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Original Research Article

Ecosystem Services Rendered by Plant Species in Tropical Dry Evergreen Forest on the Coromandel Coast of India: Fruit Traits and Fruit Resource Use by Faunal Community

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Abstract	Keywords
<p>As a part of ecosystem service assessment, we investigated fruit traits and fruit resource users of 110 plant species in tropical dry evergreen forest (TDEF) on the Coromandel Coast of India. These plant species offered various fruit rewards (pulp and aril) to a total of 22faunal species. Among them, birds formed the predominant fruit resource users utilising the rewards offered by 72% of plant species. The fruit resource users were significantly related to any one or more of fruit traits (type, colour and reward).The most common frugivores were the White-headed babbler (20%) followed by White-browed bulbul (17%) and Common wood shrike (15.4%). Information on different fruit resource users and their food plants provide an insight into faunal dependence on plant resources and such data on ecosystem services would be useful for conservation planning and management of this and similar tropical forests.</p>	<p>Ecosystem service Fruit resource users Fruit traits Plant physiognomic groups Tropical dry evergreen forest</p>

Introduction

Management of tropical forests need quantitative information of ecosystem processes and services. Ecosystem services include ecological services, biodiversity services, economic services and cultural services (Millenium Ecosystem Assessment, 2005). Forests are particularly valued for various benefits they provide such as food and building materials, fresh water, recreational activities and also they sequester carbon and modify global climate (Christensen et al.,

2000; Schowalter, 2012). The pulp of fleshy fruit is a major food resource for many frugivores such as mammals, birds and also reptiles (Howe, 1986), which successively disperse the seeds. Therefore, frugivory is a fundamental process in plant populations where natural regeneration is strongly dependent upon seed dispersal by animals (Jordano, 2000). Most plant species in the tropics reach their place of growth via the gut of an animal (Corlett, 2011). Thus the fruit

preferences of local frugivore fauna can have a major influence on which plant species come at a site and how promptly. According to Corlett (1998) fruit resources in tropical forest are used by a variety of frugivores including birds and mammals. Plant-frugivore mutualism is an important ecosystem services and this interaction affects the potential for plant regeneration (Albrecht et al., 2012).

It has been reported that recruitment and elimination of plant species got reduced in some forests due to loss of dispersal agents (Benjamin et al. 2007; Gabriella and Howe, 2007). Loss of certain fruit resources also affected the local elimination of some frugivores (Bleher et al. 2003; David et al. 2011). The plants that produce fleshy fruits eaten by birds that disperse their seeds constitute mutualistic interaction network (Corlett, 2011). However, the absence of food and suitable perches greatly reduces the movements of these tolerant dispersal agents. A few studies have concluded that establishing the functional aspects of ecosystems such as trophic structures, plant-animal mutualism is more important for restoration success (Forup and Memmott, 2005). The fruiting traits and phenology of plants can act up on the reproductive activity and seasonal movements of frugivores (Levey, 1988; Loiselle and Blake 1991; Thies and Kalko, 2004) and it plays a key role in the ecology of frugivores (Jordano et al., 2003).

Community-level plant resource use as an ecosystem service to faunal community remains as a scientific gap. Hence, to fill up this gap, a comprehensive research on foliar, floral and fruit resource use by fauna was undertaken and this communication deals with fruit resource use by fauna in TDEF. In this study we addressed the following questions: (1) who are the major fruit resource users in tropical dry evergreen forest and (2) what is the relationship between fruit traits and fruit resource users.

Materials and methods

Study area

This study was conducted in tropical dry evergreen forest located in Villupuram (11°56' N and 79°53' E) and Cuddalore (11°43' N and 79°49' E) districts of Tamil Nadu on the Coromandel Coast of peninsular India. Field surveys were made for flower visitors in nine sites of tropical dry evergreen forest (TDEF) on

the Coromandel Coast. The forest area of each study site ranges from 1.2 to 10 ha. Fifty-year (1954 to 2014) climate data of the nine sites revealed a mean annual temperature of 28.3 °C and the mean annual rainfall of 1,171 mm (www. world clim.com). The mean number of rainy days in the annual cycle is 55.5. The climate is tropical dissymmetric type with the bulk of the rainfall received during the northeast monsoon (October-December). Soils are red ferralitic belonging to the Cuddalore sandstone formation of the Miocene period (Meher-Homji, 1974).

The vegetation of this area is tropical dry evergreen forest type. These closed-canopy forests are 2-3 layered, tree-dominated and liana-dense (Champion and Seth, 1968; Parthasarathy et al., 2008). The canopy is about 10–12 m in height, dominated by large trees such as *Pterospermum canescens* and *Lanea coromandelica*, while the sub-canopy is composed of smaller trees such as *Memecylon umbellatum*, *Canthium dicoccum* and *Garcinia spicata*. Major lianas include *Strychnos lenticellata* Dennst., *Combretum albidum* G. Don., *Reissantia indica* (Willd.) Halle, *Pyrenacantha volubilis* Wightand, *Capparis zeylanica* L., *Ecbolium viride* (Forsskal) Alston and *Sansevieria roxburghiana* Schultes & Schultes f. are the major native perennial herbs present in this forest type (Parthasarathy et al., 2008).

Data collection

Fruit traits of a total of 110 plant species (60 trees, 45 lianas and 5 herbs) of tropical dry evergreen forest (TDEF) and their fruit resource users (Appendix 1) were studied from August 2012 to July 2014. A minimum of 2 to 4 individuals for each species (for rare and sub-dominant species) to a maximum of 10 individuals (for common and dominant species) were observed for all plant species to evaluate fruit traits and fruit resource users, when the species was in fruiting, using a binocular. The fruit resource users of each plant species were observed for a minimum of eight hours during the study period. To study fruit traits, 2-3 fruits were collected from each individual of every species. Fruit traits studied include type, colour and reward. Besides our observations, relevant literature and regional flora books (Gamble and Fisher, 1915-1935; Matthew, 1991) were referred to confirm the categorization of fruit traits. Pearson correlations were performed to evaluate the association between fruit traits and fruit resource users.

Results

Fruit characteristics and frugivore assemblage

In Indian tropical dry evergreen forest, the most common fruit type was berry (37.27%) with red colour (41%) (Appendix 1). The frugivore assemblage in tropical dry evergreen forest on the Coromandel Coast of India consists of four species of mammals, 14 species of avian frugivores and four species of bugs (Table 1, Fig. 1). The most common

frugivores were the White-headed babbler (20%) and White-browed bulbul (17%), Common wood shrike (15.4%) followed by Coppersmith barbet (11.8%) and Asian koel (10%) (Table 1). Common frugivore mammals in TDEFs were Short-nosed fruit bat, Indian palm squirrel, Indian jackal and Asian palm civet. Bat shows a positive relation with fruit type syconia and squirrels with fruits containing arillated seeds (Table 2). Fruits of *Manilkara hexandra* were found exclusively handled by the Short-nosed fruit bat.

Table 1. Faunal assemblage and number of plant species and exclusive plant species whose fruits are consumed by them in tropical dry evergreen forest on the Coromandel Coast of India (fauna arranged in descending order of fruit plants consumed by them).

Faunal group	Common name	Scientific name	Code	No. of plant species	No. of exclusive plant species
Mammals	Indian palm squirrel	<i>Funambulus palmarum</i>	M2	3	1
	Short-nosed fruit bat	<i>Cynopterus sphinx</i>	M1	2	1
	Indian jackal	<i>Canis aureus indicus</i>	M3	2	-
	Asian palm civet	<i>Paradoxurus hermaphrodites</i>	M4	1	-
Birds	White-headed babbler	<i>Turdoides affinis</i>	B11	22	3
	White-browed bulbul	<i>Pyconotus luteolus</i>	B10	19	1
	Common wood shrike	<i>Tephrodornis pondicerianus</i>	B1	17	7
	Coppersmith barbet	<i>Megalaima haemacephala</i>	B12	13	2
	Asian koel	<i>Eudynamis scolopacea</i>	B2	11	2
	Rose-ringed parakeet	<i>Psittacula krameri</i>	B8	10	10
	Purple sunbird	<i>Cinnyris asiaticus</i>	B6	9	2
	House sparrow	<i>Passer domesticus</i>	B3	7	-
	Purple-rumped sunbird	<i>Nectarinia zeylonica</i>	B4	5	5
	Eurasian golden oriole	<i>Oriolus oriolus</i>	B13	4	4
	Orange-headed thrush	<i>Zoothera citrina</i>	B5	3	3
	Red-vented bulbul	<i>Pyconotus cafer</i>	B7	2	-
	Tickells flowerpecker	<i>Dicaeum erythrohynchos</i>	B9	2	-
	Jungle crow	<i>Corvusma crorhynchos</i>	B14	2	1
Bugs	Red cotton bug	<i>Dysdercus cingulatus</i>	Bu2	5	2
	Jewel bug	<i>Chrysocoris stollii</i>	Bu1	2	-
	Stainer bug	<i>Iphthiya sp.</i>	Bu4	2	2
	Man-faced bug	<i>Catacanthus incarnatus</i>	Bu3	1	-

Avian frugivores include 14 species, in which Common wood shrike prefers bright coloured berry fruits and shows a negative relation with brown and green coloured fruits (Table 2). Fruits of seven plant species were exclusively handled by Wood shrikes (Appendix 1). Birds show positive relation with drupes and berries and shows negative relation with follicle, capsule and pod (Table 2). *Crateva magna* and *Argyrea cymosa* fruits were exclusively handled by Asian koel. Purple-rumped sunbird prefers yellow drupes of *Lepisanthes tetraphylla* (Appendix 1). *Salvadora persica* and *Dendrophthoe falcata* fruits were exclusively handled by purple sunbird.

Red-vented bulbul prefers follicle compared to other fruit type. Rose-ringed parakeet shows positive relation with yellow coloured fruit, but mostly prefer aril as reward and it shows a negative relation with red coloured fruit in TDEFs. *Phoenix pusilla* fruit was handled by white-browed bulbul. It prefers black, purple fruit and negative relation with yellow fruits. White-headed babbler prefers purple coloured drupes and shows negative relation with pods and berries. Coppersmith barbet prefers syconia type with brown colour. Eurasian golden oriole shows positive relation with black coloured drupes. Jungle crow mainly prefers yellow coloured fruits.

Fig. 1: Various types of frugivores in tropical dry evergreen forest.

A. Jewel bug visiting a fruit of *Breynia vitis-idea*; B. Man faced bug in *Benkara malabarica*; C. Stainer bug in *Pterospermum canescens*; D. Red cotton bug; E. Orange headed thrush in *Ehretia pubescens*; F. White-browed bulbul in *Garcinia spicata*; G. Purple-humped sunbird in *Lepisanthes tetraphylla*; H. Short nosed fruit bat in *Ficus*.

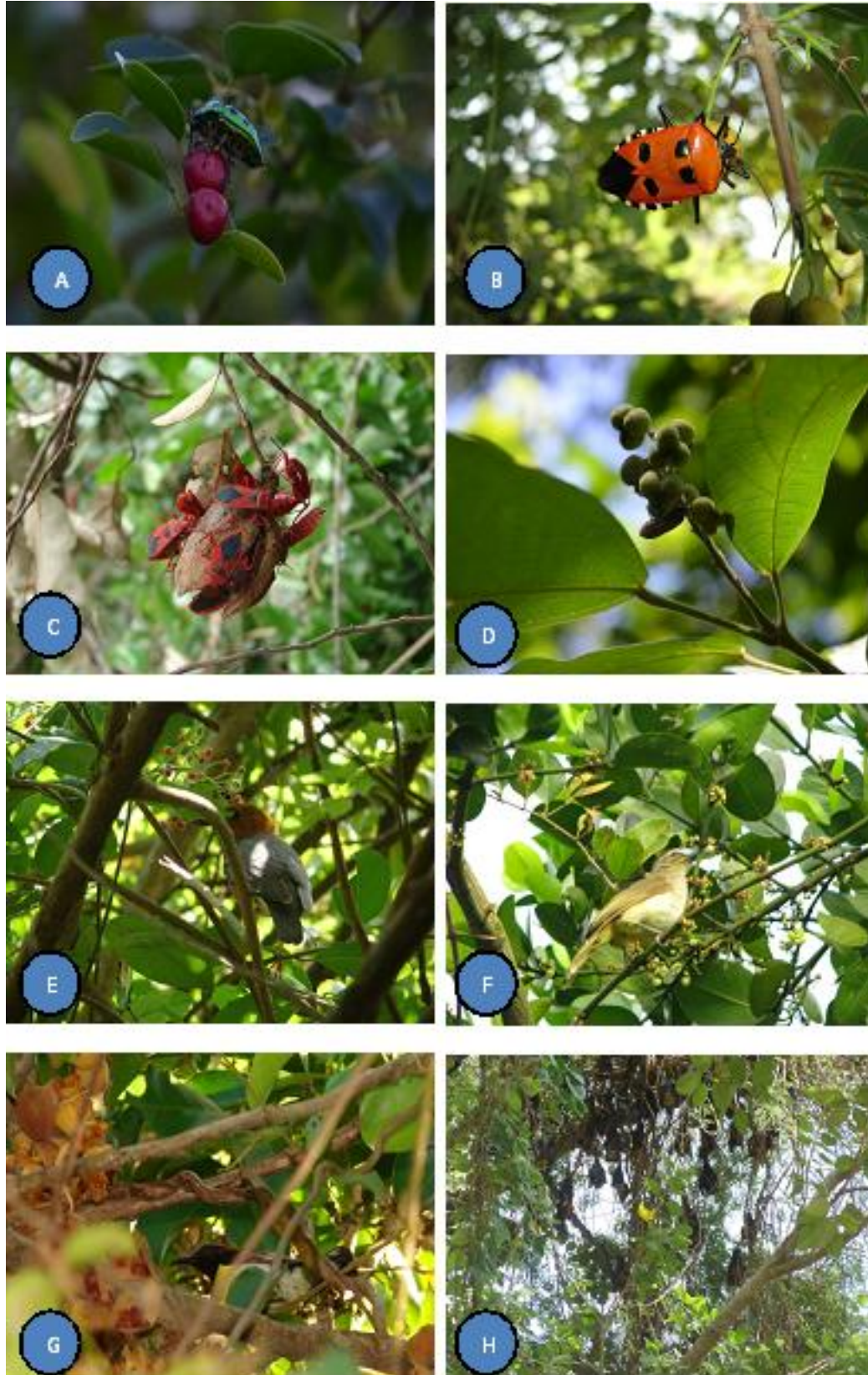


Table 2. Pearson correlation between fruit traits of plant species and fruit resource using faunal group in tropical dry evergreen forest on the Coromandel Coast of India. Significant correlations ($P < 0.05$) are given in bold and correlations with $P < 0.001$ are in bold and underlined.

	Mammals	Birds	Bugs
Plant trait			
Deciduous	-0.124	-0.105	-0.140
Brevi-deciduous	.0191	-0.060	-0.014
Evergreen	-0.068	0.132	0.118
Fruit trait			
Berry	0.001	<u>0.274</u>	0.149
Capsule	0.033	<u>-0.364</u>	<u>0.340</u>
Drupe	0.034	<u>0.428</u>	<u>-0.216</u>
Follicle	-0.067	<u>-0.294</u>	-0.076
Syconia	0.087	-0.116	-0.076
Pod	-0.098	<u>-0.429</u>	-0.111
Fruit colour			
Black	0.065	0.168	-0.054
Brown	0.042	<u>-0.313</u>	0.007
Green	0.033	<u>-0.364</u>	-0.100
Orange	0.070	0.163	-0.082
Purple	-0.027	0.060	-0.030
Red	-0.093	0.157	<u>0.232</u>
Violet	-0.038	0.085	-0.043
Yellow	-0.053	0.111	-0.079
Fruit reward			
Aril	<u>.0224</u>	-0.066	-0.043
None	-0.152	<u>-0.721</u>	0.130
Pulp	0.078	<u>0.723</u>	-0.114

Fruit resource use by bugs has received almost no attention in TDEF; it includes Jewel bug, Red cotton bug, Man-faced bug and Stainer bug (Table 1). Jewel bug shows positive relation with red coloured fruits. Red cotton bug shows positive relation with red coloured and capsular type fruits. Man-faced bug prefers black coloured fruit. Stainer bug shows positive relation with brown coloured and capsular fruit. In tdef, a bug mainly prefers capsular fruits and negative relation with drupes (Table 2).

Discussion

In tropical dry evergreen forest (TDEF), more than 25% of fruit was contributed by capsule, follicle and pods; while in Gabon 28% of the fruit types were capsule or pods (Gautier-Hion et al., 1985). In South-east Asia, their ratio is higher and prevailed by the winged fruit of the Dipterocarpaceae (Willson, 1991). In neotropical dry forest (31-36%) and paleotropical forest (26.5%) are wind-dispersed (Howe and Smallwood, 1982). In TDEF, fruiting of fleshy fruits occurred during the wettest months (August-

December) and for dry fruits it was summer (April-June) (Selwyn and Parthasarathy, 2006). Likewise, vertebrate-dispersed fleshy fruits were produced during the wettest period of the year in relatively seasonal forest of eastern Costa Rica (Frankie et al., 1974) and Colombia (Hilty, 1980). In our tropical dry evergreen forests, fruit resources of 75% of plant species are utilised by vertebrates, while Vertebrate dispersal is high in neotropical wet (82.3-91.5%) as well as moist forests (82.5%) and it is comparatively less in paleotropical forest (37.5-60%; Howe and Smallwood, 1982).

Fruit resources are crucial for maintaining the frugivores. In this studied forest major fleshy fruit rewarding species such as *Lepisanthes tetraphylla*, *Grewia rhamnifolia*, *Lannea coromandelica* and *Memecylon umbellatum*, are particularly important for many vertebrate fauna, which depend on these resources. Thus the conservation of the tropical dry evergreen forests is important not only for the plant species but also to support the forest fauna, which depend on them for fruit rewards. This baseline study

provides data on the fruit resource use by fauna at the community level. For conservation of biodiversity it is important to understand biotic interaction in forest communities. The trait-based approach shows promising results, especially for plant traits, in which plants interact for the provision of ecosystem services (Lavorel, 2013). Recent studies (Mouillot et al., 2011; Dias et al., 2013) also admitted that community-level traits have strong effects on ecosystem processes and services. Restoration of ecosystem is growingly becoming a priority in tropical regions to hold back the loss of biodiversity (Lamb et al., 2005). Successful restoration of an ecosystem result in renewal of its structural, functional and biodiversity components (Higgs, 1997; Reay and Norton, 1999; Ehrenfeld, 2000). Management practices that have a holistic approach taking into account various aspects of forest functioning including plant resource use by faunal community will likely to be more effective for maintaining biodiversity and a broader approach to manage forest resources.

Conclusion

Fruit resource users have substantial and complex effect on ecosystem structure and functioning (seed dispersal etc.). Evidently, plant trait-based framework can also support the understanding and aid the management of multiple ecosystem services (Lavorel and Grigulis, 2012). Such baseline research on plant resource use by faunal communities will be valuable in understanding the complex web of forest biotic interactions useful for conservation of this and similar tropical forests. Therefore, we recommend a community-level approach for forest conservation with the involvement of local people.

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Appendix - 1

Fruit resource use by various faunal groups in tropical dry evergreen forest on the Coromandel Coast of India(Lf- Life-form : T- tree, L – liana, H - herb; Plant-type: E-evergreen, B-brevi-deciduous, D-deciduous; Ft (fruit type): B- berry; D- drupe; Po- pod; Ca- Capsule; Fo- follicle; Sy- Syconia. Co (fruit colour): G- green; Y- yellow; R- red; Br- brown; Or- orange; Bl- black/blue; V- violet. Re (fruit reward): Pu- pulp; Ar- aril; O- none. For expansion of codes of faunal group see Table 1).

Sl. no.	Plant species	Family	Sample size	Lf	Plant type	Fruit type	Colour	Reward	Fruit resource user
1	<i>Aglaia elaeagnoidea</i> (Juss.) Benth.	Meliaceae	4	T	E	B	Br	Pu	B11,M2
2	<i>Albizia amara</i> (Roxb.) Boivin	Mimosaceae	10	T	D	Po	Y	O	B8
3	<i>Albizia lebeck</i> (L.) Benth.	Mimosaceae	4	T	D	Po	Y	O	B8
4	<i>Allophylus serratus</i> (Roxb.) Kurz	Sapindaceae	4	T	E	D	R	Pu	B10,B11
5	<i>Atalantia monophylla</i> (L.) Correa	Rutaceae	10	T	E	B	Y	Pu	B2,B3,B9
6	<i>Azadirachta indica</i> A. Juss.	Meliaceae	10	T	B	D	Y	Pu	B14
7	<i>Barringtonia acutangula</i> (L.) Gaertner	Barringtoniaceae	4	T	E	B	G	O	
8	<i>Bauhinia racemosa</i> Lam.	Caesalpiniaceae	4	T	D	Po	G	O	
9	<i>Benkara malabarica</i> (Lam.) Tirven.	Rubiaceae	4	T	E	B	R	Pu	B1,Bu2
10	<i>Breynia vitis-idaea</i> (Burm. f.) Fischer	Euphorbiaceae	4	T	E	B	R	Pu	B1, Bu1
11	<i>Butea monosperma</i> (Lam.) Taubert	Papilionaceae	4	T	D	Po	Br	O	
12	<i>Calophyllum inophyllum</i> L.	Clusiaceae	4	T	E	D	Y	Pu	B4
13	<i>Canthium dicoccum</i> (Gaertn.) Teijsm. &Binn.	Rubiaceae	10	T	E	D	Bl	Pu	B10,B11
14	<i>Cassia fistula</i> L.	Caesalpiniaceae	4	T	D	Po	Br	Pu	
15	<i>Chionanthus zeylanica</i> L.	Oleaceae	10	T	E	D	Bl	Pu	B2,B3
16	<i>Cordia obliqua</i> Willd.	Cordiaceae	4	T	B	D	Or	Pu	B8
17	<i>Crateva magna</i> (Lour.) DC.	Capparaceae	4	T	D	B	Y	Pu	B2
18	<i>Diospyros ebenum</i> Koen.	Ebenaceae	10	T	E	B	R	Pu	B1,B6
19	<i>Diospyros ferrea</i> (Willd.) Bakh	Ebenaceae	4	T	E	B	Or	Pu	B1,B6
20	<i>Drypetes sepriaria</i> (Wight and Arn.) Pax and Hoffm.	Euphorbiaceae	4	T	E	D	R	Pu	B10,B11
21	<i>Ehretia pubescens</i> Benth.	Boraginaceae	4	T	B	B	Or	Pu	B5
22	<i>Eugenia bracteata</i> (Willd.) Roxb.	Myrtaceae	4	T	E	B	R	Pu	B1,Bu1

Sl. no.	Plant species	Family	Sample size	Lf	Plant type	Fruit type	Colour	Reward	Fruit resource user
23	<i>Ficus benghalensis</i> L.	Moraceae	4	T	B	Sy	Br	Pu	M1,B12
24	<i>Ficus hispida</i> L.f.	Moraceae	4	T	B	Sy	Br	Pu	B12
25	<i>Ficus religiosa</i> L.	Moraceae	4	T	B	Sy	Br	Pu	B12
26	<i>Flacourtia indica</i> (Burm.f.) Merr.	Flacourtiaceae	4	T	B	D	R	Pu	B10,B11
27	<i>Garcinia spicata</i> (Wight & Arn.) J.D. Hook.	Clusiaceae	4	T	E	B	Y	Pu	B11
28	<i>Glycosmis mauritiana</i> Yuich. Tanaka	Rutaceae	4	T	E	B	R	Pu	B1
29	<i>Gmelina asiatica</i> L.	Verbenaceae	4	T	E	D	Y	Pu	B4
30	<i>Ixora pavetta</i> T.Anderson	Rubiaceae	4	T	E	D	Bl	Pu	B10,B11
31	<i>Lannea coromandelica</i> (Houtt.) Merr.	Anacardiaceae	4	T	D	D	Y	Pu	B4
32	<i>Lepisanthes tetraphylla</i> (Vahl.) Radlk.	Sapindaceae	10	T	E	D	Y	Pu	B4
33	<i>Mallotus philippensis</i> (Lam.) Muell.-Arg.	Euphorbiaceae	4	T	E	Ca	R	O	Bu2
34	<i>Mallotus rhamnifolius</i> Muell.-Arg.	Euphorbiaceae	4	T	E	Ca	Y	O	Bu2
35	<i>Manilkara hexandra</i> (Roxb.) Dubard	Sapotaceae	4	T	B	B	Y	Pu	M1
36	<i>Maytenus emarginata</i> (Wild.) Ding Hou.	Celastraceae	4	T	E	Ca	G	Ar	M2
37	<i>Memecylon umbellatum</i> Burm.f.	Melastomataceae	10	T	E	B	V	Pu	B2, B3,B6
38	<i>Mimusops elengi</i> L.	Sapotaceae	4	T	E	B	R	Pu	M2,M1
39	<i>Morinda coreia</i> Buch. -Ham.	Rubiaceae	10	T	E	Sy	Bl	Pu	
40	<i>Morinda pubescens</i> Sm.	Rubiaceae	4	T	B	Sy	Bl	Pu	
41	<i>Ochna obtusata</i> DC.	Ochnaceae	4	T	D	D	Bl	Pu	B10,B11
42	<i>Pamburusmissionis</i> (Wight) Swingle	Rutaceae	4	T	E	B	Y	Pu	B8
43	<i>Pleiospermium alatum</i> (Wall. ex Wight. & Arn.) Swingle	Rutaceae	4	T	E	B	G	Pu	B5
44	<i>Pongamia pinnata</i> (L.) Pierre	Papilionaceae	4	T	B	Po	Br	O	
45	<i>Premna latifolia</i> Roxb.	Verbenaceae	4	T	E	D	Bl	Pu	B13
46	<i>Pterospermum canescens</i> Roxb.	Sterculiaceae	10	T	B	Ca	Br	O	Bu4
47	<i>Pterospermum xylocarpum</i> (Gaertn.) Sant. & Wagh.	Sterculiaceae	4	T	B	Ca	Br	O	Bu4
48	<i>Salvadora persica</i> L.	Salvadoraceae	4	T	B	B	R	Pu	B6
49	<i>Sapindus emarginatus</i> Vahl	Sapindaceae	4	T	B	D	Bl	Pu	B10,B11

Sl. no.	Plant species	Family	Sample size	Lf	Plant type	Fruit type	Colour	Reward	Fruit resource user
50	<i>Securenega leucopyrus</i> (Willd.) Muell.-Arg.	Euphorbiaceae	4	T	E	Ca	Y	Pu	b11
51	<i>Semecarpus anacardium</i> L. f.	Anacardiaceae	4	T	D	D	Y	Pu	B4
52	<i>Streblus asper</i> Lour.	Moraceae	4	T	E	B	Y	Pu	B8
53	<i>Strychnos nux-vomica</i> L.	Loganiaceae	4	T	D	B	Y	Pu	B8
54	<i>Syzygium cumini</i> (L.) Skeels	Myrtaceae	4	T	B	D	Bl	Pu	B10,B11,M3,M4
55	<i>Tamarindus indica</i> L.	Caesalpiniaceae	4	T	B	B	Br	Pu	B1
56	<i>Tarenna asiatica</i> (L.)Kuntz ex Schumann	Rubiaceae	4	T	E	B	Bl	Pu	B2,B3,Bu3
57	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Combretaceae	4	T	D	D	P	Pu	B10,B11
58	<i>Tricalysia sphaerocarpa</i> (Dalz.) Gamble	Rubiaceae	10	T	E	B	G	Pu	B8
59	<i>Vitex altissima</i> L.f.	Verbenaceae	4	T	D	D	Or	Pu	B13
60	<i>Walsura trifolia</i> (A.Juss.) Harms	Meliaceae	4	T	E	B	Y	Pu	B14
61	<i>Abrus precatorius</i> L.	Papilionaceae	4	L	B	Po	G	O	
62	<i>Acacia caesia</i> (L.) Willd.	Mimosaceae	10	L	B	Po	Br	O	
63	<i>Ampelocissus tomentosa</i> (Heyne ex Roth) Planch.	Vitaceae	2	L	B	B	R	Pu	B1
64	<i>Argyrea cymosa</i> (Roxb.) Sweet	Convolvulaceae	4	L	E	B	Br	Pu	B2
65	<i>Canavalia virosa</i> (Roxb.) Wight & Arn.	Papilionaceae	4	L	D	Po	Br	O	
66	<i>Cansjera rheedii</i> Gmel.	Opiliaceae	4	L	E	D	R	Pu	B10,B11
67	<i>Capparis brevispina</i> DC.	Capparaceae	10	L	E	B	R	Pu	B1,B6
68	<i>Capparis rotundifolia</i> Rottl.	Capparaceae	4	L	E	B	R	Pu	B1,B6
69	<i>Capparis sepiaria</i> L.	Capparaceae	4	L	E	B	Bl	Pu	B2,B3,B6
70	<i>Capparis zeylanica</i> L.	Capparaceae	4	L	E	B	R	Pu	B1,B6
71	<i>Carissa spinarum</i> L.	Apocynaceae	10	L	E	B	Bl	Pu	B7, B2
72	<i>Cayratia pedata</i> (Lam.) Juss. exGagnep.	Vitaceae	4	L	E	B	R	Pu	B1
73	<i>Cissampelos pareira</i> L. var. <i>hirsute</i> (Buch.-Ham. ex DC.) Forman	Menispermaceae	4	L	B	D	R	Pu	B10,B11
74	<i>Cissus quadrangularis</i> L.	Vitaceae	10	L	E	B	R	Pu	B1
75	<i>Cissus vitiginea</i> L.	Vitaceae	10	L	D	B	Bl	Pu	B2,B3
76	<i>Coccinia grandis</i> (L.) Voigt	Cucurbitaceae	10	L	E	B	R	Pu	B1,Bu2

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77	<i>Combretum albidum</i> G.Don	Combretaceae	10	L	D	Ca	R	O	
78	<i>Derris ovalifolia</i> (Wight & Arn.) Benth.	Papilionaceae	4	L	E	Po	Br	O	
79	<i>Dioscorea oppositifolia</i> L.	Dioscoreaceae	4	L	D	Ca	Br	O	
80	<i>Grewia rhamnifolia</i> Heyne ex Roth	Tiliaceae	10	L	B	D	Br	Pu	B10,B11
81	<i>Gymnema sylvestre</i> (Retz.) R.Br. ex Schultes	Asclepiadaceae	10	L	E	Fo	Br	O	
82	<i>Hugonia mystax</i> L.	Linaceae	10	L	E	D	R	Pu	B10,B11
83	<i>Ichnocarpus frutescens</i> (L.) R.Br.	Apocynaceae	4	L	E	Fo	Br	O	B7, B2
84	<i>Jasminum angustifolium</i> (L.) Willd.	Oleaceae	4	L	E	B	Bl	Pu	B2,B3
85	<i>Lantana camara</i> L.	Verbenaceae	4	L	E	D	Bl	Pu	B13
86	<i>Leptadenia reticulata</i> (Retz.) Wight & Arn.	Asclepiadaceae	4	L	B	Fo	Br	O	
87	<i>Maerua oblongifolia</i> (Forsk.) A.Rich.	Capparaceae	4	L	E	B	Y	Pu	B8
88	<i>Mukia maderaspatana</i> (L.) M. Roem.	Cucurbitaceae	4	L	B	B	R	Pu	B1
89	<i>Olex scandens</i> Roxb.	Olaceae	4	L	E	D	V	Pu	B10,B11
90	<i>Pachygone ovata</i> (Poir) Miers ex Hook.	Menispermaceae	10	L	E	D	Or	Pu	B10,B11
91	<i>Plecosperrum spinosum</i> Trecul	Moraceae	4	L	E	Sy	Br	Pu	
92	<i>Premna corymbosa</i> (Burm.f.) Rottl. & Willd.	Verbenaceae	10	L	E	D	Bl	Pu	B13
93	<i>Pyrenacantha volubilis</i> Wight	Icacinaceae	10	L	E	D	Or	Pu	B10,B11
94	<i>Reissantia indica</i> (Willd.) Halle	Celastraceae	10	L	E	Po	G	O	
95	<i>Rivea hypocrateriformis</i> (Desr.) Choisy	Convolvulaceae	4	L	E	Ca	Br	Ar	B8
96	<i>Salacia chinensis</i> L.	Hippocrateaceae	4	L	E	B	R	Pu	B1
97	<i>Strychnos lenticellata</i> Hill	Loganiaceae	10	L	E	B	Y	Pu	B8
98	<i>Tiliacora acuminata</i> (Lam.) Hook. f. & Thoms.	Menispermaceae	4	L	E	D	R	Pu	B5
99	<i>Tinospora cordifolia</i> (Willd.) Hook. f. & Thoms.	Menispermaceae	4	L	D	D	R	Pu	B10,B11
100	<i>Toddalia asiatica</i> (L.) Lam.	Rutaceae	4	L	E	B	R	Pu	B1,Bu2
101	<i>Toxicarpus kleinii</i> Wight & Arn.	Asclepiadaceae	4	L	E	Fo	Y	O	
102	<i>Tylophora indica</i> (Burm. f.) Merr.	Asclepiadaceae	4	L	D	Fo	Y	O	
103	<i>Ventilago madraspatana</i> Gaertn.	Rhamnaceae	4	L	E	Po	G	O	

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104	<i>Wattakakka volubalis</i> T. Cooke	Asclepiadaceae	4	L	E	Fo	G	O	
105	<i>Zizyphus oenoplia</i> (L.) Mill.	Rhamnaceae	10	L	B	D	Bl	Pu	B10, B11, M3
106	<i>Dendrophthoe falcata</i> (L.f.) Ettingsh	Loranthaceae	4	H	E	D	R	Pu	B6
107	<i>Ecbolium viride</i> (Forssk.) Alston	Acanthaceae	4	H	E	Ca	G	O	
108	<i>Phoenix pusilla</i> Gaertn.	Arecaceae	4	H	E	D	Bl	Pu	B10
109	<i>Sanseveria roxburghii</i> Schultes & Schultes	Agavaceae	10	H	E	D	Or	Pu	B9, M2
110	<i>Theriophonum minutum</i> (Willd.) Baillon	Araceae	4	H	E	B	R	Pu	B11