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PHOTOGRAPHS BY: DR. NIKUNJ GAJERA

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Editorial

Dear Colleagues,

This issue of *Guide.net* carries many articles that are of relevance to Kachchh and arid zone ecosystems such as *Prosopis*, solid waste management, medicinal aspects of Kachchh flora and on bats. Environmental issues of Kachchh are apparently unique and to address it, we need to device innovative and special approaches. One such example is the issue of *Prosopis*. Its spread in Kachchh is estimated to be at the rate of 47 sq.km/year which is on the rise every year.

Proliferation and ecological implication of *Prosopis* is widely debated and a final concrete management approach to control it is yet eluding. In the light of the fact that its physical eradication is next to impossible, focused research on its biological and ecological aspects and utilizing the modern techniques of biotechnology is to be explored to manage this species. Taking inspiration from traditional knowledge, the article on Kachchh floral wealth narrates how the plants of Kachchh could be a valuable medicinal resource and highlights their conservation significance and sustainable utilization. The article on electronic waste, a universal and ubiquitous environmental problem, suggests some possible avenues to recycle and overcome this growing menace. The article on flying foxes (Bats) by one of our dissertation students dispels many myths about this wonderful flying mammal which is common in Kachchh.

Graphic & Design
Mr. Dayesh M. Parmar

It deserves to be highlighted that some long term but urgent environmental issues whose threat perception is higher for Kachchh is yet to grasp our attention. For example, climate change and the concomitant issues of sea level raise (SLR), change in rainfall pattern, recurrence of drought, further spreading of deserts, etc. It is high time that these issues and their long term implication *vis-a-vis* arid zones are paid more attention by our researchers in order to tackle their long term impact.

Once again, I thank you all for your sustained interest in G*uide.net* which keeps us aware of the consent need to improve its quality and content.

G.A.Thivakaran
Editor, Guide.net

My experience with indian flying fox (Pteropus giganteus)

If you are like many people, hearing the word “Bat” would make you shudder with fear and dislikes (Dee Stuart, 1994). Somewhere, you may have heard that bats attack people, morass in your head, bite you and are the carriers of rabies. Unfortunately a number of myths and misconceptions about bats have been in existence throughout the ages and sometimes all the bats are referred to as “Vampires”. This has resulted in bats’ being one of the world’s most unfairly accused and misunderstood creatures. Bats belong to the taxonomic order Chiroptera, which is the second largest order of mammals with more than 1100 species which are divided into two suborders Megachiroptera and Microchiroptera based on their size and feeding habits and are the only mammals which possess the ability of true flight. India is home to nearly 120 species of bats out of which 13 belong to the suborder Megachiroptera and the remaining to the suborder Microchiroptera.

I have got opportunity to understand the behaviour of Indian flying fox, *Pteropus giganteus* belonging to the suborder Megachiroptera. Flying foxes are the giants of the bats world that weigh up to 1.5-2 kg with the wingspan reaching up to 6 feet. This is a fruit eating bat, widely distributed in India seems to be adapted to hot and dry climate. I have observed the behaviour of this species in some localities of Bhuj city where these flying foxes roost in large number on the trees of *Polyalthia longifolia* and *Cocos nucifera* in Sharad Baug Palace which is the only permanent roosting site of these bats in Bhuj city. Bats are social animals and are found in colonies specifically located amidst human population. They are present in large colonies of about 300-400 individuals. The colonies of these flying foxes comprise of adults, sub-adults and young ones. It travels long distances up to 150-200 km to and fro from its roost every night in search of fleshy fruits. Their colonies generally have permanent roost with 2-3 temporary roosts where individuals shift depending on the season. In Bhuj this temporary roost site is served by Rajendra Bagh which is located in the centre of Hamirsar Lake where the colony can be sometimes found roosting on *Azadirachta indica* (Neem) trees. As bats are known to be

nocturnal species, much less is known about their daytime activity budget. Hence, I have initiated the study to understand its daytime behaviour.

Figures (anti-clockwise from top right): Sharad Baug Palace, a colony of about 50-60 individuals roosting on Neem tree, an individual performing Scanning and an individual performing Brachiation.

I observed various behaviour of flying fox during day time which included resting (hanging with eyes closed), scanning (hanging with eyes open), fighting, grooming, wing flapping, communication, sexual behaviour, feeding, brachiation (moving from one branch to the other) and flying. While resting was seen as the most frequent activity done during the daytime followed by wing flapping and scanning respectively, feeding and sexual behaviour were among the least observed activities. It was seen that a high number of individuals of the colony were sleeping just before the sunset which could be a possible method of saving energy before they go out for flight after sunset.

Conservation Status

According to a study by Mahato et al. (2012) and discussion with locals, it was found that the colony was increasing in number and was seen to be healthy but still the population of these bats has decreased as compared to the population before 2001 earthquake, which resulted in the felling down of trees which were their roosting sites. This further decreased the population of these flying foxes. As in other parts of the country where these flying foxes are killed for their meat (especially Assam and other states of North East India), these bats do not have such a direct threat to them in Bhuj but the reconstruction and development activities post 2001 earthquake, rapid industrialization, urbanization and encroachment of the woody invasive plant *Prosopis juliflora* are some of the reasons that posed indirect threat to these bats as it led to the decrease in the number of their roosting trees. Even damage to the temporary roosting site can have significant effect on the population as they cannot migrate to an earlier trusted place in time of unfavorable conditions in the permanent roosts.

Bats are ecologically very important species as they are one of the major pollinators and some of the plant species solely depend on them for pollination. They also possess medicinal value. This species *Pteropus giganteus*, is one of the most persecuted fruit bats in South Asia and listed as a vermin under the Schedule V of the Indian Wildlife (Protection) Act. This species is listed on Appendix II of the CITES and regular population monitoring is needed to establish major threats and overall declines. With reference to the study area, Bhuj, apart from regular population monitoring, emphasis should be laid on managing the human encroachment aiming construction activities which are a threat to their roosting sites. In addition, effective measures need to be taken to control the invasion of *Prosopis juliflora* which is gradually decreasing the plant diversity of the area by thriving them for vital soil nutrients and assuring its spread. This would be harmful for the trees which are roosting sites for these majestic creatures.

Priyanshu Joshi
Guru Gobind Singh Indraprastha University,New Delhi

Beheda (Terminalia bellirica (Gaertn.)Roxb): a potential source for Pharmaceutical industries

Family: Combretacae

Vernacular names: Baheda

Habit: (15 to 20) m long.

Parts used: stem, fruits, bark, leaves,

Bark: ash–coloured or grayish brown, longitudinally fissured.

Leaves: 4.5 – 26 * 2.7 – 15.5 cm acuminateat apex, base narrowed and cuneate, emarginated, both surfaces puberulous when young, glabrous and reticulate when old, margins entire, subcrenulate pellucid.

Inflorescence: 5-10 cm long, auxiliary solitary or clusterd spikes.

Flower: 0.5 cm across, creamy – white or pale yellow, upper unisexual

Androecium: stamens 10.

Gynoecium: absent in male flowers and hermaprrodite flower. Ovary 0.15 cm, unilocular, ovules 2 or 3; style up to 0.4 cm long.

Fruit: Drupe, 1.5 – 2.5 cm across, brown

Seed: Solitary, exalbuminous, cotyledons convolute

Distribution: Throughout India

Action/uses: The bark is mildly diuretic. The fruits are astringent, acrid, sweet, thermogenic, anti-inflammatory, anodyne, styptic, narcotic, digestive, antihelminthic, aperients, expectorant, ophthalmic, antipyretic, antiemetic and rejuvenating.

The bark is useful in leucoderma. The fruits are useful in vitiated conditions of vata and pitta, cough, bronchitis, pharyngitis, insomnia, dropsy, dyspepsia, flatulence, dipsia, vomiting, hemorrhages, ophthalmopathy, strangury, splenomegali, ulcer and general debility. The oil obtained from the seeds is useful in dyspepsia, skin diseases, leucoderma and greyness of hairs.

Commercial utility: Fruits sold in market, used extensively in preparing ayurvedic medicine.

Bhagirath Paradva
JRF, Gujarat Institute of Desert Ecology

Kachchh: An abode of unique flora

Kachchh district has unique geographical location which is surrounded by water and saline desert. Administratively, the district is divided into ten talukas *viz.*, Bhuj, Mundra, Mandvi, Abdasa, Lakhpat, Nakhtrana, Rapar, Bhachau, Gandhidham and Anjar. The climatic condition is very typical, represented by extreme cold in winter and extreme hot in summer and the annual rainfall is around 370 mm. Hence, the district represents the harsh climatic condition.

The forest type is also a unique to the world as describe by the Champian and Seth (1968) as "Northern Tropical Thorn Forest". To know the floral wealth of the district, a study has been initiated by C. T. Palin in 1880. Later on many researchers such as Blatter (1908-1909), Kapadia (1954), Puri Jain and Despande (1959), Jain and Despande (1960), Jain and Kanodia (1960), Patel (1971), Shah (1978), Blatter and Hallberg (1984), Bhandari (1990), Thakar (1926), Bhatt (1993) and Patel (2012)

Typical thorn forest of Kachchh District

contributed richly on the floral wealth of Kachchh. Of late, Gujarat Institute of Desert Ecology has been intensively studying the floral diversity of various region of the district since last 18 years. The cumulative results of these studies revealed a total of 695 species of flowering plants distributed in different parts of Kachchh region. Apart from this, Thakar (1926) had earlier described a total of 511 plant species as having medicinal value. The thorn forest and Savanna are two dominant ecosystems in Kachchh. These vegetation types exits in the form of a mosaic in hilly tract and plain area. Hilly tract supports rich mixed thorn forest, Euphorbia scrub and Acacia forest which are classified based on the floristic composition of each habitat and plain area supports mainly grassland and saline scrub. Their forest types support good number of threatened plant species i.e. Commiphora wightii, Helicrysum cutchicum, Heliotropium rariflorum and Convolvulus stocksii, including Commiphora wightii, Capparis cartilaginea, Boerhavia diffusa and Tribulus terrestris.

These species possess high medicinal values and are facing the threat of extinction by overexploitation for commercial purpose.

An update on the floral diversity of the district indicates a total of 988 higher plant species (including one gymnosperm) belonging to 118 families and 503 genera, which represents 805 species of dicots and 183 monocots. Herbs were the most dominant plant form in Kachchh, represented by 457 species (46.25% of total species reported), followed by shrubs (162), trees (149), grasses (104) and climbers (43). Poaceae, the monocotyledon is the dominant family reported with maximum of 104 species. This is followed by Fabaceae (84), Asteraceae (52), Cyperaceae (44) Malvaceae (43) and Convolvulaceae (41) families. In Kachchh, *Cyperus* is the most dominant genus under family Cyperaceae and is represented by 24 species. Other dominant genera include *Ipomoea*, *Heliotropium*, *Euphorbia*, *Indigofera*, *Cassia* and *Ficus* each represented by at least eleven or more than eleven species.

A total of 21 threatened plant species have been recorded which include: *Helicrysum cutchicum, Commiphora wightii, Heliotropium bacciferum* var. *suberosum, Heliotropium rariflorum, Ipomoea kotschyana, Dactylian drawelwitschii, Indigoferaca erulea* var. *monosperma, Limonium stocksii, Tribulus rajasthanensis, Campylanthus pungens, Hyphaene indica, Ammannia desertorum, Corallocarpus conocarpus, Dipcadi erythraeum, Pavonia ceratocarpa, Sidatiagii, Schweinfurthia papilionacea, Citrullus colocynthis, Convolvulus stockii, Talinum portulacifolium* and *Ephedra Foliata* (Gymnosperm).

Dr. Rohit Patel
Mr. Bhagirath Paradva
Mr. Piyush Vaghasiya
Gujarat Institute of Desert Ecology

Water is one of the most valuable and essential resources to mankind. It is the basis of all civilizations right from the beginning of human history. Considering historical facts, all the civilizations emerge around some water resources. From this we can arrive into a conclusion that water always plays a crucial role in the history of mankind. Water is one of the most important elements involved in the creation and development of healthy life. The quality and quantity of water resources decreases with exponential growth of industrialization and population. To avoid this situation we have to use water in a sustainable way. To achieve this, a high level of responsibility towards water usage is required, and it must be recycled according to its pollution content in order to maintain water quality and protect our environment. In 1995, the Central Pollution Control Board (CPCB) identified severely polluted stretches on 18 major rivers in India. Not surprisingly, a majority of these stretches were found in and around large urban areas. The high incidence of severe contamination near urban areas indicates that the industrial and domestic sectors' contribution to water pollution is much higher than their relative importance implied in the Indian economy. There is also considerable reduction in the ground water levels. Water is a renewable resource, in the sense that it could absorb pollution load up to certain levels without affecting its quality. The problem of water pollution occurs when the pollution load exceeds the natural regenerative capacity of the water resource. The control of water pollution is therefore to reduce the pollution loads from anthropogenic activities to the natural regenerative capacity of the resource.

The sustainable use of water is the only way to achieve this. Water should also be treated before disposal. From early centuries itself wastewater is directly dumped to sea or nearby water resources. During that time the regenerative capacity of the water Resource is more. With increase in population and industrialization, the pollution load exceeds the regenerative capacity of the water resources. If this situation prevails, with in no time there will be no water for humans, not even for the plants to uptake. If there should be a war, then it will be for water. Since water is all around us, we can use all that

water because of the salinity and other parameters. Freshwater resource in earth is only 2.5%. In that only 0.7% is available in lakes and other water bodies, remaining are trapped in polar ice caps and glaciers which are non-accessible to humans. So the only way is to treat wastewater, since we can't stop industries.

Many methods of water treatment have been researched and employed by different nations around the globe. There are various parameters that must be considered when a wastewater treatment choice is made, including level of pollution and the amount of water to be treated within a period of time. The use of plants for wastewater treatment is appropriate in smaller communities and agglomerations because they are easily constructed, inexpensive to maintain and efficient. Constructed wetlands use plants which are able to cope with different concentrated pollutants in water and help bacteria's to break down these substances.

Constructed wetlands are essentially inspired by natural processes taking place in naturally occurring wetlands. Natural wetlands which include marshes, swamps, bogs and everglades are highly productive ecosystems storing large volumes of water, recirculating nutrients, providing habitats that support a diverse population of plants and animals, and removing pollutants from the water.

Wetland

Wetland is an area consisting of soil, plant and water where the soil is covered by water or saturated with moisture such as marsh, swamp or bog. The Ramsar Convention (The Ramsar Convention; 1971) define wetland as, Land inundated with temporary or permanent water that is usually slow moving or stationary, shallow, fresh brackish or saline where the inundation determine the type and productivity of soils and plant and animals communities. Generally wetland can be categorized into two, which are natural wetland and constructed wetland.

Natural Wetland

Wetland is an area consisting of soil, plant and water where the soil is covered by water or saturated with moisture such as marsh, swamp or bog. Wetland is an area consisting of soil, plant and water where the soil is covered by water or saturated with moisture such as marsh, swamp or bog. Natural wetlands have long been used for discharge of treated wastewater effluents primarily as a disposal measure, but also as a means of reducing nitrogen and phosphorus concentrations in the effluent. However, intentional and planned use of constructed wetlands for wastewater treatment is relatively new.

Constructed Wetland Systems

Constructed wetland is an opposite of natural wetland where it is define as engi-neer-made equivalent of natural wetlands, and designed to reproduce and intensify the wastewater treatment processes that occur in natural wetlands (Hammer *et al.*, 1994). They were first introduced to treat wastewater by Siedel in 1952 in Germany (Chen *et al.*, 2007). Basically constructed wetland treatment systems consist of four major components which are soil or gravel, water or shallow pond, aquatic plant or macrophytes and also microorganism. In general constructed wetland has been use to be a good solution to treat the polluted water and restored the ecosystem health (Chen *et al.,* 2007).

Constructed wetlands are effective and eco-friendly ways to remove suspended solids, organics, and heavy metals to improve water quality, at the same time, nutrients are recycled to be reused. Besides, constructed wetlands also provide a particular value of flooding control, studying cases for investigation and research, habitat for fish and birds; in the meantime, they help to enhance the landscape aesthetically (DuPoldt, *et al*.).Environmentalists have referred to wetlands as nature's kidneys. Much interest has developed in recent years in using constructed wetlands to remove contaminants from water, whether it is effluent from municipal or private waste systems, industrial or

agricultural wastewater, or acid mine drainage.

At first natural wetland are used in treating wastewater. But there are some operational difficulties in using the natural wetland as a wastewater treatment medium. Wetland are the most simple and inexpensive technique for wastewater treatment. The operational limitations associated with natural wetland systems are the difficulties in hydraulic control and potential interference of the wastewater constituents on wild life habitat and ecosystems. Constructed or artificial wetlands that represent an emerging Eco technological treatment system are designed to overcome the disadvantages of natural wetland systems, but possess the positive attributes of a natural wetland.

The emergent aquatic plants most commonly planted in constructed wetlands are;

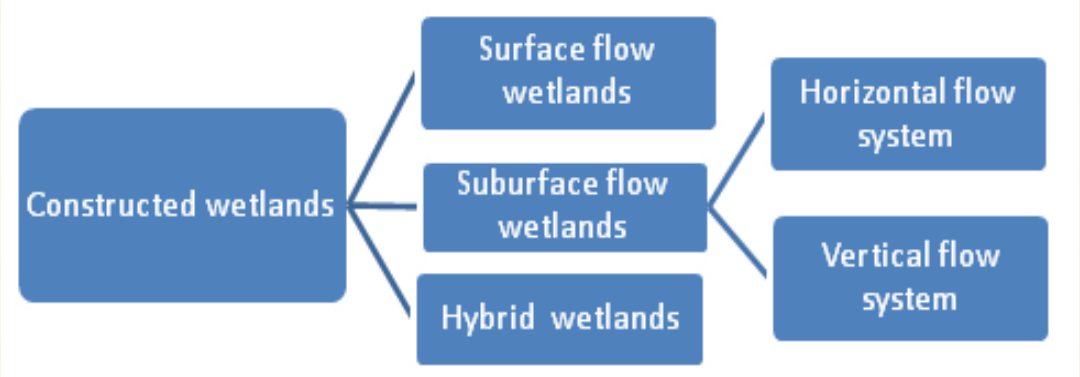
Cat tails (*Typha*)

- Common reeds (*Phragmitis*)
- Bulrushes (*Scirpus*)
- Sedges (*Carex*)

Types of constructed wetland

Constructed wetlands could be classified into three types in terms of the water level in the wetlands and the different pollutants that they can remove.

- Free Water Surface Systems (FWS)
- Subsurface Flow Systems (SF)
- Hybrid Wetlands



Free Water Surface Systems (FWS)

This system mimics natural marsh lands. It has a natural or constructed clay layer or impervious liner made of geotechnical material as bottom to prevent seepage. Above the impervious layer is the soil or the other suitable medium to support the growth of emergent plants. Wastewater at a relatively shallow depth, flow horizontally over the soil surface. The configuration of the system, which is usually in the form of long narrow channel, the shallow water depth, low flow velocity and presence of plant stalks, as well as litter, provide the necessary conditions for near plug-flow hydraulic pattern.

Subsurface Flow Systems (SF)

The SF wetlands basically consist of the same components as the FWS systems, but the wastewater is confined to the substratum. The media supporting plant growth normally consist of soil, sand, gravels and rocks in that order downwards to provide better bed porosity. The flow format of wastewater can be up flow, down flow or horizontal flow. With the most commonly encountered SF wetlands belonging to the horizontal type. Most systems have been designed with 1% slope or slightly higher.

Hybrid Wetlands

Different types of constructed wetlands can be combined to achieve greater efficiency in wastewater treatment especially in the nitrogen and pathogen removal. Various wetlands

complement each other and because of that there has been a growing trend in building hybrid systems. On the negative side it must be said that those wetlands are more expensive to build and also more complicated to operate than non-hybrid systems (Hoffmann *etal*, 2011). A widely used VF-HF design consists of two stages. In the first part several VF beds are installed in parallel to remove organics and provide nitrification. The second stage consists of two or three HF beds in series to further remove solids and nitrogen from the water (Vymazal, 2011).

Components of constructed wetlands

- Water
- Substrates, sediments and litter
- Vegetation
- Microorganisms
- Animals

Working of Treatment Wetlands

Natural wetlands perform many functions that are beneficial to both humans and wildlife. One of their most important functions is water filtration. As water flows through a wetland, it slows down and many of the suspended solids become trapped by vegetation and settle out. Other pollutants are transformed to less soluble forms taken up by plants or become inactive. Wetland plants also foster the necessary conditions for microorganisms to live there. Through a series of complex processes, these microorganisms also transform and remove pollutants from the water. Nutrients, such as nitrogen and phosphorous, are deposited into wetlands from storm water runoff, from areas where fertilizers or manure have been applied and from leaking septic fields. These excess nutrients are often absorbed by wetland soils and taken up by plants and microorganisms. Wetlands are some of the most biologically diverse and productive natural ecosystems in the world. While not all constructed wetlands replicate natural ones, it makes sense to

construct wetlands that improve water quality and support wildlife habitat. Constructed wetlands can also be a cost-effective and technically feasible approach to treating wastewater. Wetlands are often less expensive to build than traditional wastewater treatment options, have low operating and maintenance expenses and can handle fluctuating water levels. Additionally, they are aesthetically pleasing and can reduce or eliminate odors associated with wastewater.

Planting zones	**Common name**	**Scientific name**
Marsh and deep marsh (0.3-1.0 m)	Common Reed	*Phragmiteskarka*
	Spike Rush	*Eleocharisdulcis*
	Greater Club Rush	*Scirpusgrossus*
	Bog Bulrush	*Scirpusmucronatus*
	Tube Sedge	*Lepironiaarticulata*
	Fan Grass	*Phylidriumlanuginosum*
	Cattail	*Typhaangustifolia*
Shallow marsh (0-0.3 m)	Golden Beak Sedge	*Rhynchosporacorymbosa*
	Spike Rush	*Eleocharisvariegata*
	Sumatran Scleria	*Scleriasumatrana*
	Globular Fimbristylis	*Fimbristylisglobulosa*
	Knot Grass	*Polygonumbarbatum*
	Asiatic Pipewort	*Erioucaulonlongifolium*

Advantages of Wetland over Conventional Wastewater Treatment Systems

Constructed wetlands are designed to take advantage of the same processes that occur in natural wetland, but do so with a more controlled environment. Some of these systems have been designed and operated with the sole purpose of treating wastewater, while others have been implemented with multiple use objectives in mind, such as using treated wastewater as a water source for the creation and restoration of wetland habitat for wild life and environmental enhancement (Bastian, 1993; Kadlec and Brix, 1995; Kadlec and Knight, 1996). Haberl (1999)

has summarized the main advantages of the constructed wetland over traditional treatment plants. These are as follows:

- Utilization of natural processes
- Simple construction
- Simple operation and maintenance
- Low energy consumption
- Little excess sludge production
- Cost effectiveness
- Process stability
- Increase in biodiversity
- Utilization of the harvested aquatic plants for a variety of purposes.

A list of common wetland plants used in constructed wetland systems

The constructed wetlands are more efficient than natural wetland in many ways. It's a cheaper way to treat wastewater without producing much more pollution rather than any conventional wastewater treatment processes. Since no chemicals are used, the cost of treatment is less and less pollution. CWS show a significant removal on nitrate, sulphate and phosphorus.

Water is known as the elixir of life. Scarcity of safe drinking water is a major problem faced by mankind in recent years. Because of increase in population and over exploitation of the natural water resources, fresh water resources are declining day by day. Considering the above scenario, protection of the available limited fresh water resources from deterioration in quality deserves utmost importance. In order to achieve this goal, treatment of the wastewaters to safe

levels before discharging into water bodies is a need of the hour. Exhorbitant costs involved in treatment of wastewater by conventional wastewater treatment measures are a factor limiting the adoption of these technologies in many instances. Treatment of wastewater by wetland system is a low cost method for wastewater treatment.

Midhun G
Environmental Analyst
Gujarat Institute of Desert Ecology

Is Prosopis a curse or a blessing?

Concern about deforestation, desertification and fuel wood shortages in the 1970s and 1980s provoked an avalanche of projects that introduced Prosopis juliflora and other hardy tree species to new environments across the world. P. juliflora has survived where other tree species have failed and in many cases it becomes a major nuisance to the environment. Invading P. Juliflora has been on the list of world's 100 least wanted species for many years. In spite of that it is one of the most economically and ecologically important tree species in arid and semi-arid zones of the world. P juliflora (locally known as gando baval - Mad tree) is a weed; no doubt, it is an aggressive plant and competes with local flora.

There are many factors that make Prosopis species a successful invader to the new environment such as environmental flexibility, prodigious seed production that remain viable for decades and faster growth rate. Prosopis root systems allows them to efficiently utilize both surface and ground water (to depths of more than 50 m). Many Prosopis species can also withstand extreme conditions such as very high temperatures, low rainfall, and they are not limited by alkaline, saline or unfertile soils.

***Prosopis juliflora* as an economic resource**

Prosopis plays a leading role in the afforestation of arid lands. It has ability to grow on degraded land under arid and semi-arid conditions. Being a multipurpose

tree, Prosopis is suitable for controlling soil erosion, stabilizing sand dunes, improving soil fertility, reducing soil salinity, providing fuel energy resources, supplying feed and forage for grazing animals, furnishing construction timber and furniture wood, supplementing food for humans, and promoting honey production.

Prosopis juliflora produces a high calorific value of good quality fuel, which burns well even when freshly cut. It also produces high quality charcoal and its heartwood is strong and durable. It branches are widely used as fencing posts, while its pods which are high in protein and sugars may be important fodder for livestock, and/or food for humans. Banni woodland in Kachchh district alone produces over 50 tons of Honey/year, which

was collected from Prosopis. It provides up to 70% of fuel wood needs for local households in villages of some dry regions.

Prosopis, a dry land resource is considered as a valuable tree species of the desert ecosystem, particularly in the arid zone of the north-western Gujarat such as Kachchh district. It constitutes a large percentage of vegetative cover, producing about 25 to 30 tons of biomass/ha/year at a short rotation age of 4 to 5 years. It also has a tremendous potential for pod production. Between 1990 and 1995, the Gujarat Agricultural University collected about 2000 metric tons of pods. During the same period the university collected, processed and marketed about 300 metric tons of honey, which generated about a half million man-days of labor, an important source of employment and income for local people. In addition, the Gujarat Agricultural University manufactures charcoal from Prosopis juliflora. Between 1990-1995, it manufactured about 300,000 bags of charcoal and generated about 300,000 man days of labor demand.

In South Africa, pods are collected to produce organic medicines (called "manna") which are said to have properties that stabilize blood sugar levels in humans. This company is making profits of $100,000 per annum and has the potential to increase profits ten-fold if the product is marketed internationally. A company in Brazil, Riocon, has an annual turnover of six million US dollars a year from the sale of Prosopis pod flour for animal Feeds. In the dry lands of India, P. juliflora is considered as a most valuable tree species.

Positive and Negative impact of Prosopis invasion

Prosopis invasion also have a variety of negative social, ecological and economic impacts. They alter ecosystem services such as water supply, hydrological functioning, grazing potential and soil quality. In many parts of Africa Prosopis invasion produces detrimental impacts on local community structure and functioning, leading to an increase in their vulnerability to drought. This includes potential loss of land rights for local livestock herders.

Prosopis juliflora has also been used to shelter agricultural crops from wind and to reduce the movement of soil and sand. Its leaves contain various chemicals known to affect palatability of livestock, but also suppress the germination and growth of crops, weeds and other trees. However, the pods have been reported to result in facial contortions, impacted rumen and constipation among livestock. These ill effects may sometimes result in death.

***Prosopis juliflora* as an alien invader**

In Sudan, *Prosopis* invasion is reported to depress the growth and survival rate of indigenous vegetation. Some farmers in the area of Kassala claim that they lost their farmlands due to *Prosopis* invasion; others complain that not only it is costly to clear but it also destroys agricultural crops, while others are wary of *Prosopis* thorns which are harmful both to farm workers and their machinery. Additionally, it is said to consume underground water.Herders claim that the plant's pods bring about some animal diseases. In Ethiopia, the aggressive invasion in pastoral areas is displacing 15 native trees, forming impenetrable thickets and reducing grazing potential. Agricultural lands and protected areas such as the Awash National Park are threatened.

Considering all these facts and to sum up it is it is still a question.....whether *Prosopis* is a Boon or bane', 'Pest or providence, weed or wonder tree?', 'Invasive weed or valuable forest resource.....?'

Dhruma Vaidya,
JRF
Gujarat Institute of Desert Ecology

Use of plastic waste in road construction and fuel

What is plastic?

A material that contains one or more organic polymers of large molecular weight, solid in its finished state and at some state while manufacturing or processing into finished articles, can be shaped by its flow. Waste plastics are one of the most promising resources for fuel production because of its high heat of combustion and due to increasing availability in local communities. Unlike paper and wood, plastics do not absorb much moisture and the water content of plastics is far lower than the water content of biomass such as crops and kitchen wastes. If used in road construction, it reduces the need of bitumen by around 10%, increase the strength and performance of the road, and reduce the cost to around Rs. 5000/km of single lane road, generate jobs for rag pickers, develop a technology, which is eco-friendly.

Conversion of plastics waste into liquid fuel

The process adopted is based on random de-polymerization of waste plastics in the presence of catalyst into liquid fuel. The entire process is undertaken in closed reactor vessel followed by condensation, if required. Waste plastics when heated up to 2700 to 3000°C, convert into liquid-vapour state, which is collected in condensation chamber in the form of liquid fuel. The tarry liquid waste is topped-down from the heating reactor vessel. The organic gas generated in the process is presently vented due to lack of storage facility; however, the gas can be used in dual fuel diesel generator set for generation of electricity.

Environment Related Observations

- There are no liquid industrial effluents; floor washing as waste material is not washed.
- There is no organized stack and process emissions are let out.
- Odour of volatile organics has been experienced in the processing area due to some leakages or lack of proper sealing.
- Since, absolute conversion of liquid-vapor was possible into liquid, some portion of gas (about 20%) is connected to the generator. However, the process could be improved in full scale plant.
- PVC plastic waste is not properly used, sometimes if used, it is less than 1%. In case PVC is used, the chlorine can be converted into hydrochloric acid as a by-product.
- The charcoal (Charcoal is formed due to tapping of tarry waste) generated during the process has been analyzed and contain heavy metals, poly aromatic hydrocarbon (PAH) which appears to be hazardous in nature. The source of metals in charcoal could be due to presence of additives in plastics and multilayer and laminated plastics.
- Monitoring of process fugitive emissions in the work area as well as emissions from the engines/diesel generator sets, where this liquid fuel is used, for various parameters such as CO, HCl, Styrene, Benzene, VOCs is necessary.

Ratansi Chudhary,
Chemical Engineer
Gujarat Institute of Desert Ecology

Solid waste management: an overview

Unwanted or useless solid material generated from the household, industrial and commercial activities in a given region are referred as 'Solid Waste'. With increasing industrialization, urbanization and other developmental activities, thousands of tons of solid waste are generated all over the world daily and most of it end up in dumps and wetlands, thereby contaminating the surface and ground water. The generated solid wastes ranged from about 0.5-0.6 kg/person/day and in some cases can reach up to 0.8 kg/person/day. The waste generated from your kitchen to the high level industries where your kitchen equipments and other items are produced. The gradual increase in this solid waste generation can be attributed to the ever increasing population that acts as the major carrier for solid waste increase. The industries and the general community can be seen as the most important stakeholders in this steady increase of solid waste all around the world.

The sources of these solid wastes are tabulated below along with the types of wastes that are generated from these sources:

Source	Typical waste generators	Types of solid wastes
Residential	Single and multifamily dwellings	Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g., bulky items and household hazardous wastes.).
Industrial	Light and heavy manufacturing, fabrication, construction sites, roads, etc.	Housekeeping wastes, packaging, food wastes, construction and demolition materials, hazardous wastes, ashes, special wastes.
Commercial	Stores, hotels, restaurants, markets, etc.	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes.

Institutional	Schools, hospitals, prisons, government centers.	Same as commercial.
Municipal services	Street cleaning, landscaping, parks, beaches, other	Street sweepings; landscape and tree trimmings; general wastes from parks, beaches, and other recreational areas; sludge.
Process (manufacturing, etc.)	Refineries, chemical plants, power plants etc	Industrial process wastes, scrap materials, off-specification products, slay, tailings.
Agriculture	Crops, orchards etc.	Spoiled food wastes, agricultural wastes etc.

Municipal Solid Waste

In India, there has been a steady and regular increase in the generation of municipal solid waste and it can be attributed to the outburst in the population of the country since a decade. The daily per capita generation of the solid waste has ranged from about 100gm in small town to about 500gm in big cities. According to a study by CPCB, the population of Mumbai grew from 8.2 million in 1981 to 12.3 million in 1991 and with this growth the municipal waste generation grew from 3200 tonnes per day to 5355 tonnes per day, clearly indicating the effect of population growth on the municipal waste generation. With all these facts and figures into consideration, there is a need to manage this solid waste. According to the Ministry of Rural Development, Solid Waste Management (SWM) deals with the collection, transport, processing, recycling or disposal of solid waste which generally produced by human activity, in order to minimize its effect on human health, sanitation, agricultural yield, soil quality and other life processes.

Management of Municipal Solid Waste: A Case Study of Thoothukudi District of Tamil Nadu

Thoothukudi district is a port town located in the Gulf of Mannar about 125km north of Cape Commorin and is a fast growing industrial belt of South India. The area of the town is about 4,621 Sq. km and accommodates a population of 17,38,376 (as per 2011 census). According to the District Vision booklet by Tamil Nadu government, the town generates about 110 metric tonnes of solid waste per day i.e, per capita around 500gms of solid per day. With the increase in population in the district from 222,000 in 2008 to 720,000 in 2014, the solid waste generation has gone up from 110 tonnes in 2008 to 540 tonnes in 2014. With this increase came a drastic need for the effective management of this solid waste. In 2013-14, Dr. Palanivel from PSG College of Arts and Science, Coimbatore and his colleagues worked for creating awareness on effective municipal waste management in Thoothukudi district. They made people aware of the different types of municipal waste, its segregation and methods of decomposition. The types of waste are residential, commercial and slurry wastes.

The method used for its segregation is mainly manual which includes hand-picking and separating glassware, plastic, polythene paper, metal, ceramics and organic material from one another. From these separated materials, plastic and polythene paper were taken for use through various industrial processes, ceramic and glassware were dumped and organic material for composting process after which it could be used as a fertilizer for agricultural fields. The municipal workers were given hands-on training for proper separation and post separation processes by the team. The team visited frequently for 3-4 months and made the workers employs proper methods of separation and processing. This helped in proper disposal of the municipal solid waste and was further applied in various other districts of Tamil Nadu.

Figure (clockwise from top left): Dumping yard, Teaching workers, Composting pit and Segregation.

Conclusion

The municipal solid waste generated in the district was found mainly coming from Industries and household drains. The waste generated was steadily increasing with the increase in population and developmental activities. The waste, if separated and decomposed correctly, can be immensely beneficial in terms of better ecosystem services as well as economically. The scientific techniques for the management are to be transferred to the local municipal workers who can employ them and would yield maximum benefits. The amount of money spend on agricultural fertilizers can be brought down with the use of organic fertilizer which is produced by the proper composting of the organic waste.

T. Dhananjayan,
JRF
Gujarat Institute of Desert Ecology

Electric and Electronic waste: a growing Environmental Menace

Electronic waste, e-waste, e-scrap, or waste electrical and electronic equipment (**WEEE**) are the discarded electrical or electronic devices. "Electronic waste" may also be defined as discarded computers, office electronic equipment, electronic entertainment devices, mobile phones, television sets and refrigerators. This definition includes used electronics which are destined for reuse, resale, salvage, recycling, or disposal.



The manufacturing of electrical and electronic equipment is one of the emerging activities all around the world. In India the amount of e-waste is increasing day by day. Rapid economic growth and change in lifestyle of people is the one of the main factors identified to be responsible for the increased consumption and production of electrical and electronic equipment. Although the global e-waste problem has been able to attract attention across the world, today, developing countries like India is burdened with the huge problem of e-waste which is either locally generated or internationally imported, causing serious threat to human health and environment. E –waste contains certain toxic constituents in their components such as lead, cadmium, mercury, polychlorinated bi-phenyls (PCBs), etched chemicals, brominated flame retardants, etc.,The Indian Information Technology (IT) sector is one of the major industry responsible for the generation of the bulk of E-waste or Waste Electrical and Electronic Equipment in India. The e-waste is generated from the following waste materials viz., Large household appliances, Small household appliances, IT and telecommunications equipment, Consumer equipment, Lighting equipment, Electrical and electronic tools

(with the exception of large-scale stationary industrial tools), Toys, leisure and sports equipment, Medical devices (with the exception of all implanted and infected products), Monitoring and control instruments and automatic dispenses.

The hazardous components in electrical and electronic equipment are a major concern during the waste management phase. In Indian context, recycling of WEEE is not undertaken to an adequate quantity. E-waste is another addition to the ever growing hazardous waste stream. In the absence of proper recycling and disposal facilities of these wastes which lead to environmental problems. The dismantling operations are carried out in hazardous manner leading to major environmental and health problems. So a proper handling of e-waste can prevent of both serious environmental damage and also recover valuable materials, especially for metals.

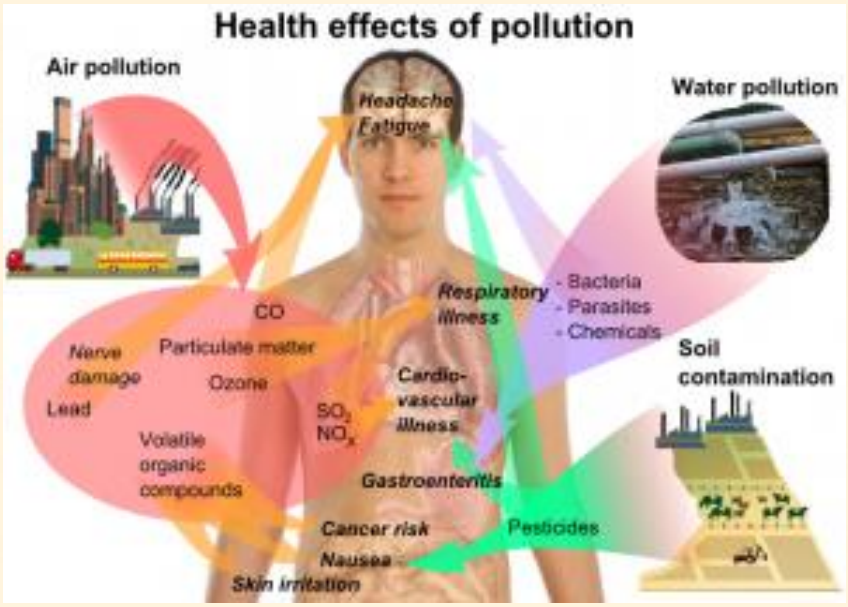
The National Environmental Policy, 2006 (NEP) provides a focus on sustainable development and the need to facilitate the reuse/recovery/recycling of useful materials from waste, thereby conserving the natural resources and reducing the wastes destined for final disposal to ensure environmentally sound management of all wastes.In India there is an urgent need to address the issues related to E-waste in order to avoid its detrimental future consequences. Electronic and Electrical Equipment are composed of an enormous amount of components under hazardous category. Majority of these components contain toxic substances that have adverse impacts on human health and the environment , if not handled properly. Often, these hazards arise due to the improper recycling and disposal processes that are very common practice in most of the developing countries including India. Such offensive practices can have serious repercussion for those staying in proximity to the places where E-waste is recycled or burnt. Disposal of E-wastes is an unembellished problem faced by many regions across the world. Electronic wastes that are land filled produces contaminated leachates which eventually pollute the groundwater. Acids and sludge obtained from melting computer chips, if disposed on

the ground causes acidification of soil. This is due to disposal of recycling wastes such as acids, sludge, *etc*. Recycling raw materials from end-of-life electronics is the most effective solution to the growing e-waste problem. Most electronic devices contain a variety of materials, including metals that can be recovered for future uses. By dismantling and providing reuse possibilities, intact natural resources are conserved and air and water pollution caused by hazardous disposal is avoided.

Nithul Lal K. P
JRF
Gujarat Institute of Desert Ecology

Carbon Monoxide (CO):-

- Carbon monoxide is a highly toxic and flammable gas, which is a major product of the incomplete combustion of carbon and carbon-containing compounds.
- Environmental tobacco smoke in dwellings, offices, vehicles and restaurants can raise the average carbon monoxide concentrations.



Effects on Health and Environment:-

- High degree of exposure to carbon monoxide can reduce the amount of oxygen supplied to the brain, to the point that the person becomes unconscious and can suffer brain damage from shortness of oxygen.
- Carbon monoxide may contribute to the greenhouse effect and global warming.

A. Sulfur Dioxide (SO_2) and Hydrogen Sulfide (H_2S):-

- Sulfur dioxide (SO_2) is an acid tasting, colorless, pungent smelling and toxic gas.
- Major sources are heat and power generation facilities that use poor quality oil or coal containing sulfur.
- Hydrogen Sulfide (H_2S) is a highly toxic and corrosive gas with a bad smell.
- H_2S is a product of bigamous digestion.

- It is released in refineries, blast furnaces, pulp and paper industry, gasworks, coking, wastewater treatment and biogas plants.

➢ **Effects on Health and Environment:-**

- The effects observed include reductions in pulmonary volume, increases in breathing resistance and symptoms such as wheezing, chest tightness or shortness of breath, headache and nausea.
- Sulfur dioxide is one of the major precursors of acid rain, which accelerates corrosion of buildings and monuments as well as it acidifies soils, lakes and streams. Furthermore, it leads to reduced visibility.
- H_2S destroys hemoglobin and paralyses intracellular respiration.
- In contact with humidity at mucus membranes it converts to alkaline sulfides causing heavy irritations in the eyes, nose, throat and lungs.
- H_2S is a neurotoxin.
- The bad smell of H_2S is unbearable.
- The lower limit of detection by humans may be as low as 2 ppb. Because of its acidity H_2S is a very corrosive gas.
- It damages switch panels and other electronics in the industrial units.

itrogen Oxides (NO_2) :-

- The nitric oxide (NO) molecule is quite reactive and unstable.
- In ambient air, it reacts with oxygen to form the toxic nitrogen dioxide (NO_2).
- Human activity has drastically increased the production of nitric oxide in combustion chambers, e. g. car engines and power plants.
- The phase-in of new NO_2 thresholds values will make the nitrogen oxides a subject of major public interest.

➢ **Effects on Health and Environment:-**

- Nitric oxide has a multitude of effects, primarily in the lung but also in other organs such as the spleen and liver.
- In the blood it leads to the creation of meta-hemoglobin, which cannot transport oxygen.

Nitric oxide in the air may later convert to nitric acid in acid rain.

- Furthermore, both NO and NO_2 contribute to a reduction in the ozone layer.

B. Particulate matter (PM_{10} / $PM_{2.5}$) :-

- PM_{10} and $PM_{2.5}$ are not a single compound but the mass concentration of all particles smaller than 10μm (PM_{10}) or 2.5μm ($PM_{2.5}$) in diameter, suspended in the ambient air.
- In areas with high traffic related pollution, the threshold values for this pollutant are frequently exceeded, which makes them pollutants of major public interest.

Effects on Health and Environment:-

- A number of studies have shown short term cardiovascular effects related to PM, a direct relation between the number of heart attacks and the PM concentration has been proven.
- Long term effects are the toxicity of the particles itself, their potential to carry and hold toxic compounds in the respiration system and irritation of the immune system due to their penetration deep in to the lungs.

Mayur Goswami
Jr. Chemist
Gujarat Institute of Desert Ecology

- **Dr. B. Anjan Kumar Prusty**, has been appointed as a Senior Scientist in the Division of Environmental Impact Assessment in GUIDE. He holds a doctoral degree in Environmental Sciences for his work on Speciation and bioavailability of heavy metals in soil in different habitat types of Keoladeo National Park, Bharatpur, Rajasthan. He was earlier working as Scientist at Sálim Ali Centre for Ornithology & Natural History (SACON), Coimbatore. He has 13 years of working experience on various environmental themes, *viz.,* Environmental Bio-Geochemistry, limnology, detrital dynamics, Wetlands, Trace metal speciation and Environmental Health Implications; and Environmental impact assessment, monitoring and planning. Besides he has been involved in teaching Environmental Science to B Sc and M Sc students of Orissa University and KSKV Kachchh University. Presently he has more than 35 research papers to his credit in journals of repute, 46 abstracts in national and international conference proceedings, 06 books (coauthored/edited); 17 chapters in edited books and also 10 technical reports. He has guided more than a dozen Post-graduate students for dissertation, and supervising three doctoral research students currently. He is a member of various societies and was involved in developing teaching programme in various universities including Indira Gandhi National University (IGNOU), New Delhi; and acts as an Editorial Board Member of various International journals.
- Mr. Ratansi Chaudhary, Mr. Midhun Gopi, Mr. Dhananjayan, Mr. Vaghasiya Piush Madhu Bhai and Miss Swati are newly joined to our GUIDE team.
- Additional Director Dr. V. Vijaykumar has visited at IDS Sussex University, Brighton, UK.

- Mr. Sudhanshu Ch. Mohapatra and Mr. Mayur Goswami Underwent a 4 days training programme at **Kolkata**, to fulfill the accreditation process of NABL for GUIDE Laboratory. During the four days training programme, they thoroughly got trained in ISO/ IEC 17025: 2005 standard procedures, management and technical requirement procedures and internal Auditing for industries.

- GUIDE has conducted a one day workshop with IUCN on best practices for corporate-community mangrove restoration on 04th July 2014, at B cub hotel, Bhuj, Kachchh, Gujarat. Director R.V. Asari, Rtd., IFS, Additional Director (Dr. V. Vijaykumar), workshop organizer (Dr. G. Thivakaran), Scientists, Research

scholars, IUCN Country Representative (Mr. Sinha), IUCN MFF Coordinator (Dr. Ishwar), IUCN MFF officer (Miss. Nisha D'Souza) Marine National Park Director (R.D. Kamboj, IFS), Sustainability officer Chief conservator of Forest (Kachchh), officials from 16 corporate, Non-Government organization and media peoples attended the workshop.

- Biodiversity Board team from Gandhinagar has visited GUIDE for discussion.
- Mrs. Jagruthi Sanghvi, has successfully completed her women scientist programme in GUIDE under DST Women Scientist Scheme.
- Member Secretary, Gujarat Ecology Commission visited GUIDE on 8th May, 2014 for detailed discussion on scientific and research topics of mutual interest.
- Dr. G. Thirumaran has attended a one day seminar on 4th April, 2014 at Forest Department, Jamnagar. He delivered a special lecture on Mangrove plantation, conservation and restoration.
- Dr. G.A. Thivakaran attended conservation cell for advisory committee meeting as a part of ongoing ESSAR project about Marine monitoring studies at Vadinar ESSAR oil terminal and SBM, Jamnagar on 13.5.2014.
- GUIDE represented Dr G. A. Thivakaran participated in the Environmental day conducted by Adani Ports and Special Economic Zones Ltd, Mundra and at Tata Power Ltd., at Mandvi on 5th June, 2014. He delivered a special lecture on Environmental Issue.

Upcoming Conferences

1. National Conference on Environment and Biodiversity of India, 4-5 October 2014, New Delhi.
2. International Conference on Environment, Energy and waste management, 7-8 February 2015, New Delhi. https://www.waset.org/conference/2015/02/new-delhi/ICEEWM
3. 4th International Conference on Hydrology and Watershed Management, 29 October - 1 November 2014, http://www.ichwam.org/
4. International Conference on Water: From pollution to purification, ICW 2015, 23-26 January 2015, Kottayam, Kerala, India.
5. 4th International Conference on Environmental Pollution and Remediation, 11 - 13 August 2015,http://icepr.org/
6. International Congress on Ecological Integrity and Environmental Ethics. Living for Sustainable Future, Pantnagar, Uttrakhand, India. 8-10 November 2014. http://www.gbpuat.ac.in/27062014_8-10nov14_International_Congress-Ecological_Integrity.pdf
7. 3rd World Conference in Marine Biology and Biodiversity, 12 October, Qingdao.http://ioc-unesco.org/index.php?option=com_oe&task=viewEventRecord&eventID=1487
8. Mares Conference on Marine Ecosystem Health and Conservation, Othao, Portugal.www.maresconference.eu/.../First%20Announcement_MARES%20Confe...
9. SER 2015 World Conference on Ecological Restoration, 20-30 August 2015, Manchester, UK. www.ser.org/programmes/world-conference/ser-2015-world –conference-on-ecological-restoration
10. 2nd International Conference on Ecology, Environment and Energy, ICEEB< 12-13 April, 2015.http://conf.iu.edu.iq/iceee2014/Home.aspx
11. 10th International Conference on Ecosystems and Sustainable Development. 3 - 5 June, 2015, València, Spain, www.wessex.ac.uk/ecosud2013
12. 3rd UNCCD Scientific Conference, 9-12 March 2015. Mexico, http://www.agropolis.fr/pdf/actu/2015-annonce-conference-scientifique-unccd.pdf
13. XXIII International GrasslandCongress&X International RangelandCongress2015, http://www.igfri.res.in/2013/Revised_India_Bid%20_GC_IRC_2015.pdf
14. Aquatic Biodiversity- International Conference, 7 - 10 October, 2015, Sibiu, Transylvania, Romania, European Union. http://stiinte.ulbsibiu.ro/aquatic_biodiversity_conference/

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Gujarat Institute of Desert Ecology

P.O. Box No. 83, Mundra Road,

Bhuj, Kachchh-370001,

Gujarat, India

Tel: 02832-329408, 235025 Fax: 02832-235027

Website: http://www.gujaratdesertecology.com