup> )
T0	655.9 <sup>d*</sup>	131.33 <sup>e</sup>	3488.8 <sup>c</sup>	8566.6 <sup>d</sup>
T1	757.3 <sup>bc</sup>	163.99 <sup>ab</sup>	4266.6 <sup>b</sup>	59322.1 <sup>bc</sup>
T2	786.66 <sup>b</sup>	176.16 <sup>a</sup>	4577.7 <sup>ab</sup>	10688.8 <sup>bc</sup>
T3	743.8 <sup>c</sup>	149.33 <sup>bc</sup>	4411.0 <sup>b</sup>	9944.4 <sup>c</sup>
T4	791.9 <sup>b</sup>	187.99 <sup>a</sup>	4399.4 <sup>b</sup>	11577.7 <sup>ab</sup>
T5	874.6 <sup>a</sup>	174.49 <sup>ab</sup>	5077.7 <sup>a</sup>	12177.7 <sup>a</sup>
T6	754.6 <sup>bc</sup>	149.16 <sup>bc</sup>	4255.5 <sup>b</sup>	10388.8 <sup>bc</sup>
CD	37.40	2612	569.99	1296.3

\*values super scribed by identical alphabets are not significantly different

**Table 4**  
Economics of Bio-inoculants application for Upland rice, Kumarakom 2011-2012

Treatment	Production cost/ha (Rs)	Income/ha (Rs)	Benefit cost ratio	Additional income/treatment (Rs)
T0	45000	58803	1.306	0
T1	46250	72539	1.56	13736
T2	46350	77826	1.67	19023
T3	45100	74987	1.66	16184
T4	45100	74783	1.65	15980
T5	46875	86326	1.84	27523
T6	45200	72335	1.60	13532

## SUMMARY AND CONCLUSION

Cultural practices that can enhance the foraging area of rice roots and deeper root system are beneficial for modan rice cultivation as deeper root system can impart drought tolerance. In the present field trial five bio-inoculants, viz., VAM, *Azospirillum*, *Pseudomonas fluorescense*, *Biopotash* and *Phosphobacteria* were evaluated for their effect on the growth and yield of modan /aerobic rice. The results suggested that consecutively for two seasons, soil plus seed treatment (T5) with bio-inoculants has enhanced the root development, vegetative characters, grain and straw yield, and yield attributes of aerobic rice. All the vegetative and productive characters were positively influenced by these bio-inoculants. The combination treatment of soil and treatment of seed with the bio inoculants (T5) resulted in the highest B: C ratio of 1.84. Reintroduction of the system to the 70 lakh homesteads can recapture the

lost glory of paddy cultivation in the state. The tradition of *modan* cultivation in courtyards and open spaces in homesteads can keep the rice crop close to the heart of Keralites

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# Evaluation of Organic Alternatives to Fertilizers for the Medicinal Rice Variety -Njavara

Jisha Ninan<sup>1</sup>, N K Sasidharan<sup>2</sup>, C Biji<sup>1</sup>, D Ambikadevi <sup>2</sup>  
and Vandana Venugopal<sup>3</sup>

<sup>1</sup> SRF, <sup>2</sup> Professor, <sup>3</sup> Associate Professor, Regional Agricultural Research Station, Kumarakom

## INTRODUCTION

The Indian heritage is rich with the knowhow of use of rice not only as a staple food but as a curative for many health related problems. Njavara is one of such precious specialty rice survived for centuries due to the patronage by farmers. It is a medicinal rice variety native to Kerala (Rani and Balachandran 2006). The green revolution technologies of using fertilizers and plant protection chemicals for this medicinal rice have adverse effect on the usefulness on its medicinal properties. However dependence on organic manures to meet its full nutrient requirement is not practical on account of the non availability of such huge quantity and costs involved. Utility of home made organic nutrient formulations like *Jeevamrutha*, as an alternative to fertilizers and bulky organic manures have recently been discussed (Nair, 2010). In this back ground investigations were taken up to validate the merit of such organic nutrient formulations in sustaining soil properties and, growth and yield of njavara rice in comparison to the existing practices.

## MATERIALS AND METHODS

Field experiments were conducted for two seasons during *virippu* (June-september) and *mundakan* (October-January) seasons of 2012- 2013, at the Regional Agricultural Research Station Kumarakom (9° 30'N latitude and 76° 30'E longitude and altitude of 0.6 m above mean sea level). The experiment was laid out in RBD with seven treatments (Table. 1) replicated thrice. The popular yellow *njavara* rice variety obtained from Rice Research Station Moncompu was dibbled in upland field plots of 20 m<sup>2</sup> size at a spacing of 15x 20 cm. The seeds for treatment 1 to 4 were treated with an organic nutrient formulation (*Beejamrutha*) containing water, cow dung and cow urine in a 4:1:1 proportion to which slaked lime at the rate of 100g/60kg of the formulation and a hand full of surface field soil were added. This was followed by the soil application of (*Jeevamrutha*) a fermented nutrient formulation containing water, cow dung, cow urine, jaggery and pulse flour in 100:5:2.5:1:1 proportion mixed with a hand full of farm soil, at the rate of 500 l /ha each at 10, 40 and 70 days

after sowing. T3 and T4 received straw mulch of 2.5 cm thickness at seedling stage. Fertilizer in the form of urea, rock phosphate and muriate of potash was given to T5. Farm yard manure at the rate of 8 tons/ha and vermi compost at the rate of 4 tons/ha in two equal split doses as basal and at tillering stage of crop was applied to T6 and T7 respectively.

**Table.1**  
**Treatment details and cost\* involved**

Treatments	Treatment details	Costs (Rs/ha)
<b>T1</b>	Seed treatment with <i>Beejamrutha</i> + three applications of <i>Jeevamrutha</i> from <i>Vechoor</i> cow at the rate of 500 l/ha	2100/-
<b>T2</b>	Seed treatment with <i>Beejamrutha</i> + three applications of <i>Jeevamrutha</i> from cross bred cow at the rate of 500l/ha	2100/-
<b>T3</b>	T1 + straw mulch at 1" thickness	4600/-
<b>T4</b>	T2 + straw mulch at 1" thickness	4600/-
<b>T5</b>	NPK at the rate of 40:20:30	3422/-
<b>T6</b>	Farm yard manure 8 tons ha half basal, half 30 days after sowing	7800/-
<b>T7</b>	Vermi compost 4 tons/ha half basal, half 30 days after sowing	18000/-

**\*Including cost of application.**

The crop was raised as per the package of practices recommendation (KAU, 2012) for upland rice. The crop was harvested on maturity, at 90 days after sowing. Observations on morphological characters, growth characters, yield and yield attributes of crop were recorded during the various stages of the experiment. Chlorophyll content of Y leaves of rice was estimated at the panicle initiation stage (Yoshida et al., 1976). After the harvest of rice soil samples were collected (0-15cm depth) and analysed for pH, Electrical conductivity (EC), Organic carbon (OC), available Phosphorous ( $P_2O_5$ ) and available Potassium ( $K_2O$ ) following standard methods (Jackson,1973).

## RESULTS AND DISCUSSION

### Effect on soil properties

The nutrient formulation from the *Vechoor* cow had a total bacterial load of  $24 \times 10^8$  cfu/ml, while that of the crossbred cow was  $20 \times 10^8$  cfu/ml. Effect of different nutrient sources on soil properties is given in table.2 .Application of *Jeevamrutha* has lowered the pH of the soil significantly. T1 recorded the lowest pH value which was at par with that of T2. Bulky organic treatments of farm yard manure and vermi compost has significantly enhanced the pH of the soil which was, however on par with fertilizer application. The low pH for *Jeevamrutha* is an indirect effect of increased microbial activity which might have triggered the release of some organic acids on fermentation. Similar observations were reported by Kiran et al., 2012. The electrical conductivity values have also been influenced significantly by the treatments. The farm yard manure treatment (T6) followed by organic nutrient formulation from



cross bred cow (T2) had significantly higher electrical conductivity values which may be due to the release of certain organic fractions resulting in higher mobility of ions. The combination treatments of mulch with both the nutrient formulations (T3 and T4) however had the least electrical conductivity values, probably due to the incomplete decomposition of the organic mulch in a short span of 2-3 months.

**Table.2**  
Effect of nutrient sources on soil properties, Kumarakom 2012-13

Treat-ments	Soil Physico – Chemical Properties						Soil Biological Properties ('000 cfu/ml)	
	pH	EC	OC (%)	Av.P <sub>2</sub> O <sub>5</sub> kg/ha	Av.K <sub>2</sub> O kg/ha	Av.Na kg/ha	Total Bacterial Load	<i>Pseu-domonas</i>
<b>T1</b>	3.54 <sup>b</sup>	0.45 <sup>bc</sup>	6.7 <sup>bc</sup>	15.13 <sup>b</sup>	167.2 <sup>b</sup>	451.0 <sup>a</sup>	185 <sup>f</sup>	11.0 <sup>e</sup>
<b>T2</b>	3.483.48 3.48 <sup>b</sup> 3.48 <sup>b</sup>	0.53 <sup>b</sup>	9.6 9.6 <sup>a</sup>	22.80 <sup>a</sup>	73.3 <sup>b</sup>	406.3 <sup>a</sup>	246 <sup>e</sup>	14.7 <sup>d</sup>
<b>T3</b>	3.55 <sup>b</sup>	0.37 <sup>c</sup>	6.4 <sup>c</sup>	1.05 <sup>d</sup>	51.3 <sup>b</sup>	266.9 <sup>b</sup>	356 <sup>d</sup>	17.0 <sup>cd</sup>
<b>T4</b>	3.86 <sup>a</sup>	0.40 <sup>c</sup>	7.2 <sup>b</sup>	0.42 <sup>d</sup>	108.5 <sup>b</sup>	317.5 <sup>bc</sup>	490 <sup>b</sup>	18.0 <sup>c</sup>
<b>T5</b>	3.86 <sup>a</sup>	0.41 <sup>c</sup>	6.0 <sup>c</sup>	4.34 <sup>c</sup>	533.9 <sup>a</sup>	254.5 <sup>bc</sup>	89.66 <sup>g</sup>	7.3 <sup>f</sup>
<b>T6</b>	4.08 <sup>a</sup>	0.65 <sup>a</sup>	8.2 <sup>ab</sup>	6.30 <sup>c</sup>	662.9 <sup>a</sup>	247.1 <sup>c</sup>	376.0 <sup>c</sup>	21.3 <sup>b</sup>
<b>T7</b>	3.88 <sup>a</sup>	0.45 <sup>bc</sup>	6.4 <sup>c</sup>	1.53 <sup>d</sup>	132.0 <sup>b</sup>	222.2 <sup>c</sup>	592.7 <sup>a</sup>	48.6 <sup>a</sup>
<b>CD (0.05%)</b>	0.293	0.101	1.53	4.116	155.67	64.25	7.74	2.37

\* Values super scribed by the same alphabet are not significantly different

The soil fertility as indicated by organic carbon and available P<sub>2</sub>O<sub>5</sub> revealed positive influence of the nutrient formulation from the cross bred cow, as evidenced by the highest values for these parameters. The organic carbon content of the farm yard manure treatments was however at par, which was significantly superior to the fertilizer treatment. The available phosphorus was the highest for T2 followed by T1 receiving Jeevamrutham from cross bred and *Vechoor* cow respectively. The available P<sub>2</sub>O<sub>5</sub> from all the other treatments were significantly less, revealing the highly significant effect of this organic formulation in solubilising soil phosphorus. This might be due to the specific micro flora activity capable of releasing phosphate ions from organic sources. Kiran et al., 2012 also reported similar enhanced availability of soil nutrients by the application of fermented organic nutrient formulations like *Dashagavya* and *Panchagavya*. The available potassium however, was highest for T6 (FYM) which was at par with T5 (Fertilizer). The low content of available K for T1 and T2 indicate lesser activity of potassium solubilising micro flora in the *Jeevamrutha* preparations. The available sodium on the other hand was the highest for T1 and T2 which were at par each other and significantly superior to all the other treatments.

This indicates the significant role of the fermented organic nutrient formulations in stimulating decomposition of organic complexes resulting release of sodium ions.

### **Effect on biological properties of soil**

The highly significant effect of the nutrient sources on the biological properties of soil is presented in table 2. The negative effect of fertilizer treatment on biological properties was evident as illustrated by the lowest values of total bacterial load and the pseudomonas count. The vermi compost treatment (T7) had the highest values followed by the farm yard manure treatment (T6) for total bacterial load and pseudomonas count. Enhanced biological property by composting especially with vermi compost is well established. The *Jeevamrutha* treatments in combination with straw mulch (T3 and T4) however, were superior to the *Jeevamrutha* alone treatments. This is probably due to bulky organic material availability for the microbial build up. The enhanced biological activity of the organic manure treatments (T6 and T7) is due to the faster multiplication of the micro flora on account of the availability of energy rich compounds, carbon and nutrients from the organic manure added (Bunemann *et al.*, 2006). All the organic treatments were significantly superior to the fertilizer treatment (T5) on this respect. The least total bacterial load and *pseudomonas* count for the fertilizer treatment is an indication of the deleterious effect of fertilizers on the build up of soil microbes.

### **Effect on crop growth and yield**

All the parameters except vegetative tillers and chaff number were found to have significant influence by the treatments (Table.3). The height of plants was significantly higher for T6, receiving farm yard manure which was at par with the fertilizer treatment (T5), *Jeevamrutha* treatments (T1 and T2) and vermi compost (T7). Straw mulch along with *Jeevamrutha* application (T3 and T4) had the least height. This may be due to the non availability of nutrients for crop during the initial period, due to the utilization of nutrients for the build up of soil micro flora and decomposition of the straw mulch. Vermicompost application (T7) recorded the highest grain yield followed by the organic nutrient formulation derived from *Vecoor* cow (T1). The grain yields for the fertilizer treatment (T5) was however, significantly lower than the organic treatments except T2. However the straw yields were higher for the fertilizer treatment (T5), which was at par with the vermicompost (T7). The increased grain yields in T7 and T1 were contributed by an increased number of grains/panicle. The significantly lesser number of half filled grains in T1 also contributed to the higher grain yield. A significant finding of the study is the increased chlorophyll content in leaf tissues of rice plants treated with both the forms of *Jeevamrutha* (T1, T2, T3 and T4). This may be due to presence of increased population of photosynthetic bacteria in this organic formulation.

The suitability of *Jeevamrutha* preparations as an alternative to fertilizers and organic manures is further strengthened by its universal availability and low cost. The cost of different nutrient sources used in the experiment is furnished in table 1. The cost involved for T7 and T6 are very high on account of the relatively larger quantities of farm yard manure and compost required to meet the nutrient requirement of the crop. The fertilizer (T5) and the *Jeevamrutha* preparations (T1 and T2) on the other

hand require in smaller quantity which made them cheaper by 5 to 10 times. But the costs for T3 and T4 were almost two fold as that of fertilizer, as mulching with paddy straw requires increased labour cost.

**Table.3**  
Effect of treatments on the growth and yield of Njavara rice , Kumarakom 2012-13

Treatment	Height	Veg- etative tillers/ hill	Yield		Yield attributes			Chlo- rophyll content (mg/g)
			Grain (kg/ha)	Straw (kg/ha)	Filled grains/ panicle (no)	Half filled grains	Chaff per panicle	
T1	115 <sup>abc</sup>	8.01	2207 <sup>a</sup>	6747 <sup>bc</sup>	66.17 <sup>a</sup>	5.05 <sup>c</sup>	7.1	2.25 <sup>a</sup>
T2	120.7 <sup>a</sup>	8.0	1450 <sup>c</sup>	6530 <sup>bc</sup>	45.38 <sup>b</sup>	5.72 <sup>b</sup>	4.8	2.68 <sup>a</sup>
T3	101.3 <sup>c</sup>	7.7	2053 <sup>a</sup>	6220 <sup>c</sup>	62.40 <sup>a</sup>	7.03 <sup>b</sup>	5.0	2.21 <sup>ab</sup>
T4	108.0 <sup>bc</sup>	7.4	2153 <sup>a</sup>	6887 <sup>bc</sup>	63.33 <sup>a</sup>	9.83 <sup>ab</sup>	6.7	2.33 <sup>a</sup>
T5	126.4 <sup>a</sup>	9.4	1947 <sup>b</sup>	8447 <sup>a</sup>	63.17 <sup>a</sup>	11.0 <sup>a</sup>	5.8	1.72 <sup>bc</sup>
T6	128.0 <sup>a</sup>	9.9	2180 <sup>a</sup>	7313 <sup>b</sup>	62.6 <sup>a</sup>	12.68 <sup>a</sup>	4.1	1.62 <sup>c</sup>
T7	120.7 <sup>ab</sup>	8.7	2240 <sup>a</sup>	9600 <sup>a</sup>	69.8 <sup>a</sup>	7.75 <sup>b</sup>	4.9	1.25 <sup>c</sup>
CD	14.01	NS	240	887	9.907	4.28	NS	0.48

\* Values super scribed by the same alphabet are not significantly different

## CONCLUSIONS

Evaluation of alternate sources of nutrients for the medicinal rice variety *njavara* indicated, *Jeevamrutha* - a home made organic formulation as effective and economic. The grain yield from *Jeevamrutha* preparation from local cow breed was equally good as application of 40 kg N/ha as vermi compost and farm yard manure. *Jeevamrutha* application has contributed to qualitative changes in the soil physico-chemical and biological properties on par with the bulky organic manure application and significantly reduced the expenditure on manure application.

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# Food and Non-Food Resource Consumption in Kasaragod District of Kerala – A Sustainability Assessment

**P Padma<sup>1</sup>, M Ramesan<sup>1</sup>, Mary Jency<sup>1</sup>, E V Ramasamy<sup>1</sup>,  
T V Muralivallabhan<sup>3</sup> and A P Thomas<sup>2</sup>**

*1. School of Environmental Sciences, Mahatma Gandhi University, Kottayam, Kerala, India.*

*2. Advanced Centre of Environmental Studies and Sustainable Development - An inter university centre (ACESSD), M. G University, Kottayam, Kerala, India – 686 560.*

*3. SVR NSS College, Vazhoor, Kottayam, Kerala, India.*

*\* Corresponding author e-mail: padmaram2007@rediffmail.com, Mobile: 9446924228*

## INTRODUCTION

Consumption of resources is one among the determinants of a complex set of socio-economic, cultural, religious, psychological, ethical and environmental factors. In general, a country's consumption pattern reveals its standard of living, poverty level, human development and its economic growth. Human consumption habits which directly influence the country's consumption pattern also affect the natural environment especially water, soil and air qualities. Our traditions and cultures in the past were closely associated with nature, people of Kerala for example are well known for developing their own culture through the ages. The traditional custom of living, food and dressing habits of Keralites were evolved on the basis of Indian philosophy and thoughts. However, the emergence of modernism and global culture has triggered the changes in the culture and consumption pattern of Kerala. Most of these changes are oriented towards materialism and marketing. The change in the food habits of the people of Kerala is the best example to cite. The traditional food habits were well planned and nutritive; food items like banana flower, dishes like avial, thoran, puttu, appam etc were good for health. In the modern age our choices are mostly ready made food available in the market. In modern cities and towns mobile catering centres are mushrooming in large numbers, dishes prepared by them are rich in flavour and artificial colour which are dangerous to human health. On the contrary, our traditional food culture especially in Kerala was mostly vegetarian and almost each family had its own kitchen garden and the vegetables from these garden were used. Thus the traditional food habits were oriented towards sound health and better environment, while the modern life style including the food habits and materialist consumption patterns are not only harmful to human health also to the environment and natural resources. In order to counteract / reduce the negative consequences of the modern lifestyle of the human society , sustainability is insisted globally more seriously. Sustainability refers to the quality of life which is

achieved in a manner that does not harm the quality of the life of future generations. Sustainable development (SD) has been identified as the means of attaining this goal of 'sustainability' in a scientific way.

One among the major steps leading to sustainability is the scientific assessment of the current level of consumption of resources in a society. In this context, the state of Kerala which has been identified as the top most consumer state in the country need to be studied in detail. Among the 14 districts of Kerala, Ernakulam, Thiruvananthapuram, Pathanamthitta and Kottayam are found to be responsible in promoting Kerala as the top consumer state of the country. Kasaragod and Wayanad districts have been identified as the least contributors in state's consumption pattern (Padma et al 2013). As a part of the ongoing studies by the authors on the consumption of resources in selected districts of Kerala, the findings pertaining to the household level consumption of resources in Kasaragod district are presented in this paper. The level of consumption is expressed in terms of monthly expenditure. The specific objectives of the study are as follows:

1. To assess the consumption patterns of food and non-food items at household level in Kasaragod district, with respect to different income levels and localities.
2. To evaluate the consumption pattern of Kasaragod district in the context of stability or consistency.

## **METHODS**

Systematic stratified random sample technique was used in this study. The data from 360 households representing two panchayats (Kayyur-Cheemeni, Cheruvathur) and two municipalities (Kasaragod and Nileshwar) were collected for this study. Self designed questionnaire on consumption pattern was used as the tool in the study. Mean, standard deviation, percentage analysis, coefficient of variance and test of significance - Z -test are the statistical tools used in the present study.

## **RESULTS AND DISCUSSION**

The sample size used in this study was 360 families. Out of 360 families (consisting 1533 members), 180 were from urban and rest were from rural sector.

In urban sector, out of the 180 families consisting of 760 members were studied. Out of this 760, 26 members are government employees, 212 are in private sector, 120 are self employed and the rest 402 are dependents of the earning members. Regarding the housing, 175 live in their own houses, 5 live in rented houses. Out of 180 houses, 72 with simple flooring, 108 with tiled floor. Regarding the infrastructure of the houses, 49 houses are with 2 bed room, rest are with more than 2 bed rooms. 62 houses are with single toilet and 118 are with more toilets, All 180 have separate kitchen, separate toilet facility, electrical connection and public water distribution system. Based on the survey conducted out of 180 houses 61 are with basic facility, 74 are of comfortable types and 45 are luxury types.

In rural sector, out of the 180 families consisting of 773 members were studied. Out of this 773, 5 members are government employees, 235 are in private sector, 150

are self employed, 10 are retired persons and 373 peoples are engaged in various occupations. Regarding the housing, 155 have their own houses and 25 live in rented house. Regarding the infrastructure of the houses 46 houses are with 2 bed rooms rest are with more than 2 bed rooms 62 houses are with single toilet and 118 are with more toilets. All 180 have separate kitchen, separate toilet facility, electrical connection and public water distribution system. Based on the survey conducted out of 180 houses 61 are with basic facility, 60 are of comfortable types and 59 are luxury types.

### Overall consumption pattern of Kasaragod district

The overall expenditure on food, non-food items at household level, in Kasaragod district is presented in Table 1. It can be inferred from this table that maximum expenditure is on non-food item followed by food items.

The expenditure pattern of rural and urban populations in Kasaragod district (Table

**Table 1**  
Total consumption of resources in terms of expenditure (₹) in Kasaragod district

Item	Expenditure in ₹
Food	23,19,593
Non-food	2,03,64,178

**Table 2**  
Expenditure (₹) on food and non-food resources in rural and urban sectors

Item	Rural	Urban
Food	1230441	1089152
Non-Food	6134289	14229889

2) indicates that as far as food items are concerned, the amount spent on is more in the case of rural population than urban population whereas in the case of non-food items the urban population spends more than the rural population. Even though the data on expenditure on various resources indicates a difference between urban and rural population, when tested for the statistical significance using 'Z -test', the findings show that there exists no difference between rural and urban population (Table 3).. Hence the difference between the rural and urban population of Kasaragod district with respect to the expenditures on food and non-food items is statistically not significant.

The expenditure pattern of low, middle and high income levels within Kasaragod district has been assessed. Data indicates that the high income group spends more on non-food items followed by food. Similar trend is observed with low and middle income groups also. Even though the data on various resources indicates a difference among low, middle and high income groups, when it was tested for the statistical significance using 'Z -test', the findings show that there exists no difference among low, middle and high income groups (Table 4). Hence there is no statistically significant difference among low, middle and high income groups of Kasaragod district with respect to the expenditures on food and non-food items.

**Table 3**  
**Summary of Z-test results with respect to expenditure on food and non-food items in Kasaragod district**

Test /Comment	N	Food	Non-food
Z-test	360	0.58 NS	0.83 NS

Note: NS –Not Significant

**Table 4**  
**Summary of Z-test results of Kasaragod district between rural and urban with respect to food and non-food items**

Rural Vs Urban income level	Food	Non-food
Rural low income Vs Urban Low income	0.27 (NS)	0.57 (NS)
Rural middle income Vs urban middle income	0.76 (NS)	0.70 (NS)
Rural high income Vs urban high income	0.51 (NS)	0.40 (NS)

Note: NS –Not Significant

The budget share analysis of the overall expenditure data of the district infer that in general, the expenditure on non-food exceeds the food expenditure. As far as expenditure food items are concerned urban people spend more than their counterparts. This may be due to the price difference existing between the localities. In the case of non-food expenditure, the reverse pattern is observed between rural and urban sectors. This could be attributed to the life style and infrastructure development of a region, which are comparatively in low profile in the rural sector than the urban sector. (Table 5 & 6).

**Table 5**  
**Percentage of expenditure on different items with respect overall expenditure in Kasaragod (Locality basis).**

Items	Rural	Urban	Items	Rural	Urban
Cereals	1.5	2.8	Toxic item	0.49	1.16
Pulse	0.3	0.6	Fuel & energy	2.08	5.25
Milk	0.8	1.8	Clothing	5.79	12.76
Oil	0.5	1.0	Foot ware	1.05	1.95
Meat, egg, fish	1.4	3.1	Toilet goods	0.35	0.69
Vegetables	0.92	1.8	Education	1.43	2.56
Fruits	0.43	3.0	Medical	1.37	2.87
Sugar	0.22	0.5	Entertainment	4.51	2.51
Spices	0.16	0.4	Communication	4.67	3.9
Bakery items	0.41	0.9	Other non -food	71.15	49.64
other food exp	0.31	0.7	Non -food exp	<b>92.89</b>	<b>83.29</b>
<b>Food exp</b>	<b>7.11</b>	<b>16.7</b>	Overall exp	100	100

**Table 6**  
**Percentage of expenditure on different items with respect overall**  
**expenditure in Kasaragod – (Income basis ).**

Items	Rural			Urban		
	Low	Middle	High	Low	Middle	High
Cereals	2.4	2.8	1.0	2	4.2	2.4
Pulse	0.9	0.5	0.2	1	0.9	0.4
Milk	3.0	1.0	0.6	3.2	2.1	1.3
Oil	1.8	0.8	0.3	1.9	1.2	0.7
Meat, egg, fish	5.2	2.1	1.0	5.9	3.5	2.3
Vegetables	3.7	1.4	0.5	3.4	2.2	1.4
Fruits	1.0	0.8	0.3	1.3	9.1	0.9
Sugar	0.5	0.5	0.2	0.4	0.6	0.4
Spices	0.4	0.3	0.1	0.7	0.5	0.2
Bakery items	1.2	0.9	0.2	1.4	1.3	0.6
other food exp	0.3	0.6	0.2	0.8	1.3	0.5
<b>Food exp</b>	<b>20.4</b>	<b>11.7</b>	<b>4.6</b>	<b>22</b>	<b>26.9</b>	<b>11.1</b>
Toxic items	1.6	0.8	0.3	1.6	1.6	1.0
Fuel & energy	5.4	2.7	1.6	4.8	6.9	4.6
Clothing	22.3	9.1	3.3	24.9	17.6	7.9
Foot ware	6.0	1.8	0.4	4.4	2.5	1.1
Toilet goods	1.3	0.6	0.2	0.8	0.8	0.6
Education	4.5	1.8	1.0	3.7	2.8	2.2
Medical	9.5	1.8	0.5	5.0	3.6	2.0
Entertainment	4.1	2.5	5.1	3.3	3.2	2.0
Communication	2.4	4.1	5	2.3	2.5	4.9
Other non -food	22.6	63.1	78	27.2	31.6	62.6
<b>Non-food exp</b>	<b>79.7</b>	<b>88.3</b>	<b>95.4</b>	<b>78</b>	<b>73.1</b>	<b>88.9</b>
<b>Overall exp</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

### Consumption pattern of Kasaragod in the context of stability or consistency-Evaluation

The expenditure pattern of each group are analysed for coefficient of variance in order to assess the consistency of the expenditure pattern of that group. If the value obtained as coefficient of variation is less, it indicates that the group is less variable or more consistent / more stable. Analysis of coefficient of variance between rural population exhibits stability in the expenditure on consumption of food items while urban population shows stability with respect to non-food items (Table 7).

The result of analysis of coefficient of variance of Kasaragod district with respect to food and non-food categories reveals that rural sector is more consistent or stable in expenditure with respect to food categories such as milk, vegetables, fruits and bakery items, while urban sector is more consistent or stable in spending on food items like cereals, pulses, meat, fish, egg (Table 7). Regarding the non-food expenses urban people are more consistent in case of medicine, communication, energy and liquor consumption, while as the rural people are stable in education..



**Table 7**  
**Summary of Coefficient of Variance Analysis of Kasaragod district with respect to food and non-food categories on the ground of locality.**

Items		Rural	Urban
Food	Cereals, pulses	33	<b>32</b>
	Vegetables, fruits	<b>40</b>	50
	Meat, fish , egg	48	<b>44</b>
	Milk	<b>39</b>	47
	Bakery	<b>84</b>	100
Non-food	Education	<b>93</b>	103
	Medicine	200	<b>136</b>
	Communication	518	<b>50</b>
	Energy	509	<b>92</b>
	Toxic, Liquor	55	<b>54</b>

Table 8 elucidates the status of stability of expenditure on food and non food items in Kasaragod district on the basis of income level. It expresses that the urban low income people are more stable in expenditure pertaining to education, medicine, communication while in the case of rural low income people is observed only in milk purchase. The urban middle income people are consistent in spending on cereals and pulses of food items and for energy in the case of non-food items. The rural high income people were stable only on spending on liquor consumption where as urban high income people are having stability in spending on bakery, meat, fish and egg of food items.

**Table 8**  
**Summary of Coefficient of Variance Analysis of Kasaragod district with respect to food and non-food categories on the ground of income level.**

Items		Rural			Urban		
		Low	Middle	High	Low	Middle	High
Food	Cereals, pulses	86	46	39	49	<b>35</b>	39
	Vegetables, fruits	58	69	49	<b>47</b>	539	55
	Meat, fish & egg	64	56	49	67	53	<b>42</b>
	Milk	<b>56</b>	77	65	62	61	69
	Bakery	60	122	44	47	56	<b>46</b>
Non-food	Education	85	115	76	<b>69</b>	94	90
	Medicine	147	122	207	<b>120</b>	334	139
	Communication	101	357	689	<b>52</b>	74	231
	Energy	179	91	682	139	<b>70</b>	115
	Toxic, Liquor	182	169	<b>62</b>	116	134	66

## DISCUSSION

The overall findings of this study on Kasaragod district indicate that the expenditure on non-food items is greater than on food items. A detailed analysis of the results show, that in the rural sector the expenditure on food items is higher than the non-food items, while it is *vice-versa* in the urban sector. However this expenditure pattern of Kasaragod district when tested for statistical significance it was proved that the differences noted are statistically non significant. Even though the statistical significance for this difference is negative similar trend of consumer pattern has been observed by many researchers. Madhava Menon (2000) reported that the consumption pattern of Kerala shows a trend of high expenditure on non-food items among different expenditure classes. The study conducted on rural population indicates that the expenditure is more towards food items as observed in the present study. Similar observation by Rup Kumar et al (1995) in their study on family level consumption pattern in rural sector of Vidarbha (India) has indicated that their expenditure is more on food items.

The analysis on the stability/consistency of expenditure, in Kasaragod district, rural population shows stability in the expenditure on consumption of food items like milk, vegetables, fruits and bakery items, while urban population shows stability in spending on cereals, pulses, meat, fish and egg. Regarding non - food items, urban population shows stability in medicine, energy, communication, and liquor items at the same time the rural population shows stability only on education.

Sunny (1994) has reported a changing consumption pattern in Kerala. He pointed out that with every increase in income, the proportion of expenditure on food items in both rural and urban areas decreased correspondently, while that of non-food items has increased. Kumar and Mathur (1996) argued that the demand for food is not only influenced by income changes, but also by differences in urban and rural life styles, the development of more advanced marketing systems and occupational changes that are closely linked with increasing per capita income with the availability of money and higher value commodities in the food basket. Gopalakrishnan (2005) reported that a change has taken place in the food consumption of Kerala. Keralites have moved a lot from their simple, nutrient-rich, digestible traditional foods towards the trap of the fast food culture.

In summary, a change in the consumption pattern of the Keralites has been noticed and reported in various studies and reports. An increase in income levels, life style changes more observed more in urban population, and inflow of money from foreign countries have been cited as major cause of these changes in the consumption pattern. The findings of the present study also indicate a similar trend in Kasaragod district surveyed. The shift from expenditure on food items to non-food items indicate a shift in the culture from traditional one - which was oriented towards nature - to modern culture which is based on materialistic demand.

## CONCLUSION

The findings of the study indicate a clear shift in the consumption pattern which is expressed in terms of expenditure from food resources to non-food resources. The kind of consumption pattern alarms that the trend is non-sustainable leading to

depletion of natural resources and environmental degradation. Necessary policies for reverting the current trend of unsustainable consumption of resources have to be framed and implemented without much delay.

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# Possible Conservation and Medicinal Importance of Plants with Special Reference to Mari Theyyam

**R Raji and K Raveendran**

*Dept. of P G Studies & Research in Botany Sir Syed College Taliparamba-670142, Kannur*

## INTRODUCTION

Hindus in Kerala set aside a portion of land around the house, as abode of Gods, Goddesses or Serpents which in turn becomes a traditional method for preserving medicinal and other useful plants. Certain believes of the people have been given a religious touch to make them readily acceptable and popular. These believes relate to luck, health, prosperity, good harvest, easy childbirth and other facets of human life related to prosperity and happiness. Many such believes lead to regulated exploitation which in turn promotes habit of conservation. Our ancestors were well aware of the importance of worshipping and conserving plants. To promote such awareness, they made use of various methods which would conserve plants as well as promote good old traditional values of life. *Theyyam* is such a method. It creates religious atmosphere as well as brings people to protect and conserve plants.

Plants are used in many ways including worshipping of gods and goddesses, for the protection and betterment of human life. In every human society prayer is offered with traditional rituals for every ones well-being. Many tribal communities preserve this tradition through folklore and worship their deities right from the moment of birth to the mourning of death.

The ancient rituals in the name of zonal and religious festivals associated with the Hindu community offers great scientific ideas for the modern society. The use of plants, plant parts and food items gives a scientific basis to the studies of plants. The innocent folks, who created these festivals, might have been ignorant of science, but what they have offered in the bargain is an elaborate branch of study of plants and their uses. *Theyyam* is a good example for this.

## Theyyam

The two important cults of north Kerala are *theyyam* and *thira*. In ancient days this cult played an important role in the life of people, it offers clear perspective to the life of ancient generations. The word "*theyyam*" is merely a corruption of the word *daivam*, meaning god. Yet, it encompasses a complex universe centered on the

believes that a man can after suitable mental, physical and spiritual preliminaries attain the costume of a particular deity and then believed to become that deity.

In this elevated state he assumes superhuman and divine powers speaking, moving, blessing and even healing as a god or goddess. What is crucial is that the person is not possessed by the spirit of the deity.

There are about 400 *theyyam* in North Malabar area based on different type of myth. One among them is the *Mari*. This *theyyam* is performed only on *Karkkidakam* 16<sup>th</sup>, it is the time of heavy rain. It is conducted to prevent the spreading of epidemic disease. This paper elucidates the botanical identity and to explain the medicinal importance of plants used by this deity. This work may point out the possibility of conservation of these valuable plants by worship and scope for the use of ethno medicinal knowledge for new generation.

## MATERIALS AND METHODS

### Study Area

The study area is Madai, a small village in Kannur district, Kerala, South India. It is located near Pazhayangadi. The area lies in between 11°58'0"N 75°18'0"E.

### Criteria for informant selection

A list of fifty *theyyam* performers including *vaidyas* was prepared. Most of them had more than twenty five years of experience in this field. All of them had performed in more than 100 – 150 *theyyam* programmes during their career and are the people who inherited the art of *theyyam* from their ancestors. The informants selected included:

- Traditional performers in the age group of 15 – 25, 25 – 35, 35 – 45, 45 – 55 and 55 above.
- The traditional *theyyam* performers aged above 55 years and are now not active in this field.
- *Tanthri*, who plays a significant role by giving orders to the performance and *koyma*, who looks after the rules and regulations framed by *tanthri*.
- Individuals who acquired traditional knowledge from ancient scripts on copper plate and palm leaf.
- The performers who engaged only in *theyyam* performance.
- *Theyyam* performers who are traditionally trained and experienced in the treatment of wounds, snake bite and illnesses related to children.
- Persons who have gained knowledge and other beneficiaries from *theyyam* performers.
- Traditional ayurvedic practitioners among the *theyyam* performers.
- Herbal practitioners who perform *theyyam* only in houses.
- The *velichapadu* or *komaram*, the oracle who has to perform rituals on important occasions.
- Oracles, volunteers and the care takers of sacred centers.

- *Kalasakkaran*.
- The person involved in the collection of plant related to *theyyam* performance.

A total number of 25 informants were interviewed of which 16 are related with *Mari* and 9 other *theyyam*.

### Data collection

Data were collected through interviews, direct participatory observation, guided field trips, artifact interview, unstructured interview and discussions among the *theyyam* performers (*Mari*) in their local language (Malayalam). Purpose of the study was clearly explained to the participants to avoid possible misinterpretations.

During the field visit, interviews with aged performers (key informants), local experts, priest and villagers were made regarding the availability of plants, folklore, folk medicine, magico religious belief in relation to the plant resources, conservation and cultivation practices, rituals related to cutting of plants, festivals and rituals associated with agriculture and funeral ceremonies.

During field survey in-depth interviews and informal discussions were made to collect the information. Previously prepared questionnaires were supplied to collect ethno medico botany details from the *theyyam* performers and herbal practitioners. Experts among the group were contacted individually and in-depth interviews were held with them. Separate interviews were taken with men and woman of three different age groups viz above 65, 30 – 40 and below 30.

Structured questionnaires also allowed descriptive responses about the plant used or the part of the plant used, particularly in collecting useful parts (season and time of collection, types of plants harvested, position of the moon, age of the plant part, one or two important characters for identity), specificity in usage (fresh, dried, juice, powder, mixtures) in *theyyam* performances as well as other uses (ornaments, costumes, *prasadam*, *nivedyam*, *theyyam* attires), detailed method of colour preparation, quantity of plant parts taken, allergies if any, same mixture if used for curing other illness, duration of the treatment, responses of the patient and devotees. All additional pieces of information were also recorded.

Data, regarding the *thottampattu* of the *theyyam* mentioning the usage of medicinal plants, the traditional *Samhithas* and the hereditary knowledge regarding the traditional curing related to *theyyam* performance were also collected.

### Data analysis

All the collected data were recorded species wise. The photographs of plants (flowering or fruting stage), facial makeup, ornaments, *theyyam* performances and curing sessions were also taken. The results were compared with the published literature like, monographs, reports, journals, checklist and floras (Manilal & Sivarajan, 1982; Ramachandran & Nair) and these were again confirmed with the specimen available in the Herbaria of the Calicut University, KFRI and TBGRI. Later the photographs were labeled with vernacular names recorded during field surveys and up to date authoritative Botanical names were worked out as per IPNI, NYVH, APNI, TROPICOS.

## RESULTS AND DISCUSSION

During the performance of *theyyam* 41 plants or their parts are used (Table 1). Plant parts used were flowers leaves, stem, flower, fruits etc.

**Table 1**  
**Details of plants used by Mari theyyam**

Sl. No	Botanical name	Local name	Family	Morphology of useful part	Uses in <i>theyyam</i>
1	<i>Alpinia galanga</i> (L.) Sw.	Aratha	Zingiberaceae	Leaf, Rhizome	Pooja
2	<i>Alstonia scholaris</i> (L.) R. Br	Ezhilampala	Apocynaceae	Wood	Ornament
3	<i>Annona squamosa</i> L.	Athachakka	Annonaceae	Fruit	Food
4	<i>Areca catechu</i> L.	Adakka	Arecaceae	Inflorescence, Stem, Leaf	Ornament, Pooja
5	<i>Artocarpus heterophyllus</i> Lam.	Plavu	Moraceae	Wood, Latex	Ornament
6	<i>Azadirachta indica</i> A. Juss	Aryaveppu	Meliaceae	Leaf, Stem	Pooja
7	<i>Bambusa bambos</i> (Retz.) Voss.	Mula, Illi	Poaceae	Stem	Dress
8	<i>Benincasa hispida</i> (Thunb.) Cogn.	Kumbalam, Nai kumbalam	Cucurbitaceae	Fruit	Food, Pooja
9	<i>Brassica juncea</i> (L.) Czern.	Katuku, Cerukatuku	Brassicaceae	Seed	Pooja
10	<i>Butea fondosa</i> Roxb. ex Willd .	Chamata, Plash	Papilionaceae	Flower	Pooja
11	<i>Calophyllum inophyllum</i> L.	Punna	Clusiaceae	Leaf	Make up
12	<i>Capsicum annum</i> L.	Vattal-mulaku, Kappalmulaku	Solanaceae	Fruit	Pooja, Nivedyam
13	<i>Citrullus lanatus</i> L.	Thanni mathanga	Cucurbitaceae	Fruit	Food
14	<i>Cocos nucifera</i> L.	Thengu	Arecaceae	Fruit, Leaf	Dress, Pooja
15	<i>Cucumis sativus</i> L.	Kakkirikka	Cucurbitaceae	Fruit	Food, Pooja
16	<i>Cucurbita maxima</i> Duch. in Lam.	Mathan	Cucurbitaceae	Fruit	Pooja
17	<i>Curcuma longa</i> L.	Manjal	Zingiberaceae	Rhizome	Prasadam, Make up
18	<i>Cyathula prostrata</i> (L.) Blume	Cherukataladi	Amaranthaceae	Leaf	Kanmashi
19	<i>Desmodium gangeticum</i> (L.) DC.	Orila	Papilionaceae	Leaf	Pooja

Sl. No	Botanical name	Local name	Family	Morphology of useful part	Uses in theyyam
20	<i>Eclipta prostrata</i> (L.) L. Mant.	Kayyoni, Kanjoonni	Asteraceae	Leaf	Kanmashi
21	<i>Erythrina variegata</i> L.	Murikku	Papilionaceae	Wood	Ornaments
22	<i>Ipomoea marginata</i> (Desr.) Verdc.	Tiruthali	Convolvulaceae	Whole plant	Pooja
23	<i>Ixora coccinea</i> L.	Thechi, Cetti, Tetti, Checki	Rubiaceae	Flower	Prasadam, Pooja
24	<i>Lagenaria siceraria</i> s (Mol.) Standley	Kaipanchura, Kattuchura, Pechura	Cucurbitaceae	Fruit	Food
25	<i>Leea indica</i> (Burm. f) Merr.	Njezhuku, Maniperanti	Leeaceae	Stem, Leaf	Pooja
26	<i>Momordica charantia</i> L. var. <i>charantia</i>	Pavakka, Kaippakka, Kaipa	Cucurbitaceae	Fruit	Food, Nivedyam
27	<i>Murraya koenigii</i> (L.) Spreng.	Kariveppu, Karuveppu	Rutaceae	Leaf	Nivedyam
28	<i>Musa paradisiacal</i> L.	Vazha, Kadalivazha, Ksetrakadali	Musaceae	Fruit	Pooja
29	<i>Ocimum tenuiflorum</i> L.	Krisnattulasi, Thulasi, Trt-tavu, Karutta tritavu	Lamiaceae	Leaf, Flower	Pooja
30	<i>Oryza sativa</i> L.	Nellu, Ari	Poaceae	Grain	Nivedyam
31	<i>Panicum sumatrense</i> Roth ex Roem. et Schult.	Chama	Poaceae	Grain	Food
32	<i>Piper betle</i> L.	Vettilakodi, Kodyyila, Vettila	Piperaceae	Leaf	Pooja
33	<i>Piper nigrum</i> L. var. <i>nigrum</i>	Kurumulaku	Piperaceae	Seed	Nivedyam
34	<i>Ricinus communis</i> L.	Avanakku	Euphorbiaceae	Seed oil	Kanmashi
35	<i>Santalum album</i> L.	Chandanam	Santalaceae	Wood	Pooja
36	<i>Setaria italica</i> (L.) P. Beauv.	Thina	Poaceae	Grain	Food
37	<i>Trichosanthes cucumerina</i> L.	Kaypan patolam, Papatolam	Cucurbitaceae	Fruit	Food
38	<i>Trigonellafoenum-graecum</i> L.	Uluva	Papilionaceae	Seed	Food



Sl. No	Botanical name	Local name	Family	Morphology of useful part	Uses in theyyam
39	<i>Vernonia cinerea</i> (L.) Less.	Poovam-kurunnila	Asteraceae	Leaf	Kanmashi
40	<i>Vitex negundo</i> L.	Karunochi	Verbenaceae	Leaf	Pooja, Nivedyam
41	<i>Zea mays</i> L.	Cholam, Makka cholam	Poaceae	Grain	Food

Six plant products as the source of colouring materials for make up, while four plant part used as ornament and two plant parts used as dresses of the performer. Flowers, leaves and fruits of 19 plants were used to perform *pooja* during the different stages of *theyyam*. Different parts of same plants were used for different purposes. In this *theyyam*, 17 plants play significant role as symbol of gods. *Alstonia scholaris*, *Ocimum tenuiflorum*, *Oryza sativa*, *Piper betle* etc., the previous studies of these plants related with rituals, their role in ethno medicine and traditional rosary making property of *Erythrena variegata* (Jain & Kapoor 2007) were also reported.

Performers consume a variety of food due to their availability, palatability, traditional values and medicinal importance. Usage of *Setaria italica* (L.) P. Beauv. helps to get control over urination, which in turn helps the performer to complete the performance of long duration in a successful way. Recent research revealed that the oral administration of *Setaria italica* (L.) P. Beauv. significantly reduces the level of uric acid in liver and kidney (Kumaravel *et al.*, 2010). This attribute makes the usage of the millet an ideal food for the performers.

*Vitex negundo* L. is used as *nivedyam*. This *theyyam* is performed during the rainy season (*Karkkidakam* 16 of *Malayalam* month), which is the time of severe epidemic diseases due to *Vibrio cholerae* and other bacteria. Recent studies have found out that *Vitex negundo* L. show antibacterial property against *V.cholerae*, *Escherichia coli*, *Klebsiella pneumonia*, *Pseudomonas aeruginosa* and *Pseudomonas putida* (Srinivas *et al.*, 2010). In addition to this, this plant is cited for its property against various pathogens and pests. It is also used in different *hawanas* (Prasad & Raveendran, 2010). *Leea indica* (Burm. f) Merr is also used for *pooja* in *Mari* and it shows antiviral property (Ali *et al.*, 1996).

*Cyathula prostrata* (L.) Blume., *Ocimum tenuiflorum* L., and *Vernonia cineria* (L.) Less. are used for making *kanmashi*. The leaf juice of *Ocimum tenuiflorum* L., along with *triphala* is used in ayurvedic eye drop preparations, recommended for glaucoma, cataract, chronic conjunctivitis and other painful eye diseases (Prakash & Gupta, 2005). *Vernonia cineria* (L.) Less. is also used for various eye infections (Nadkarni, 1976) and *Cyathula prostrata* (L.) Blume. is traditionally used to cure short sight. These findings also support their traditional use.

During the performance of *theyyam gurusy* is prepared. This is a solution containing mainly calcium carbonate and turmeric powder. It is used for *pooja* and rituals

associated with *theyyam*. This *theyyam* visit houses during the end of performance and *gurusy* is poured around the houses. This solution acts as germicidal agent in an ecofriendly manner.

## CONCLUSION

The close participation of the *theyyam* with their environment and their awareness of usefulness of plant resources around them are highly admirable as revealed in the scheduled interviews, focused group discussions and *in situ* observations.

Many of the beliefs of the people have been given religious touch to make them easily acceptable and popular. *Theyyam* gives turmeric powder to the devotees as *prasadam*. A portion of this powder is consumed by them while the rest is stored in their *pooja* room (as they consider it divine) till the next *theyyam* season. Collection of turmeric powder as *prasadam* from the deity makes the devotee to store it in their house which in turn forms a readily available house hold remedy. Devotees believe that these plants are sacred due to the use by the diety. Due to this belief they do not pluck the plants so plant worship through *theyyam* performance play an important role in the conservation of our medicinal plant diversity.

It can be concluded that North Kerala is rich in wide variety of plants and the *theyyam* performers are not only familiar with the flora in their ecosystem, but also well aware of the ecological interactions of their resources. Their socio cultural activities and ritual practices are the finest example of their interdependency and harmony with the biodiversity.

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## ***Organiser's Profile***





## CENTRE FOR ENVIRONMENT AND DEVELOPMENT

The Centre for Environment and Development is an independent research and development, training and consultancy organisation focussing in fields related to Environment and Development and is the **Centre of Excellence on Solid Waste and Wastewater Management** of MoUD, GoI and **National Key Resource Centre for Drinking Water and Sanitation** of the MDWS, GoI. CED is the **Regional Resource Agency of MoEF, GoI**. CED is an ISO 9001 – 2008 Certified Institution. CED has completed nearly 95 projects sponsored by various agencies during the last 20 years. CED has its Head Quarters at Thiruvananthapuram and Eastern Regional Campus at Bhubaneswar, Regional Centre at Hyderabad and projects at Andhra Pradesh, Jharkhand, Bihar, West Bengal, Gujarat and Maharashtra apart from Odisha and Kerala.

### Vision

***To Serve as a Centre of Excellence in Environment Management for Sustainable Development***

### Mission

***Integrated Environment Management through Research, Technology Transfer, Capacity Building with Participatory Approaches, Partnership Programs and Networking with Academic Institutions and Local Governments***

### Program Areas of CED

1. Natural Resources and Environment Management
2. Water, Sanitation and Health
3. Climate Change and Energy Studies
4. Urban and Rural Studies
5. Culture and Heritage Studies
6. Information and Knowledge Management

### Core Competence

- Water Supply Engineering
- Watershed Management
- Solid Waste Management
- Waste Water Management
- Storm Water Drainage
- Public Health And Sanitation
- Geoinformatics
- Biotechnology
- Agriculture, Forestry And Wild Life
- Climate Change and Energy Studies
- Urban And Rural Studies
- Coastal And Marine Studies
- Policy Studies
- Institutional Development And Change Management
- Information And Knowledge Management



## **KERALA STATE BIODIVERSITY BOARD (KSBB)**

Kerala State Biodiversity Board is an autonomous body of the State Government and come under the Kerala State Environment Department. With the Head Quarter at Thiruvananthapuram the Board falls under the provision of the State Biodiversity Act set up in 2008 and the Biodiversity Act of 2002. The KSBB is dedicated into conservation and protection of the agro, plant and fish diversity of the State. The Board is headed by a Chairman, a Member Secretary and followed by a team of expert Government officials, leading the Board in its all vibrant activities.

### **History**

India is the first country to have the Biological Diversity Act and implement it in effective manner. The Act was conceived in the Convention on Biological Diversity (CBD) which was held in 1992 and latter in 2002 the Act was passed. The Act provides a legal framework for conservation of biological diversity of the country, sustainable use of its components, fair and equitable sharing of the benefits arising out of the use of biological resources and generation and dissemination of knowledge.

In accordance with the provisions of Act of 2002 the State Biodiversity Board (KSBB) was established in 2004. And in the same year the Biodiversity Rules was also framed.

### **Vision**

*Our vision is the conservation of biodiversity and its sustainable utilization of the biological resources for the benefit of man kind*

### **Mission**

*To ensure clean air, clean water, healthy soil and safe food to mankind*

### **Activities**

The major function of the State Biodiversity Board is to advise the State Government on any guidelines issued by the Central Government on matters relating to the conservation of biodiversity. SBB also advocate for sustainable use of biological resources and equitable sharing of the benefits arising out of the utilisation of these.

Board has the authority to grant approvals on requests for commercial utilisation or bio-survey and bio-utilisation of any biological resource by Indians. The Board also perform functions necessary to carry out the provisions of Biodiversity Act or as prescribed by the State Government.

### **Address for Communication**

Kerala State Biodiversity Board  
Pallimukku, Pettah P. O., Thiruvananthapuram-695 024  
Phone:0471 2740240, 2741134 Telefax:0471 2740234  
E mail: keralabiodiversity@gmail.com  
Website:www.keralabiodiversity.org



## **KERALA STATE COUNCIL FOR SCIENCE, TECHNOLOGY AND ENVIRONMENT**

Sasthra Bhavan, Pattom, Thiruvananthapuram-695 004

Ph no.0471-2548222, 2548220,2548442

[www.kscste.kerala.gov.in](http://www.kscste.kerala.gov.in)

*Kerala State Council for Science, Technology and Environment (KSCSTE) is an organization committed towards the promotion of Science, Education, Research and Scientific temper.*

*Sharing Kerala's constant endeavours in supporting developmental Schemes the Science & Technology Programme of KSCSTE is in the process of various creative Schemes in the Science sector. KSCSTE is now looking at the future by providing world class research and implementing globally accepted quality parameters pertaining to the State's overall development.*

### **RESEARCH AVENUES, FELLOWSHIPS & SCHOLARSHIPS**

- *Emeritus Scientist Scheme for senior Scientists*
- *Doctoral & Post-Doctoral Fellowships*
- *Fellowships in Science writing & Science Communication*
- *Prathibha Scholarships for Students opting Science learning*

### **FINANCIAL SUPPORT FOR PROJECTS**

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- *Industry linked biotechnology Schemes*
- *Intensive programmes for Innovators of Rural Technology(RTP Programme) and Biotechnology*
- *SARD Scheme focusing activity specific areas*
- *Innovation & Technology Development(TDAP)and Patent Information Centre*

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- *Kerala Shastra Puraskaram for eminent scientists*
- *Science Literature Award*
- *Back to Lab Programme for Women*
- *Vocational skill oriented reinstated training [VSORT]*
- *Tech Fest, Green Corps, Eco Clubs*
- *Sasthra Poshini & Sasthra Bhodhini*



**POPULARISATION PROGRAMMES**

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- *Support for Seminar, Symposia and Workshop*
- *National Science Day, National Technology Day, World Environmental Day, Ozone Day etc.*

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- *Technology Transfer*
- *Science City*
- *Scientific Management Training*
- *Innovation Warehouse & River Rejuvenation Projects*
- *Video Production on Science Awareness*

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## NOTES



