



An account of the 'useful weeds' associated with wetland paddy fields (Vayals) of wayanad, Kerala, India.

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Abstract: This study conducted in Wayanad District of Kerala has documented the usefulness of the vascular flora associated with wetland paddy fields (*Vayals*). The plants were recorded from the paddy fields and paddy levees (bunds) and associated habitats. 65 farmer participants of the study, through a total of 945 sightings, have identified 95 useful plants species each from Paddy Fields/Levees (dominated by the members of Cyperaceae, Asteraceae, Poaceae, Amaranthaceae) and Paddy Associated habitats (dominated by the members of Solanaceae, Asteraceae, Fabaceae, Moraceae). 33 species were common to these habitats. The study reveals the importance of the plant diversity associated with paddy fields, in meeting the multiple requirements of the rural and tribal people of Wayanad.

Key words: Wetland Paddy Field; Vayal; Weeds; Useful Weeds.

Introduction

The wet rice field can be described as a “temporary aquatic environment” or “a special type of wetland” that can be considered “a successor of shallow marshes or swamps”, which is influenced and maintained by farmers’ activities. The aquatic environment in rice fields is characterized by shallowness, great variation in turbidity as well as extensive fluctuations in temperature, pH and dissolved oxygen. Owing to the intermittent nature of the standing water, the aquatic flora and fauna, which may be rich, are transitory in nature and must have their origins in the irrigation canals and water reservoirs (Heckman, 1979; Fernando, 1993; Roger, 2002). The significance of the study of biodiversity associated with such agroecosystems is two-fold as the maintenance of biological diversity is essential for productive agriculture, and ecologically sustainable agriculture is in turn essential for maintaining biological diversity (Pimental *et al.*, 1992). Such agroecosystems perform numerous important ecological processes that provide valuable goods and services to both nature and human well being (Millennium Ecosystem Assessment, 2005). There have been many efforts in recording the flora of wetlands of Kerala (Joseph, 2002; John *et al.*, 2003; Sabu and Babu, 2007; Sanil Kumar and John Thomas, 2007; John *et al.*, 2009; Sujana and Sivaperuman, 2008), but the flora associated with the paddy fields of Kerala has not been discussed widely. The biodiversity of paddy fields of Kerala and the type of benefits accessed by various agents from the field had been described by Gopikuttan and Kurup (2004). Narayanan (2009) had listed the wild edible plants associated with paddy fields of Wayanad. Parameswaran P. *et al.* (2014) have recorded One Hundred and Eighty-Nine (189) genera (178 Angiosperm genera-nearly 20%

of the total genera reported from the District and 11 Pteridophyte genera) from the paddy fields (cultivated/non-cultivated) and paddy levees of Wayanad. From an agricultural perspective many of these plants fall under the category of ‘weeds’ which compete with the rice plant and make constraints to the cultivation and there is immense literature available on these weeds from the paddy dominated agricultural areas especially from Asian countries (Neogi and Rao, 1982; Smith, 1983; Moody, 1989; Abraham *et al.*, 1990; Sasidharan *et al.*, 1990; Holm *et al.*, 1997; Chandrasena, 1987, 1988 & 1989; Bambaradeniya *et al.*, 1998, 2004; Bambaradeniya and Gunatilleke, 2002; Abraham and Thomas, 2002; International Rice Research Institute, 2003; Vidya *et al.*, 2004a, 2004b; Caton *et al.*, 2010; Babu, 2010; and Kerala Agricultural University, 2012).

Weeds are a major constraint on crop production, yet they may be regarded as an important component of the agroecosystem, many of them are useful too. The weeds on paddy levees satisfy various functions for food, medicine, prevention of soil erosion, livestock feed, landscaping, and aesthetic plants. There are a number of studies from North-East Thailand analyzing the wild food plant diversity of rice fields which serves the utilities of food, medicines, timber, latex, oil and fodder. These rice fields are also characterized by trees apart from herbs and shrubs. Most of these wild food plants are found in paddy fields compared to secondary woody areas and home gardens (Grandstaff *et al.*, 1986; Watanabe *et al.*, 1990; Price, 1997; Prachaiyo, 2000; Manechote, 2007, Cruz-Garcia and Price, 2011). It was also noted that even though the farmers of North-East Thailand use multiple land types for gathering wild food,

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they rely much on rice fields (Price, 1997; Shibahara, 2004). The studies conducted by Datta and Banerjee (1978); Govindiah (1981); Yamaguchi and Umemoto (1996); Gopikuttan and Kurup (2004); Nath *et al.*, (2007); Immanuel and Elizabeth, (2009); Kosaka *et al.*, 2013; and Dhanam and Elayaraj, 2014 have also recorded the useful plant associated with rice-paddy system. The usefulness of the wild plants associated with paddy fields of Wayanad district of Kerala where this study was conducted were partly covered by Narayanan *et al.*, 2002, 2004 & 2007; Pramod *et al.*, 2003; Hema *et al.*, 2006; Nisha and Sivadasan, 2007; Mini and Sivadasan, 2007; Silja *et al.*, 2008; and Narayanan, 2009. As these cases in the backdrop, the present study conducted at Wayanad District of Kerala was aimed at recording the usefulness of the vascular flora associated with rice fields, many of which are normally considered as 'weeds' in the cultivated lands.

The study site: Wayanad, Kerala, India

Wayanad is a hilly terrain in southern Western Ghats and lies at an average altitude of 750 meters above sea level (Fig. 1). The district of 2,136 square kilometers is unique for its rich wealth of flora and fauna and for the diverse cultures that inhabit the land. Wayanad is a high range agro-ecological zone having moderately distributed monsoons (Kerala Agricultural University 2011). The total geographic area is 212,966 hectares with a total cropped area of 174,190 hectares (Department of Economics and Statistics 2013). The contribution to the state's foreign exchange earnings through cash crops (pepper, cardamom, coffee, tea, ginger, turmeric, rubber and areca nut) is significant (Kumar *et al.*, 2010). The genetic diversity in paddies is also notable with over 20 landraces cultivated that have peculiarities in response to flood, drought, pests and diseases (M S Swaminathan Research Foundation 2001). Nair (1911) explains that the name Wayanad is believed to be derived from *Wayanadu* meaning upper land or from *Vayalnadu* meaning land (*nadu*) of paddy fields (*vayal*) or from *Vananadu* meaning land of forests (*Vanam*). Wayanad is notable for its large Adivasi population, which accounts for 18.53% and is the largest among the districts in the state (Office of the Registrar General and Census Commissioner 2011). They can be broadly classified into farming communities (*Kurichya*, *Mullukuruma*), agricultural labourers (*Paniya*, *Adiya*), artisan communities (*Uralikuruma*) and hunter-gatherer communities (*Kattunaikka*). Others are *Thachanadan mooppan*, *Karimbalar*, *Pathiya* and *Wayanadan Kadar*. Wayanad also has the largest settler population in Kerala (Nair 1911; Indian Institute of Management 2006).

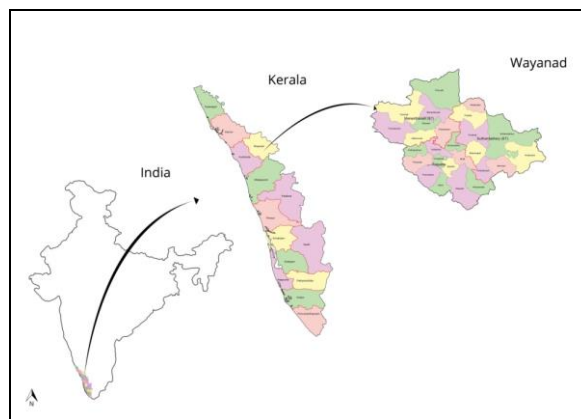


Fig. 1: Location of Wayanad

The floristic exploration of the District had recorded a total of 2034 species of Angiosperms which forms nearly 49% of the flora of the Kerala State and more than 10% of the flora of India. The study had reported a total of 596 endemic taxa in which 491 are endemic to Western Ghats. 338 taxa are endemic to southern Western Ghats of which 59 are restricted to Kerala and 15, exclusive to the District (Narayanan, 2009). Valleys surrounded by low range undulating hills characterize a typical *Vayal* in Wayanad (Fig.2&3). Paddy fields of Wayanad, are known to shelter numerous species of plants and animals of different use value. The occurrence of medicinal plants is high in the fields and they are the chief source of several wild food species. The tribal communities are accessing 18 leafy greens from the paddy fields (Narayanan *et al.*, 2004). The faunal diversity associated with paddy fields is also rich and plays a significant role in controlling harmful insects/pests attack (Kumar *et al.*, 2010). The characteristics of the paddy fields of Wayanad have been given by Gopi *et al.*, (2004).



Fig. 2: Paddy and associated landscapes – a view from Wayanad

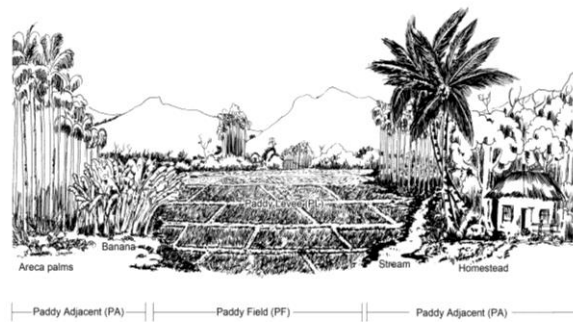


Fig. 3: A Model Paddy Landscape

Materials and Methods

This study was conducted during 2013-2014 across 34 farmers’ fields which were marked for studying the vascular flora across a gradient of agricultural intensification as a part of the transdisciplinary research project BioDIVA (<http://www.uni-passau.de/en/biodiva/home/>). The recording of the usefulness of the flora was conducted with a number of participant-guided ‘walks’ through the fields. This method (adapted from Philips and Gentry, 1993; Martin, 1995) included walking along with each of the participant (respondent farmer) separately through their-own land holdings or very adjacent lands (5 meters from the paddy levee) and recording a series of ‘events’ from the respective plots. One ‘event’ represents the sighting of a plant species by the respondent and the subsequent identification of its local name, its use (s) and the useful part(s). The sightings of one plant species from different places in a plot by the participants were counted as separate events to capture the richness of the species and the use preference of the participants. Data sheets were filled-in during the walk which included the plot number, details of the respondent, serial number of the events, local and scientific names of the spotted plants, place of occurrence of the plants (Paddy Field - PF, Paddy Levees - PL, Paddy adjacent - PA), and details on the use values and useful parts of the plants. Whenever necessary, sample materials were collected or photographs were taken to confirm the identity of the species. The plant species were identified with the help of Flowering Plants of Kerala, Ver. 2.0, and later the names were double checked with The Plant List (2013).

The use categories were given codes as Culturally Important or Magico- religious (C) Ethno-veterinary (EV), Food (F), Fodder (Fr), Firewood (Fw), Income generating (I), Primary Medicine (M), Other uses (O), Plant Protection (PP), and No Use (N- cited by its local name by the respondent but without any specific use). The uses identified by the respondents are general since there was no distinction made whether they use it presently or they reproduce it from their memory. The research ethics was embodied in a participation agreement (Prior Informed Consent between the researcher and participants/respondents) in which the research aspects, methodology, outcomes and confidentiality of the data are clearly mentioned (Parameswaran P., 2013). There was no purposeful selection of participants to tally the number in terms of age, sex and community and the methodology included open guided walks. The different local names of the plants were recorded separately from each community.

Results and Discussion

A total of 65 participants of the study (32 Men and 33 Women – Table 1), through a total of 945 events/sightings (Table 2), have identified 95 useful plants each for the categories 1&2. Category 1 included the plants recorded from Paddy Fields and Paddy Levees (PF&PL) and was dominated by the members of Cyperaceae, Asteraceae, Poaceae and Amaranthaceae. Category 2 included the plants recorded from Paddy Associated habitats (PA) and was dominated by the members of Solanaceae, Asteraceae, Fabaceae and Moraceae). 33 species were found common in these categories (Table 3). The first category of plants recorded from PF & PL are normally considered as ‘weeds’ and were uprooted during the rice cultivation period, while the second category of plants of PA are mostly not disturbed by the agricultural practices related to rice. The ‘useful weeds’ associated with Paddy Fields (PF) and Paddy Levees (PL) are represented by 95 Species belonging to 73 genera under 40 families and are discussed here (Figures 4 to 8). The dominant use classes are medicine (38 species) food (37 species) fodder (37 species) ethno-veterinary (7) cultural value (5 species) and plant protection (1 species) – Fig. 5 & Table 4.

Table 1: Total number of participants of the study

Sex	Adiya	Kurichya	Kuruma	Kattunaikka	Paniya	General	TOTAL
Men	4	4	8	5	8	3	32
Women	6	3	6	6	6	6	33
TOTAL	10	7	14	11	14	9	65

Table 2: Total number of events/sightings for the plants recorded

Category of Sample Plot	Events (as guided by Women)	Events (as guided by Men)	Total
Category 1: Paddy Field & Paddy Levee (PF&PL)	339	312	651
Category 2: Paddy Adjacent (PA)	145	149	294
Total	484	461	945

Table 3: Total number of species recorded

From Category 1 (PF&PL) – presented in this paper	From Category 2 (PA) – not presented in this paper	Number of species shared by both the categories
95	95	33

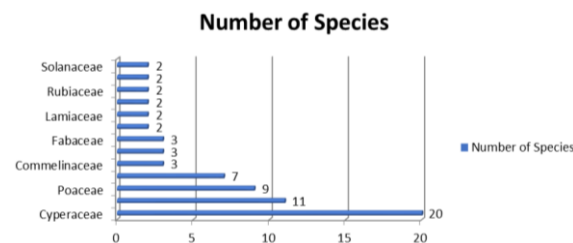


Fig. 4: Number of Species in dominant families (27 families represented one Species each)

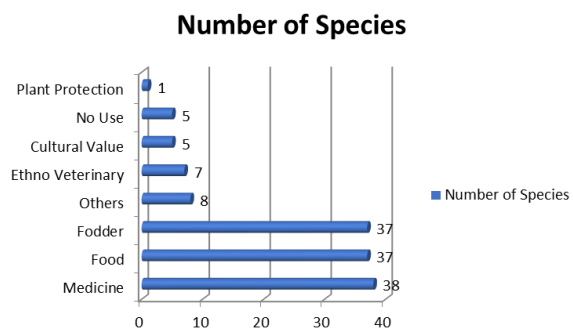


Fig. 5: Number of species and the Use Classes (No Use: cited by its local name by the respondent but without any specific use; Others: construction, masticator, scrub for bath, basketry/pottery, cosmetics, broom, tooth cleaner, fertilizer, pepper vine stalk, bow and arrow, mat, fishing poison, toddy, slate rubb, ornamental, mosquito repellent).

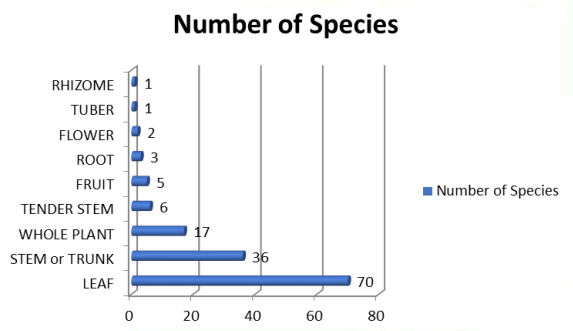


Fig. 6: Number of species and their useful parts

Table 4: Useful weeds of Paddy Fields and Paddy Levees

S. No.	Species	Family	Local name(s)	Useful parts	Use class	Specific uses/Remarks
1	<i>Achyranthes aspera</i> L.	Amaranthaceae	Kadaladi	L	M, F	Leaf syrup is used to cure cough, respiratory disorders and vomiting.
2	<i>Aemella calva</i> (DC.) R.K. Jansen	Asteraceae	Palluedanachedi	Fl	M	Chewing the flower cures tooth pain and prevents tooth decay.
3	<i>Aemella uliginosa</i> (Sw.) Cass.	Asteraceae	Mookkilpodchedi	Fl	M	Sneezing caused by inhaling the inflorescence removes cough.
4	<i>Aerva lanata</i> (L.) Juss.	Amaranthaceae	Cheroola	Wh	M,C	Syrup of the whole plant is used to cure fever and cough; used in offerings to the diseased.
5	<i>Ageratum conyzoides</i> (L.) L.	Asteraceae	Appa, Appakkaadu, Kaattuchappu, Venalpacha	L, Wh	Fr, M, N	Squeezed plant is applied on skin to cure eczema; Leaf paste cures back pain and wounds.
6	<i>Alternanthera pungens</i> Kunth	Amaranthaceae	Minnankanni	L, TS	F	The leaves are used to make, a dry recipe made using the leaves – locally called as <i>upperi</i> .
7	<i>Alternanthera sessilis</i> (L.) R. Br. ex DC.	Amaranthaceae	Ponnankanni, Meenchappu, Ponnankannichapp, Upperichappu	L, TS	F	-do-
8	<i>Alternanthera tenella</i> Colla	Amaranthaceae	Achaarcheera	L, TS	F	-do-
9	<i>Amaranthus spinosus</i> L.	Amaranthaceae	Valancheera, Mullukkeera	L, TS	F	-do-

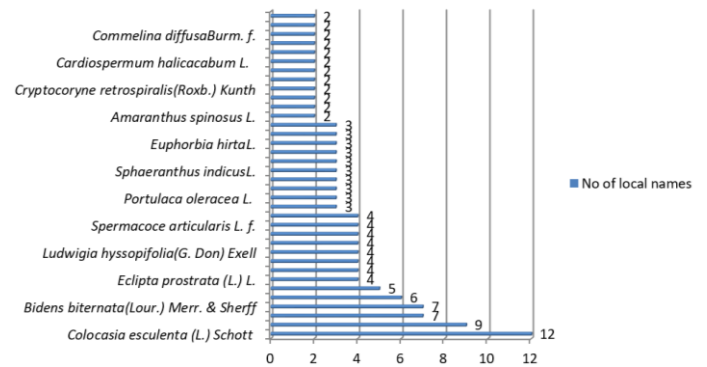


Fig. 7: Species with number of local names (One local name recorded for 56 Species and local names not recorded for 3 Species)

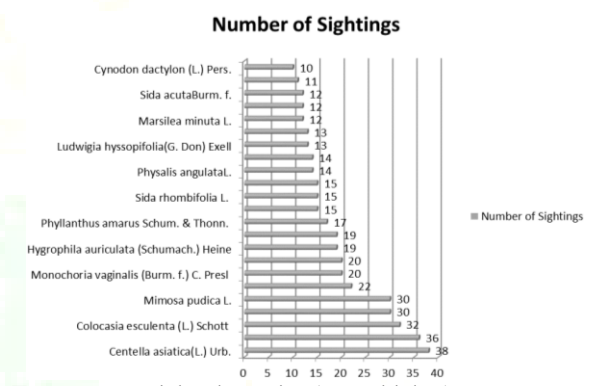


Fig. 8: Most sighted Species (10 or higher)

10	<i>Artemisia nilagirica</i> (Clarke) Pamp.	Asteraceae	Pachakkarpooram, Kaattukarpooram	L	PP, M, EV	Swiping the plant over the rice plant is effective against pests like leaf rollers; water boiled with leaves is used to cure stomach pain; water boiled with leaves is good against ecto-parasites of cattle.
11	<i>Axonopus compressus</i> (Sw.) P. Beauv.	Poaceae	Kaalappullu	L	Fr	-
12	<i>Azolla pinnata</i> R. Br.	Azollaceae	-	Wh	O	Used as natural fertilizer.
13	<i>Bacopa monnieri</i> (L.) Wettst.	Scrophulariaceae	Brahmi, Soppu	L, S	M, F	Paste of the whole plant is good for brain development and improving memory of children.
14	<i>Bidens biternata</i> (Lour.) Merr. & Sherff	Asteraceae	Ambakkaadu, Amba, Alamchappu, Aalottichappu, Aalotti, Snehakkoorkka, Kandonekkuthi,	L	F, EV, N	Used to heal wounds of cow.
15	<i>Calamus glamblei</i>	Arecaceae	Pachachooral	Wh	C, O	Wrapped around the body during an offering to the deity (daivam kaanal); used also for basketry making.
16	<i>Canscora diffusa</i> (Vahl) R.Br. ex Roem. & Schult.	Gentianaceae	Nilanaarakam	-	N	-
17	<i>Capparis brevispina</i> DC.	Capparaceae	Maradasoppu	L	F	-
18	<i>Cardiospermum halicacabum</i> L.	Sapindaceae	Uzhinja, Valliuzhinja	Wh	M	Against: fever, cough and swellings, good against stomach pain, skin diseases and hair loss, good stomach purifier. Leaves used to make <i>upperi</i> ; leaf paste is externally applied against tooth pain and skin diseases. The leaves ground along with fresh turmeric is used against body swellings due to sprains; fresh leaves are consumed against vatha, good for improving memory especially of children and also a blood purifier.
19	<i>Centella asiatica</i> (L.) Urb.	Apiaceae	Kudakan, Kodangal, Muthil, Vaathakkolli, Moyalchevi, Upeerichappu	L, S	M, F, Fr	The leaves ground along with fresh turmeric is used against body swellings due to sprains; fresh leaves are consumed against vatha, good for improving memory especially of children and also a blood purifier.
20	<i>Christella dentata</i> (Forsk.) Browney & Jermy	Thelypteridaceae	Thaavachappu, Kaattuhaava	-	N	-
21	<i>Chromolaena odorata</i> (L.) R.M.King & H.Rob.	Asteraceae	Communist pacha	-	M, EV, N	Leaf juice heals wounds/scars.
22	<i>Cleome viscosa</i> L.	Capparidaceae	Kaattukadugu, Kadukuchedi, Naikkaduk Thalu, Kaattuthaalu, Chembinthaalu, Kollithaalu, Karinthaalu, Vayalthaalu, Chembu, Paalchembu, Kollichembu, Vayalchembu, Thondichembu, Makkaleppottichembu	L	M, F	The sweet leaves are made as a paste in water and consumed against stomach pain.
23	<i>Colocasia esculenta</i> (L.) Schott	Araceae	Valliichappu, Kannisoppu Panjithaalu, Koonthal	L, S, T	F, M	Tender leaves are used to make curry; boiled leaves used as a paste against athlete foot disease.
24	<i>Commelina diffusa</i> Burm. f.	Commelinaceae	Valliichappu, Kannisoppu	L, S	F, M	Leaves edible and used against dysentery.
25	<i>Cryptocoryne retrospiralis</i> (Roxb.) Kunth	Araceae	Panjithaalu, Koonthal	L, S	F	Tender leaves are used to make curry.
26	<i>Cucuma longa</i>	Zingiberaceae	Manjal	Rz	F, M, EV, C	Cultivated species, used as a condiment; highly medicinal curing various ailments, specific for wound healing in both human and cow; culturally important in an array of religious and cultural ceremonies, including <i>Gurusi</i> .
27	<i>Cucumis sativus</i>	Cucurbitaceae	Vellari		F, C	Cultivated species, used in traditional recipes; culturally important during the occasions of Onam and Vishu for first-sight (<i>Kani</i>); main dish made for the feast after first paddy harvest (<i>Puthari sadya</i>).
28	<i>Cyathula prostrata</i> (L.) Blume	Amaranthaceae	Moorkirichappu	L	F, M	Leaf paste helps to heal wounds.

29	<i>Cycea peltata</i>	Menispermaceae	Paadathaali	R	M, EV, O	Used as medicinal soap and shampoo, good for skin and hair; good against stomach disorders of cow.
30	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Cherukaruka, Karuaka, Karukappullu	Wh	M, Fr	Used against cough, fever and neuro disorders; good as first diet for children.
31	<i>Cyperus difformis</i> L.	Cyperaceae	Pullu	L, S	Fr	-
32	<i>Cyperus distans</i> L. f.	Cyperaceae	Pullu	L, S	Fr	-
33	<i>Cyperus exaltatus</i> Retz.	Cyperaceae	Pullu	L, S	Fr	-
34	<i>Cyperus iria</i> L.	Cyperaceae	Pullu	L, S	Fr	-
35	<i>Cyperus javanicus</i> Hoult.	Cyperaceae	Pullu	L, S	Fr	-
36	<i>Cyperus panicus</i> (Rottb.) Boeckeler	Cyperaceae	Pullu	L, S	Fr	-
37	<i>Cyperus pilosus</i> Vahl	Cyperaceae	Pullu	L, S	Fr	-
38	<i>Cyperus rotundus</i> L.	Cyperaceae	Muthangappullu	L, S	Fr	-
39	<i>Cyperus tenuispica</i> Steud.	Cyperaceae	Thalekettan pullu	L, S	Fr	-
40	<i>Diplazium esculentum</i> (Retz.) Sw.	Woodsiaaceae	Churulichappu, Churuli	L, S	F, M	Leaf paste is used against urinary infection.
41	<i>Drymaria cordata</i> subsp. diandra (Blume) J. A. Duke	Caryophyllaceae	Uzhavu	Wh	F	-
42	<i>Echinochloa colona</i> (L.) Link	Poaceae	Paandiyappullu, Andappullu,	L	Fr	-
43	<i>Echinochloa crus-galli</i> (L.) P. Beauv.	Poaceae	Pattivaalanpullu, Kapadappullu, Uthraani	L, Sd	Fr, F	Grains used for preparing a breakfast dish (<i>Upma</i>).
44	<i>Edipta prostrata</i> (L.) L.	Asteraceae	Kayyuni, Kaikkaruppan, Paalcheera, Karaanthe	L	M, F	Coconut oil, boiled with the leaves reduces hair fall; the oil is also good against scabies.
45	<i>Emilia sonchifolia</i> (L.) DC. ex DC.	Asteraceae	Muyalchevi	L	F, M	Used against fever, leaf juice purifies eye.
46	<i>Eriocaulon truncatum</i> Buch.-Ham. ex Mart.	Eriocaulaceae	-	Wh	O	For making broom.
47	<i>Euphorbia hirta</i> L.	Euphorbiaceae	Paalcheera, Minugalasappu, Meenchappu	L, TS	F, M	Leaves used against skin diseases.
48	<i>Fimbristylis acuminata</i> Vahl	Cyperaceae	Pullu	L, S	Fr	-
49	<i>Fimbristylis aestivalis</i> Vahl	Cyperaceae	Pullu	L, S	Fr	-
50	<i>Fimbristylis dichotoma</i> (L.) Vahl	Cyperaceae	Pullu	L, S	Fr	-
51	<i>Fimbristylis eragrostis</i> (Nees) Hance	Cyperaceae	Kaakippullu	L, S	Fr	-
52	<i>Fimbristylis ferruginea</i> (L.) Vahl	Cyperaceae	Pullu	L, S	Fr	-
53	<i>Fimbristylis narayanii</i> C.E.C. Fisch.	Cyperaceae	Pullu	L, S	Fr	-
54	<i>Fimbristylis pseudonarayanii</i> Ravi & Anil Kumar	Cyperaceae	Pullu	L, S	Fr	-
55	<i>Fimbristylis quinqueangularis</i> (Vahl) Kunth	Cyperaceae	Pullu	L, S	Fr	-
56	<i>Fimbristylis schoenoides</i> (Retz.) Vahl	Cyperaceae	Pullu	L, S	Fr	-
57	<i>Floscopa scandens</i> Lour.	Commelinaceae	Pullu	L, S	Fr	-
58	<i>Hygrophila auriculata</i> (Schumach.) Heine	Acanthaceae	Chulli, Vayalchulli, Kolamullu, Neerchulli, Kozhimullan	Fr, L, R	F, M, O, N	Flowers used to make <i>upperi</i> ; drinking boiled water with the leaves cures swelling due to vaatha; drinking boiled water with the roots purifies blood; spines are poisonous.
59	<i>Isachne globosa</i> (Thunb.) Kuntze	Poaceae	Mangupullu	L	Fr	Paddy straw need to be fed to the cattle along with this, single and over consumption may lead to diarrhea; this weed is highly destructive to the paddy.
60	<i>Kyllinga nemoralis</i> (J.R.Forst. & G.Forst.) Dandy ex Hutch. & Dalziel	Cyperaceae	Kaattumuthanga	Wh	Fr	-
61	<i>Laportea interrupta</i> (L.) Chew	Urticaceae	Chorithanam	L	F	Leaves create itching sensation; tender leaves are edible but need to be processed in boiled water.
62	<i>Leucas aspera</i> (Willd.) Link.	Lamiaceae	Thumba, Thumbachappu	L	F, M	Tender leaves are edible, used against cough and fever, stomach pain, swelling at body joints, skin diseases and snake bites.
63	<i>Ludwigia hyssopifolia</i> (G. Don) Exell	Onagraceae	Mulippannchedi, Vayalchoori, Pooppaanam, Konginchedi, Kolachappu,	-	N	Very destructive weed.
64	<i>Marsilea minuta</i> L.	Marsileaceae	Vattachappu, Unugal, Unuvlichappu	L	F, M	Leaf paste in water is applied externally against wounds.

65	<i>Mimosa pudica</i> L.	Fabaceae	Padayincha, Thottavadi, Urakkamullu	L, Wh	M, EV, Fr, N	Leaf paste in water is applied externally against wounds in men and cow as an anticoagulant; the paste is also consumed against diarrhea in men and cow.
66	<i>Mitracarpus hirtus</i> (L.) DC.	Rubiaceae	Varmbel koduveli	Wh	M	Leaf paste in water is applied externally against wounds, sprains and swellings.
67	<i>Mollugo pentaphylla</i> L.	Molluginaceae	Parppadakappullu Kulavaazha,	L, S	Fr	-
68	<i>Monochoria vaginalis</i> (Burm. f.) C. Presl	Pontederiaceae	Annikkizhangu, Vayalthaali, Karimkoovalam	L, T	F, M, N	Tubers are edible; leaf paste applied externally heals burning sensations in the body.
69	<i>Murdannia dimorpha</i> (Dalzell) G.Brückn.	Commelinaceae	Pullu	L, S	Fr	-
70	<i>Ocimum sanctum</i>	Lamiaceae	Thulasi	L, Fr	M, C	Leaves highly medicinal and sacred, good against fever & cough, flowers and leaves used in religious ceremonies.
71	<i>Ottobloa nodosa</i> (Kunth) Dandy	Poaceae	Pullu	L, S	Fr	-
72	<i>Oxalis corniculata</i> L.	Oxalidaceae	Pulinchappu, Puliyala	L, S	F, M	Used against stomach problems.
73	<i>Panicum repens</i> L.	Poaceae	Aanavaripullu	L, S	Fr	-
74	<i>Paspalum scrobiculatum</i> L.	Poaceae	Vetharappullu	L, S	Fr	-
75	<i>Phyllanthus amarus</i> Schum. & Thonn.	Euphorbiaceae	Keezharnelli	Wh	M	Boil the plant in coconut oil, rubbing it on the body cures swellings due to sprains; grind the plant (except root) in boiled water, drinking it in empty stomach cures hepatitis, jaundice and stomach ulcers.
76	<i>Physalis angulata</i> L.	Solanaceae	Mudinja, Mudungachappu, Valiya mudinja, Aanamudinja, Njottaanjodiyan, Mottampuli	L, Fr	F	-
77	<i>Portulaca oleracea</i> L.	Portulacaceae	Vaniyamchappu, Kozhuppa, Kozhuppacheera	L, S	F, M	Leaves are antipyretic and used against skin diseases.
78	<i>Pteridium aquilemum</i> (L.) Kuhn.	Dennstaedtiaceae	Thaavachappu	L	F	The tender leaves are used to make <i>upperi</i> .
79	<i>Sacciolepis indica</i> (L.) Chase	Poaceae	Pooppullu	L, S	Fr	-
80	<i>Schoenoplectiella juncoides</i> (Roxb.) Lye	Cyperaceae	Soochippullu, Maanappullu, Varangupullu	L, S	Fr	-
81	<i>Scoparia dulcis</i> L.	Scrophulariaceae	Kallurukki, Kadumadhuram, Markkari	Wh, L	M, F	Boil the plant in water, drinking in regular intervals is good for urinary disorders, especially to treat kidney stone and infection; Leaves are used to make <i>upperi</i> .
82	<i>Senna tora</i> (L.) Roxb.	Fabaceae	Thakara, Thakarassoppu, Thavara, Thakattasoppu	L, R	F, M	Leaves are used to make curry; Root paste in water is used against Snake bite.
83	<i>Sida acuta</i> Burm. f.	Malvaceae	Aanakkurunthotti, Alutha	L, S	O	Used for making broom.
84	<i>Sida rhombifolia</i> L.	Malvaceae	Kurunthotti	Wh	M, O	Making kashaya (syrup) against <i>vatha</i> ; used as a scrub during bath.
85	<i>Smithia conferta</i> Sm.	Fabaceae	-	L, S	Fr	-
86	<i>Solanum americanum</i> Mill.	Solanaceae	Kaakkachappu, Mudungachappu, Mudinjachappu, Karimudinjachappu, Manithaakkaali, Kurukkanchunda, Chundanga Kaakkapazham	L, TS, Fr	F, M	Leaves and tender stem are used to make <i>upperi</i> ; Fruits used in the preparation of <i>Vaduke</i> (a paste of solanum fruit, chilly and onion in water, made in to small balls and dried in sun, dried balls are fried in oil and consumed with rice); fruits used in the preparation of <i>Kashaya</i> (syrup) against <i>vatha</i> ; fruits are good against stomach ulcer.
87	<i>Spermacoce articularis</i> L. f.	Rubiaceae	Kodalchurukki, Kodalurukki,Varam belkoduveli, Malamkoorkka	Wh	EV	Leaf paste in boiled water is used to treat digestive disorders of cattle; the plant is an ingredient of <i>Murivenna</i> (oil made with 10 herbs and which cures wounds and sprains).

88	<i>Sphaeranthus indicus</i> L.	Asteraceae	Adakkaamaniyan, Vaanikkakkaaya, Banniyam	Wh, L	EV, M, N	Whole plant is used as a scrub while cleaning the cow (effective against Lice), effective against ecto-parasites, and good for skin diseases; the paste of the leaves heal wounds.
89	<i>Sphagnetocola trilobata</i> (L.) Pruski	Asteraceae	Bhoolokamudichi	-	N	Destructive weed.
90	<i>Spilanthes radicans</i> Jacq.	Asteraceae	Palluvadanachedi	Fr, Wh	M, Fr, N	Chewing the flowers will heal tooth pain.
91	<i>Stachytarpheta jamaicensis</i> (L.) Vahl	Verbenaceae	Sheemakkongini	-	N	-
92	<i>Tragia involucrata</i> L.	Euphorbiaceae	Kodithoova	L	F	-
93	<i>Trianthema portulacastrum</i> L.	Aizoaceae	Minnamkannichappu, Kozhuppacheera, Sambaarcheera	L	F	The leaves are used to make <i>Upperi</i> .
94	<i>Typha angustifolia</i> L.	Typhaceae	Paayappullu	Wh	O	Used for making mats.
95	<i>Waltheria indica</i> L.	Sterculiaceae	Maracheera	L	F, M	Leaf paste in water is used against wounds.

USEFUL PARTS: Fl=FLOWER; Fr=FRUIT; L=LEAF; R=ROOT; Rz=RHIZOME; S=STEM or TRUNK; Sd=SEED; T=TUBER; TS=TENDER STEM; Wh=WHOLE PLANT

USE CLASS: C=CULTURAL VALUE; EV=ETHNO-VETERINARY; F=FOOD; Fr=FODDER; M=MEDICINE; N=NO USE; O=OTHERS; PP=PLANT PROTECTION; (NO USE: cited by the local name by the respondent but without any specific use; OTHERS: scrub for bath, basketry/pottery, cosmetics, broom, fertilizer, mat).

Conclusion

As an agroecosystem, the rice field provides a range of tangible and intangible services to the local community. Apart from the Regulating, Cultural and Support services, the Provisional supporting services (Millennium Ecosystem Assessment, 2005) provided by this landscape in terms of enhancing biodiversity, sheltering several species of food, fodder, medicinal and other values are significant for the people inhabiting the land. The functions and value of these fields depend importantly upon its management by the land users.

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References

- Abraham CT, and Thomas CG. "Major Weeds of Kole rice Field of Kerala." *Proceedings of the National Symposium on Priorities and Strategies for Rice Research in High Rainfall Tropics* (2002), Kerala Agricultural University. Print.
- Abraham CT, Joseph PA, and Thomas CG. "Ecological Survey of Weeds in the rice ecosystem of Kuttanad." *Rice in Wetland ecosystem Proceeding of the National Symposium* (Nair RR, Nair KPV, and Joseph CA (Eds). (1990), Kerala Agricultural University. Print.
- Babu SD. "Floristic Diversity, Autecology and competitive behavior of weed flora in the wetland rice ecosystem." Unpublished Doctoral Dissertation, College of Agriculture, Kerala Agricultural University. (2010):220. Print.
- Bambaradeniya CNB, Edirisinghe JP, De Silva DN, Gunatilleke CVS, Ranawana KB, and Wijekoon S. "Biodiversity associated with an irrigated rice agroecosystem in Sri Lanka." *Biodiversity and Conservation*, 13. 9 (2004): 1715 – 1753. Print.
- Bambaradeniya CNB, and Gunatilleke CVS. "Ecological aspects of weed flora in an irrigated rice field ecosystem at Bathalagoda in Sri Lanka." *J. Natn. Sci. Foundation Sri Lanka*, 30.3&4 (2002): 123-147. Print.
- Bambaradeniya CNB, Fonscka KT, and Ambagahawatte CL. "A preliminary study of fauna and Flora of a rice field in kandy, Sri lanka." *Cey.J. Sci. (Bio. Sci.)*, 25 (1998): 1-22. Print.
- Caton BP, Mortimer M, Hill JE, and Johnson DE. *A practical field guide to weeds of rice in Asia*, Second Edition. Los Baños (Philippines): International Rice Research Institute (2010): 118. Print.
- Chandrasena JPNR. "Rice-field weeds in the Colombo and Gampaha Districts of Sri Lanka." *J. Natn. Sci. Coun. Sri Lanka*, 15.2 (1987): 249-265. Print.
- Chandrasena JPNR. "Floristic composition and abundance of rice-field weeds in four low-country wet zone districts of Sri Lanka." *Tropical Pest Management*, 34.3 (1988): 278-287. Print.
- Chandrasena JPNR. "A survey of the rice-field weeds in Ratnapura and Kurunegala districts of Sri Lanka." *Journal of the National Science Council of Sri Lanka*, 17.2 (1989):187-211. Print.
- Cruz-Garcia Gisella S, and Price Lisa L. "Ethnobotanical investigation of 'wild' food plants used by rice farmers in Kalasin, Northeast Thailand." *Journal of Ethnobiology and Ethnomedicine*, 7:33 (2011). <www.ethnobiomed.com/content/7/1/33>, viewed 1st May, 2016.

12. Datta S, and Banerjee A. "Useful weeds of West Bengal rice fields." *Economic Botany*, 32.3 (1978): 297-310. Print.
13. Department of Economics and Statistics, Agricultural Statistics, Government of Kerala, Thiruvananthapuram, Kerala (2013). <<http://www.ecostat.kerala.gov.in/index.php/reports/154.html>>, viewed 1st May, 2016.
14. Dhanam S, and Elayaraj B. "Ethnomedicinal aspects of some weeds from paddy fields of Villupuram district in Tamil Nadu, India." *International Letters of Natural Sciences*, 14 (2014). 1-10. Print.
15. Fernando CH. "Rice field ecology and fish culture – an overview." *Hydrobiologia*, 259 (1993): 91-113. Print.
16. Flowering Plants of Kerala ver.2.0. Kerala Forest Research Institute, Peechi, Kerala, India (2011). CD
17. Gopi G, Anil Kumar N, and Arivudai Nambi V. "Vayals: A traditional classification of agricultural landscapes." *LEISA India*, 6.4 (2004): 27-28. Print.
18. Gopikuttan G, and Parameswara Kurup KN. "Paddy Land Conversion in Kerala, An Inquiry Into Ecological and Economic Aspects in a Midland Watershed Region." Final Report, Kerala Research Program on Local Level Development, Centre for Development Studies, Thiruvananthapuram, India (2004). Print.
19. Govindiah. "Role of weeds in Ayurvedic medicine." *Bull Medico-Ethno-Botanical Res*, 4.3-4 (1981): 144-147. Print.
20. Grandstaff S, Grandstaff TB, Rathakette P, Thomas DE, and Thomas JK. "Trees in paddy fields in Northeast Thailand." *Traditional agriculture in Southeast Asia A human ecology perspective*, Marten GE (Ed.), Westview Press, London (1986): 273-292. Print.
21. Heckman CW. "Rice field ecology in Northeastern Thailand." *Monographs Biologicae*, 34.1, Dr. W. Junk Publishers, The Hague (1979): 228. Print.
22. Hema ES, Sivadasan M, and Anil Kumar N. "Studies on edible species of Amaranthaceae and Araceae used by Kuruma and Paniya tribes in Wayanad district, Kerala, India." *Ethnobot.*, 18.1 (2006):122-126. Print.
23. Holm IJ, Doll EH, J Pancho, and J Herberger. *World Weeds: Natural Histories and Distribution*. John Wiley & Sons, Inc., 605 Third Avenue, New York (1997):1152. Print.
24. Immanuel RR, and Elizabeth LL. "Weeds in Agroecosystems: A Source of Medicines for Human Healthcare." *International Journal of PharmTech Research*, 1.2 (2009): 375-385. Print.
25. Indian Institute of Management. *Wayanad initiative: a situational study and feasibility report for a comprehensive development of Adivasi communities in Wayanad* (2006). <<http://www.scribd.com/doc/4074255/Wayanad-Initiative>>, viewed 1st May, 2016.
26. International Rice Research Institute. *Main weeds of rice in Asia* (2003). <<http://www.knowledgebank.irri.org/training/fact-sheets/pest-management/weeds/main-weeds-of-rice-in-asia>>, viewed 1st May, 2016.
27. John TK, Sreekumar S, Jaya Cheriyan. *Muriyad Wetlands: Ecological Changes and Human Consequences*. Project report submitted to Kerala Research Programme on Local Development, Centre for Developmental Studies, Thiruvananthapuram. Christ College Irinjakuda, Kerala (2003). Print.
28. John, CM, Sylas VP, Joby Paul, Unni KS. "Floating islands in a tropical wetland of peninsular India Wetlands." *Ecol. Manage*, 17 (2009): 641–653. Print.
29. Joseph KT. "Flora of Wetlands." *Wetland conservation and management in Kerala*, M. Jayakumar (Ed.). Kerala State Council for Science Technology and Environment, Thiruvananthapuram, Kerala (2002): 69-84. Print.
30. Kerala Agricultural University. *Package of Practices Recommendations: Crops*, Kerala Agricultural University, Thrissur, 14th edition (2011): 360. Print.
31. Kerala Agricultural University. "Four Decades of Weed Research In Kerala." *All India Coordinated Research Project on Weed control*, Abraham CT, Durga Devi KM, Giriya, T (Eds). College of Horticulture, Kerala Agricultural University, Thrissur, Kerala (2012): 129. Print.
32. Kosaka Y, Lamphoune X, Anoulom V, Hounphet C, Shinya T, and Makoto K. "Wild Edible Herbs in Paddy Fields and Their Sale in a Mixture in Houaphan Province, the Lao People's Democratic Republic." *Economic Botany*, 67.4 (2013):335-349. Print.
33. Kumar NA, Girigan G, and Parameswaran P. "Genetic Erosion and Degradation of Ecosystem Services of Wetland Rice Fields: A Case Study From Western Ghats, India." *Agriculture, Biodiversity and Markets*, Stewart Lockie and David Carpenter (Eds.), Earthscan, London, Washington DC (2010): 137-153. Print.
34. Maneechote C. "Utilization of weeds and their relatives as resources in Thailand." *Utility of weeds and their relatives as resources*, Kim KU, Shin DH, Lee IJ. Daegu (Eds.), Kyungpook National University, Korea (2007). Print.
35. M S Swaminathan Research Foundation. *Phase – I Completion Report on Conservation, Enhancement and Sustainable and Equitable Use of Biodiversity*, M. S. Swaminathan Research Foundation, Chennai (2001): 101. Print.
36. Millennium Ecosystem Assessment. *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC(2005):1. <www.millenniumassessment.org/documents/docu ment.356.aspx.pdf>, viewed 1st May, 2016.
37. Martin GJ. *Ethnobotany: a 'People and Plants' Conservation Manual*, Chapman and Hall, London (1995): 268. Print.

38. Mini V, and Sivadasan M. "Plants used in ethno-veterinary medicine by Kurichya tribe of Wayanad district in Kerala, India." *Ethnobot.*, 19.16 (2007):16-21. Print.
39. Moody K. *Weeds reported in rice in South and Southeast Asia*. International Rice Research Institute, Los Baños, Laguna, Philippines (1989):442. Print.
40. Nair GC. *Wayanad: its People and Traditions*, Higginbotham & Co, Madras (1911), <https://archive.org/stream/wynaditspeoplest00goparich/wynaditspeoplest00goparich_djvu.txt>, viewed 1st May, 2016.
41. Narayanan RMK. *Floristic study of Wayanad District giving special emphasis on conservation of Rare and Threatened plants*, Unpublished Doctoral Dissertation, University of Calicut, Kerala (2009):1034. Print.
42. Narayanan RMK, Balakrishnan V, and Anil Kumar N. "Coping role of wild edibles - a case study from Paniya tribes of Wayanad District, India." *Agro biodiversity Source Book*, CIPUPWARD, Philippines (2002): 100-108. Print.
43. Narayanan RMK, Swapna MP, and N. Anil Kumar. *Gender Dimensions of Wild Food Management in Wayanad, Kerala*. M S Swaminathan Research Foundation, MSSRF/RR/04/12, (2004): 111. Print.
44. Narayanan RMK, and N. Anil Kumar. "Gendered Knowledge and Changing Trends in utilization of wild edible greens in Western Ghats, India." *Indian Journal of Traditional Knowledge*, 6.1 (2007): 204-216. Print.
45. Nath KK, Deka P, and Borthakur SK. "Ethnomedicinal aspects of some weeds from Darrang district of Assam." *Ethnobot.*, 19.1&2 (2007): 82-87. Print.
46. Neogi B and Rao RR. "Study on the weed flora of various Hill Agro-Ecosystems in Meghalaya." *Australian weeds*, 2.1 (1982): 9-15. Print.
47. Nisha VM, and Sivadasan M. "Ethnodermatologically significant plants used by traditional healers of Wayanad district, Kerala." *Ethnobot.*, 19 (2007): 55-61. Print.
48. Office of the Registrar General and Census Commissioner. *Census of India 2011*, Office of the Registrar General and Census Commissioner, Government of India, New Delhi (2011). <http://www.censusindia.gov.in/2011census/PCA/PCA_Highlights/pca_highlights_file/kerala/Executive_Summary.pdf>, viewed 1st May, 2016.
49. Parameswaran P, MK Ratheesh Narayanan and N. Anil Kumar. "Diversity of Vascular Plants Associated With Wetland Paddy Fields (Vayals) Of Wayanad District in Western Ghats, India." *Annals Of Plant Sciences*, 3.05 (2014): 704-714.
50. Phillips O, and AH Gentry. "The Useful Plants of Tambopata, Peru: I. Statistical Hypotheses Tests with a New Quantitative Technique." *Economic Botany*, 47.1 (1993): 15-32. Print.
51. Pimental D, Stachow U, Takacs D, Brubaker HW, Dumas AR, Meaney JJ, O'neil JAS, Onsi DE, and Corzilius DB. "Conserving biological diversity in agricultural/forestry systems." *BioScience.*, 42.5 (1992): 354-362. Print.
52. Prachaiyo B. "Farmers and forests: a changing phase in Northeast Thailand." *Southeast Asian Studies*, 38.3 (2000):156. Print.
53. Parameswaran P. "Consent on cooperation and knowledge sharing – experience from the BioDIVA subproject 'agro-ecology'." *Cultivate Diversity! A handbook on Transdisciplinary approaches to agrobiodiversity research*, Christinck A, and Martina P (Eds.) Margraf Publishers (2013): 150-151. Print.
54. Pramod C, Sivadasan M, and Anil Kumar N. "Ethnobotany of religious and supernatural beliefs of Kurichya of Wayanad district, Kerala, India." *Ethnobot.*, 15 (2003): 11-19. Print.
55. Price LL. "Wild Plant Food in Agricultural Environments: A Study of Occurrence, Management, and Gathering Rights in Northeast Thailand." *Human Organization*, 56 (1997):209–221. Print.
56. Roger PA. *Biology and management of the floodwater ecosystem in rice fields*, International Rice Research Institute, Los Banos, Philippines (2002): 250. Print.
57. Sabu T, and Babu Ambat. "Floristic Analysis of Wetlands of Kerala." *Proceedings of the Kerala Environment Congress 2007*, Centre for Environment and Development, Thiruvananthapuram (2007). Print.
58. Sanil Kumar MG and K John Thomas. "Indigenous medicinal usage of some macrophytes of the Muriyad wetland in Vembanad-Kol, Ramsar site, Kerala." *Indian Journal of Traditional Knowledge*, 6.2 (2007): 365-367. Print.
59. Sasidharan NK, Sreekumar V, John PS and Nair MS. "Intensity of weeds in the rice ecosystem of Kuttanad." *Rice in Wetland ecosystem. Proceedings of the National symposium on Rice in Wetland ecosystem*. Kerala Agricultural University, Thrissur (1990): 168-170. Print.
60. Shibahara M. "Hunting and gathering activities and public forests: the case of rain fed rice-cultivating villages in Roi Et, Northeastern Thailand." *Southeast Asian Studies*, 42 (2004):354-377. Print.
61. Silja VP, Samitha Varma K, Mohanan KV. "Ethnomedicinal plant knowledge of the Mullukuruma tribe of Wayanad district, Kerala." *Indian J. Trad. Knowl.*, 7.4 (2008): 604-612. Print.
62. Smith RJ Jr. "Weeds of major economic importance in rice and yield losses due to weed competition." *Proc. of the Conf. on Weed Control in Rice*. International Rice

- Research Institute, Manila, Philippines and International Weed Science Society (1983): 19-36. Print.
63. Sujana KA and C Sivaperuman. "Preliminary Studies on Flora of Kole Wetlands, Thrissur, Kerala." *Indian Forester*, 134.8 (2008):1079-1086. Print.
64. The Plant List. *A working list of all plant species*, Version 1.1, 2013, <<http://www.theplantlist.org/>>, viewed 1st May, 2016.
65. Vidya AS, Abraham CT and Girija T. "Weed Spectrum of Pokkali lands: The salt marsh rice ecosystem of Kerala." *Ind. J. Weed Sci*, 36.1&2 (2004a): 157-159. Print.
66. Vidya AS, Abraham CT and Girija T. "Weed Diversity in Lowland ecosystems of Kerala." *J. Indian Soc. Coastal Agric. Res.*, 22.1&2 (2004b):264. Print.
67. Watanabe H, Abe KI, Hoshikawa T, Prachaiyo B, Sahunalu P, and Khemnark. "On trees in paddy fields in Northeast Thailand." *Southeast Asian Studies*, 28 (1990):45-54. Print.
68. Yamaguchi H and S Umemoto. "Classification of paddy levees in terms of plant resource complex." *Weed Research, Japan*, 41 (1996):286-294. Print. (In Japanese with English summary).

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