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Exploring Wild Edibles of Male Mahadeshwara Betta (MM Hills) and their potential for socio economic development of local people: A Scientific and Technological Interventions Approach

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ABSTRACT
Wild edibles refer to non-cultivated edible plants found in the natural forests, fallow lands, agricultural lands etc. A variety of wild edible plants used by indigenous and tribal communities contributes significantly towards the livelihoods and socio-ecology of a landscape. Our paper examines the wild edible plants available in Male Mahadeshwara (MM Hills) Chamrajnagara, Karnataka, their uses, and scope of value addition to increase economic benefit along with ensuring sustainable forest management. The majority of the tribal people in the area, depend on collection of forest produce followed by agriculture and allied activities in and around the Sanctuary. Detailed documentation has been carried out for wild edibles on their uses, price, availability, quantities collected and communities involved in marketing them. A total of 80 wild edible plant species were documented from the study area on parameters like taxonomic family, local name, habit, feasibility and scale of use by the tribal communities. The dominant tribal communities in the area are Soligas who have inhabited these areas for generations and have traditional knowledge on use of wild plants and their parts viz., shoots, leaves, rhizomes, bark, etc. as a source of food and medicine. Analysis of the field data has shown that the wild edible plants have immense potential to increase income as a subsidiary livelihood option for local farm families. It is suggested that value addition to these plants is not only a better livelihood option but can also be used as a tool to reduce overexploitation of other forest resources and their unsustainable utilization. It is suggested that policies need to be formulated to conserve these plants in the wild habitats as well as within the study area.

Key words: Capacity Building, Forest Policy, Livelihood enhancement, Male Mahadeshwara, WEPs

INTRODUCTION

Wild edible plants (WEPs) are those plant species that don't seem to be cultivated or domesticated but are accessed from varied natural habitats and used as food and medicine. WEPs are commonly gathered from assorted habitats, viz, forests, arable fields, and even anthropogenically disturbed zones like roadsides and wastelands by different traditions throughout the planet. Ethnic communities and native people residing in developing countries draw a major part of their subsistence and bread and butter from the wild plants. Wild edible plants are a source of food for poor communities, principally tribals and other rural inhabitants, since they are freely available in the natural habitat and the people know how to gather and prepare food products from these wild plant resources. Wild plants, besides being used by poor communities, are increasingly being used today as food supplements in even the most developed regions of the world (Redzic 2006). About one billion people in the world use wild foods (mostly from plants) on a daily basis (Aberoumand 2009). Ethnobotanical investigations on wild edible plants suggest that more than 7,000 species have been used for food in human history (Grivetti and Ogle 2000).

In countries like China, India, Thailand and Bangladesh, hundreds of wild edible plants are still consumed along with domesticated species (Mazhar et al. 2007). India is a vast country bestowed by nature with a variety of botanical wealth and there are diverse types of plants growing wild in different regions. It is one of the world's mega-diversity regions with 47,147 plant species, including all lower groups (BSI 2012). About 800 wild plants are consumed as food chiefly by tribal communities (Singh and Arora 1978). The rich phyto-diversity is firmly established by investigations completed on

WEPs by different scientists all through India. Rashingam (2012) conducted ethnobotanical studies on wild plants and has listed 38 wild edible fruit species belonging to 24 families used by Irula tribes of Coimbatore district of Tamil Nadu. Bramha et al. (2013) recorded 32 species of wild fruits belonging to 23 families that are used by Bodo tribes of Kokrajhar in Assam. Arora (1996) has given a detailed account of WEP species occurring in India, while Rathore (2009) reported 600 WEP species from India. Bora and Pandey (1996) have documented 08 unreported food resources along with their habit, flowering, fruiting season and parts used from Assam. Joshi and Tiwari (2000) have enumerated 108 wild edible plants with botanical names, families, habit, flowering and fruiting period, and parts of the plants used as edibles from different altitudes in Uttar Pradesh.

In the Southern part of India, the Western Ghats region is rich in wild edible species as it is endowed with bio-geographic and climatic conditions which are conducive for supporting a variety of life forms. The state of Karnataka is well known with wild edible plant resources found in and around the forest zones, where the evolution of typical dietary habits of the inhabitants is shaped by those edible resources. Promoting the consumption of wild edibles has the potential to provide health and nutritional security to the local people. However there is no study on this aspect in the Male Mahadeshwara Hills region, particularly with reference to wild edibles. The present paper attempts to fill this gap through, not only, identification and documentation of wild edible plants species on which the local population depends, for meeting their nutritional needs but also by understanding the availability of edible plants and the current status of use as per the traditional knowledge reposited in the tribal populace.

The study intends to investigate the wild edibles found in MM Hills and to explore the scope of conserving and utilizing wild edibles for their economic and socioecological benefits. Proposing suitable mediations to the Government would empower it to make the required interventions not only for improvement of neighbourhood economy but also use it as a tool for long term sustenance of the resource through appropriate utilization of WEP. To take this forward, training programs were also conducted for the local people on value addition to WEPs using modern technologies.

The current rising demand for organic and healthy food can be met by conserving the resource and promoting value-addition to the wild edibles found in the study region. Development of rural business and entrepreneurs based on wild edibles largely depend on availability of centralized facility for processing and value-addition. These facilities may handle, wash, dry, grade, and sift wildcrafted plants in bulk to add value to the product. The facilities could also have a wider utility by using them to process and market local and regional farm crops and provide educational opportunities (Clements 1998). To bring in sustainable resource use and socioeconomic benefits out of the available resources should focus on market integration and sustainable value-chain development which enable linkages between local producers and a wider market

MATERIALS AND METHODS

Study area

The study area is located in Male Mahadeswara Betta (MM Hills) Reserve Forest of Chamarajanagara district of Karnataka, India, within latitude 12° 13' and 11° 55' N and longitude 77° 30' and 77° 47' (Fig. 1). MM Hills receives an average annual rainfall of 1100 mm. September to November is the wettest season with average rainfall during these months touching 900 mm. December, January and February are winter months. Summers from mid-March till May are dry, recording temperatures of over 40°C. This area is adjoining the Cauvery Wild life Sanctuary (WLS) and Biligiri Ranga Swamy Temple Tiger Reserve (BRT), which are also rich in biological diversity. It forms a connecting corridor between the BRT Wildlife Sanctuary to its west, and the Cauvery Wildlife Sanctuary to the northeast. MM Hills was notified as a reserve forest in 1913, with an area of 703 sqkm out of which 310 sq km was carved out to become a part of the Cauvery Wildlife Sanctuary in 1992. MM Hills is a crucial elephant passage way between the Western and Eastern Ghats.

Vegetation structure

The prominent forest type in the area is dry deciduous (64%). Dominant tree species are *Anogeissus*

latifolia, Boswellia serrata, Chloroxylon swietenia, and, at some places, *Dendrocalamus strictus*. Scrub forests covers about 20.5% of forest area, whereas moist deciduous and riparian forests accounts for 2.45%. Common species are *Pterocarpus marsupium* (hone), *Tectona grandis* (teak), and *Terminalia tomentosa*. There is a sparse distribution of *Dalbergia latifolia* and patches of Shola.

Indigenous tribe residing at Male Mahadeswara Betta

Tribals constitute an essential segment of the Indian Population. In our study area, tribal communities such as Soligas and the Lingayats have been residing for generations. These forest - dwelling communities depend on WEPs as supplementary food, especially during droughts and in case of shortfall of agriculture produce (Harisha 2011). These WEPs resources also provide essential nutrients and impart cultural identity to these communities (Harisha 2012). Soligas and Lingayats are the predominant communities in the MM Hills. Soligas are the indigenous community who shifted here from the adjacent BR Hills and Sathyamangalam. They were a hunter-gatherer tribe who practiced shifting cultivation till they were settled in hamlets, on lands allotted by the government. The Lingayats are temple priests who came here originally from Mysore. Lingayat families take turns to working in the temple once a year. Temple festivities draw about one million pilgrims every year, generating income opportunities for the Lingayat and Soliga families, in their wake. Non-timber forest products (NTFP) are also an essential source of income for both the communities.

Site selection and sampling

A systematic and synchronized study was taken in the study area of (Male Mahadeshwara Hills of Chamarajanagar district, Karnataka) during 2018-19. The study area consists of a total of eight villages spread inside and on the periphery of Male Mahadeshwara Hills. Kanchalli, Buddhipadga, Gundapura and Pacchhedoddi are four forest fringe villages, while Chikkamarur, Gorsane, Medaganane and Palar are villages inside the forest (Fig. 2). The study area is located at an average altitude of 914m

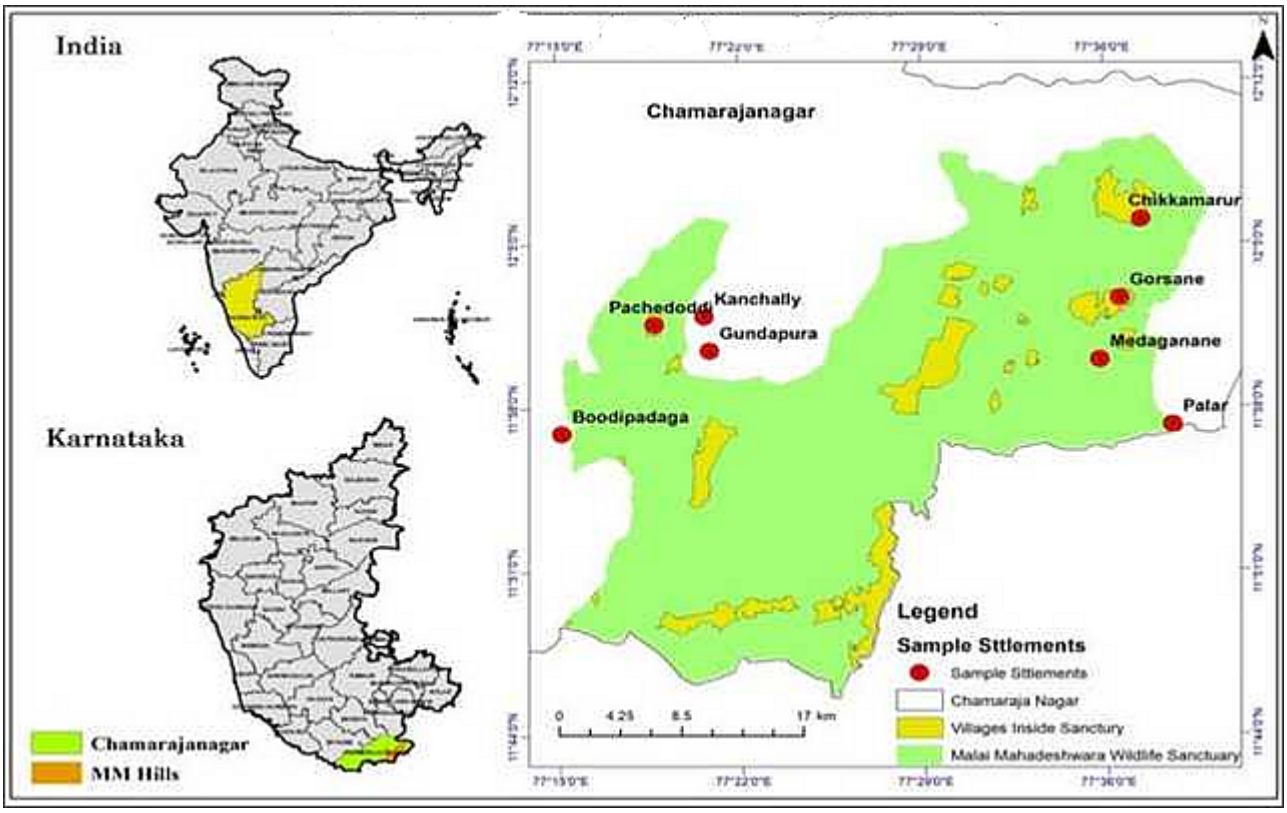

Figure 1. Study area and selected forest fringe villages

above mean sea level.

Method of data collection and analysis

A review of forest working plans and past taxonomic surveys of the region provided background information on the occurrence of wild fruit plants in the region. Fieldwork was done in two phases i.e., Household survey and Habitat survey. The fruit plant species were identified in consultation with local floras and by matching with authentic herbarium specimens. Also, field trips to each village were undertaken accompanied by local gatherers in order to identify and locate wild fruit plants and tally the local vernacular names of plants with their botanical names.

Household survey

A structured questionnaire was prepared, and oral interviews were conducted among the local inhabitants of the area. In-depth interviews were conducted with the people to gather information on practices like the season and frequency of collection, species preferred, attitude, and quantity of plants/ parts collected, consumed, or sold. Regular field visits were carried out in different seasons during the study period in villages and nearby forests to observe the phenological pattern of the wild edibles and market fluctuation in price. Gathering of wild edibles mostly done by the people of the region also by those who are engaged in marketing of the wild edibles.

Habitat survey

Quadrat studies were undertaken within the selected three forest ranges in MM Hills located near the villages, as villagers usually resort to harvesting wild edibles present in and around their locality. The forest has administrative units called Ranges. The selected ranges were divided into grids each of which was about 1.8 km in length. There was a total of total of 358 grids. Out of these, 180 grids were located in three ranges, and among them, habitat survey was carried out in 34 grids. Three quadrats for Phyto-sociological assessment were randomly laid in each grid following standard methods. The size of the

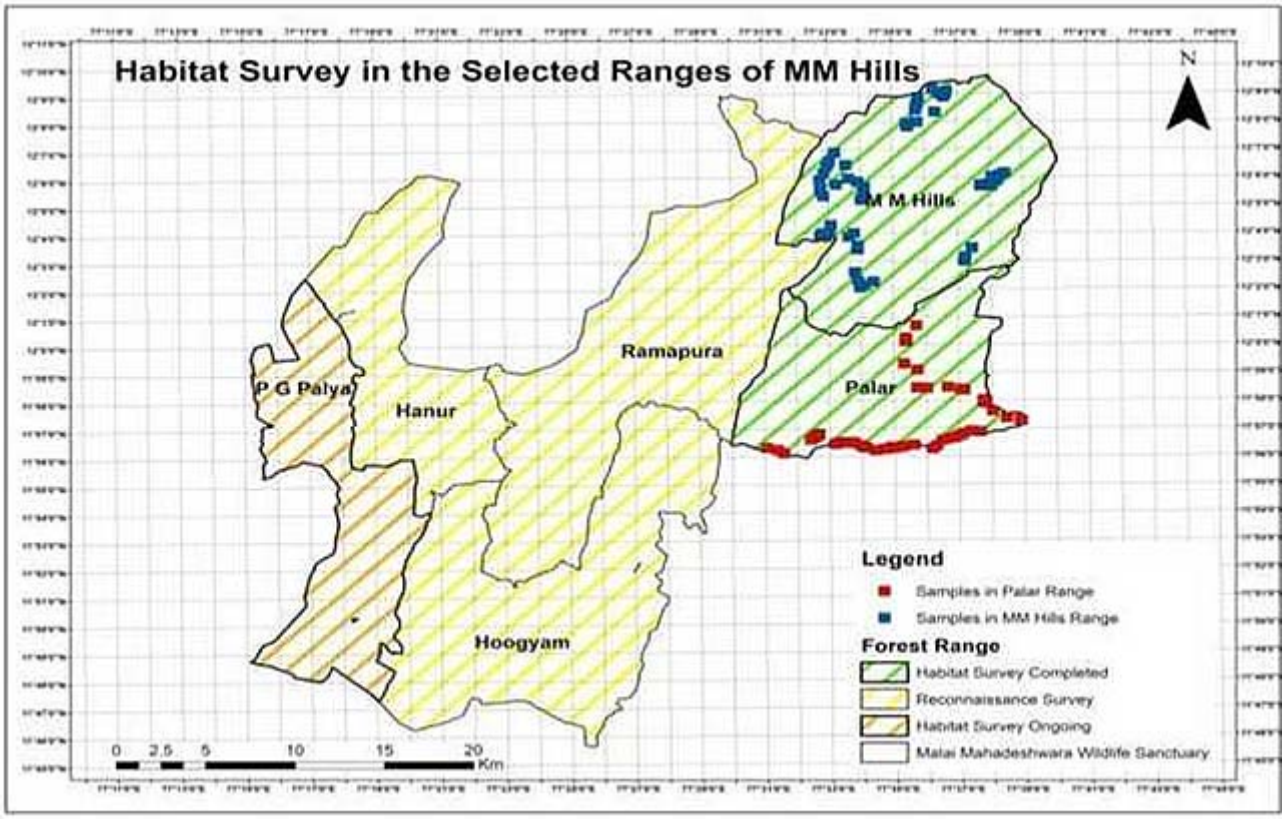

Figure 2. Habitat survey map of different forest ranges

quadrats was 1 × 1m for herbs, 5 × 5m for shrubs, and 10 × 10m for trees present in the study site.

VALUATION OF WILD EDIBLES

All information was collected with the help of forest watchers, who are in the employment of the Forest department and form the first rung of the Forest hierarchy. They are almost always drawn from the local population. Forest dwellers assisted in all the field visits. There are eight local markets for buying and selling of wild edibles. The prevailing market rates per kilogram of the value-added products were collected from collectors, local shopkeepers, middlemen, and buyers. After documentation and analysis of data thus collected for WEPs a comparison was made with similar products which are commercially sold in supermarkets to get an idea of the market potential of WEPs. A separate questionnaire was prepared to make this comparison.

Workshop on value addition

To provide a better overview to the farmers about methods of value addition and marketing of processed products a two-day workshop covering both theoretical and practical aspects of value addition to wild edibles was organized in association with the Central Food Technological Research Institute (CFTRI), Mysuru.

Several sessions were held aimed at hands-on demonstrations about modern food processing equipment like fruit pulper, fruit mill, dryer, slicer, grinder, etc., along with the methods to be followed Members were particularly interested in the practical aspect and were keen to gain expertise in the use of equipment for making pickles, lemon-honey juice, wood apple spread, amla candy, amla flakes etc. The workshop also covered theoretical aspects of raw materials quality, and maturity standards, processing and packaging of value-added products. Future technological development in the marketing sector also formed a part of the workshop

The long term expected outcome of the training program is adoption of good practices by the community in value addition to traditional NTFPs enhancing their marketability and leading to better prices and overall economic development. It is expected that exposure to modern food processing practices would encourage the community to cultivate some of the species which have a better market demand but were so far only being sourced from the wild, with the attendant consequences of unsustainability. The people could become entrepreneurs rather than just casual labourers working for daily wages.

RESULTS

Diversity of wild edible plants

A total of 80 wild edible plants were documented. These wild edible plants included 35 species of trees belonging to 21 families, 14 species of shrubs belonging to 12 families, 15 species of herbs belonging to 9 families, 15 species of climbers belonging to 10 families and 1 species of algae. Trees and shrubs made up the highest proportion of edible wild fruit species. The maximum number of species belong to the family Amaranthaceae (6 species), followed by Dioscoreaceae (4 species) (Table 1).

Usages of wild edible plants

A range of usages of the WEPs have been documented for 79 species which include species under all the habits, viz.- tree, shrub, herb and climber (Table 2). Among those, fruits/flowers/seeds are used from 34 species, only leaves are used from 10 species, whereas 23 species are important for the use

Table 1. Number of wild edible plant species documented under different families in the study area

Family	Number of species	Habit
Rutaceae, Fabaceae, Poaceae	3 each	Tree
Moraceae, Combretaceae, Meliaceae, Anacardiaceae, Rhamnaceae, Ebenaceae, Moringaceae	2 each	Tree
Fabaceae, Solanaceae	2 each	Shrub
Amaranthaceae	6	Herb
Nyctaginaceae	2	Herb
Dioscoreaceae	4	Climber
Menispermaceae, Fabaceae	2 each	Climber

Table 2. List of wild eddible plants available in the study area

	Name of species	Family	Habit
Use of fruits/seeds/flowers			
1	*Artocarpus heterophyllus*	Moraceae	Tree
2	*Terminalia chebula*	Combretaceae	Tree
3	*Limonia acidissima*	Rutaceae	Tree
4	*Cordia wallichii*	Boraginaceae	Tree
5	*Acacia nilotica*	Fabaceae	Tree
6	*Cassine glauca*	Celasteraceae	Tree
7	*Magnifera indica*	Anacardaceae	Tree
8	*Naringi crenulata*	Rutaceae	Tree
9	*Terminalia bellirica*	Combretaceae	Tree
10	*Zizipus jujuba*	Rhamnaceae	Tree
11	*Grewia tiliaefolia*	Tiliaceae	Tree
12	*Ziziphus rugosa*	Ramnaceae	Tree
13	*Flacourtia indica*	Flacourtaceae	Tree
14	*Ficus glomerata*	Moraceae	Tree
15	*Schleichera oleosa*	Sapindaceae	Tree
16	*Tamarindus indica*	Fabaceae	Tree
17	*Buchanania latifolia*	Anacardaceae	Tree
18	*Phyllanthus emblica*	Phyllanthaceae	Tree
19	*Cordia wallichii*	Boraginaceae	Tree
20	*Scolopia crenata*	Flacourtaceae	Tree
21	*Quercus infectoria*	Fagaceae	Shrub
22	*Morus australis*	Moraceae	Shrub
23	*Ximenia americana*	Olacaceae	Shrub
24	*Acacia sinuata*	Fabaceae	Shrub
25	*Ziziphus xylopyrus*	Rhamnaceae	Shrub
26	*Solanum nigrum*	Solanaceae	Shrub
27	*Carissa carandas*	Apocyanaceae	Shrub
28	*Solanum anguivi*	Solanaceaee	Shrub
29	*Tephrosia purpurea*	Fabaceae	Herb
30	*Opuntia stricta*	Rutaceae	Herb
31	*Momordica charantia*	Cucurbitaceae	Climber
32	*Lablab purpureus*	Fabaceae	Climber
33	*Ziziphus oenoplia*	Rhamnaceae	Climber
34	*Pterolobium hexapetalum*	Fabaceae	Climber
Use of roots/tubers/rhizomes			
1	*Manihot esculenta*	Euphorbiaceae	Shrub
2	*Zingiber zerumbet*	Zingiberaceae	Herb
3	*Dioscorea esculenta*	Dioscoreaceae	Herb
4	*Ipomea batatas*	Convolvulaceae	Climber
5	*Dioscorea aculeata*	Dioscoreaceae	Climber
6	*Decalepis hamiltonii*	Apocyanaceae	Climber
7	*Dioscurea wallichii*	Dioscoreaceae	Climber
8	*Dioscorea* sp.	Dioscoreaceae	Climber
9	*Dioscorea aalata*	Dioscoreaceae	Climber

	Name of species	Family	Habit
Use of leaves			
1	*Toona ciliata*	Meliaceae	Tree
2	*Murraya koenigii*	Rutaceae	Tree
3	*Acacia farnesiana*	Fabaceae	Tree
4	*Albizia amara*	Fabaceae	Shrub
5	*Solanum indicum*	Solanaceae	Herb
6	*Celosia argentea*	Amaranthaceae	Herb
7	*Digera arvensis*	Amaranthaceae	Herb
8	*Alternanthera sessilis*	Amaranthaceae	Herb
9	*Cissus repens*	Vitaceae	Climber
10	*Holostemma annulare*	Asclepiadaceae	Climber
Use of multiple parts/whole plant			
1	*Wrightia tinctoria*	Apocyanaceae	Tree
2	*Diospyros melanoxylon*	Ebanaceae	Tree
3	*Erythroxylum monogynum*	Erythroxylacece	Tree
4	*Phoenix sylvestris*	Arecaceae	Tree
5	*Diospyros montana*	Ebanaceae	Tree
6	*Moringa concanensis*	Moringaceae	Tree
7	*Syzyzium cumini*	Myrtaceae	Tree
8	*Moringa oleifera*	Moringaceae	Tree
9	*Jasminum trichotomum*	Oleaceae	Shrub
10	*Sapindus laurifolia*	Sapindaceae	Shrub
11	*Canthium parviflorum*	Rubiaceae	Shrub
12	*Atalantia monophylla*	Rutaceae	Shrub
13	*Boerhavia diffusa*	Nyctaginaceae	Herb
14	*Cocculus hirsutus*	Menispermaceae	Herb
15	*Boerhavia repanda*	Nyctaginaceae	Herb
16	*Amaranthus caudatus*	Amaranthaceae	Herb
17	*Amaranthus spinosus*	Amaranthaceae	Herb
18	*Brassica rapa*	Cruciferaceae	Herb
19	*Amaranthus viridis*	Amaranthaceae	Herb
20	*Basella alba*	Basellaceae	Climber
21	*Toddalia asiatica*	Rutaceae	Climber
22	*Anredera vesicaria*	Menispermaceae	Climber
23	*Azadirachta indica*	Meliaceae	Tree
Use of shoots/bark/stems			
1	*Bambusa arundinacea*	Poaceae	Tree-like grass
2	*Bambusa bambos*	Poaceae	Tree-like grass
3	*Dendrocalamus strictus*	Poaceae	Tree-like grass

of multiple parts or whole plant. Fruits are principally consumed raw. Some important species from which fruits are consumed by the locals include *Phyllanthus emblic*a, *Tamarindus indica*, *Syzygium cumini*, *Limonia acidissima*, and *Artocarpus heterophyllus*. Products made from *Phoenix sylvestris* are well known throughout the world for their nutritional properties. Fruits like *Phyllanthus emblica* are preserved for months or even years in the form of a local preparation called murabba (local jam);

Table 3. Scale index of some important wild edible species

	Local Name	Scientific Name	Availability	Feasibility	Market Value	Total Average
1	Nerale Hannu	*Syzygium cumini*	5	8	8	7
2	Belada hannu	*Limonia acidissima*	4	6	7	5.6
3	Hunase hannu	*Tamarandus indica*	10	10	10	10
4	Halasinakaayi	*Artocarpus heterophyllus*	4	7	7	6
5	Limbe hannu	*Citrus limon*	4	7	8	6.3
6	NelliKaayi	*Phyllanthus emblica*	7	9	9	8.3
7	Drum stick	*Moringa oleifera*	3	8	9	6.6
8	Bidiru gala	*Bambusa bambos*	4	5	10	6.3
9	Ajjigida	*Asparagus racemosus*	5	4	8	5.6
10	Medikalugadde	*Curculigo orchioides*	7	4	8	6.3
11	Makali beru	*Decalepis hamiltonii*	1	4	9	4.6
12	Maavu	*Magnifera indica*	3	5	7	5
13	Ganake soppu	*Solanum indicum*	9	3	2	4.6
14	Kaulihannu	*Carissa carandas*	6	4	3	4.3
15	Eachalu	*Phoenix sylvestris*	5	5	3	4.3
16	Basale soppu	*Besella alba*	7	4	3	4.6
17	Genasu	*Dioscorea aculeata L*	4	6	6	5.3
18	Yelasihannu	*Zizipus jujuba*	4	6	4	4.6
19	Kari bevu	*Murraya koenigii*	2	5	8	5
20	Kambalihannu	*Morus australis*	3	7	9	6.3

**SCALE: 0-3 (POOR), 4-6 (AVERAGE), 7-10 (GOOD)*

Table 4. Cost-benefits analysis of 10 wild edibles prioritized for value addition

	Local name	Scientific name	Habit	Parts used	Products made	Cost of products (Rs)	Abundance
1	Nerale Hannu	*Syzygiumcumini*	Tree	Fruit	Juice	350/ 500ml	22.5
					Powder	85/100gm	
2	Beladahannu	*Limonia acidissima*	Tree	Fruit	Jam	80/450gm	24
					Powder	200/100gm	
3	Hunasehannu	*Tamarandus indica*	Tree	Fruit	Candy	150/400gm	20
					Juice	90/250ml	
					Sauce	45/200gm	
					Powder	200/100gm	
4	Halasinakaayi	*Artocarpus heterophyllus*	Tree	Fruit	Jam	160/300gm	27
					Chips	400/500gm	
5	Limbe hannu	*Citrus limon*	Tree	Fruit	Pickle	22/100gm	18
					Juice	70/250ml	
6	NelliKaayi	*Phyllanthus emblica*	Tree	Fruit	Flakes	195/200gm	45
					Candy	150/400gm	
					Juice	210/1000ml	
					Powder	60/100gm	
7	KouliHannu	*Carissa carandas*	Shrub	Fruit	Juice	400/500ml	18
					Pickle	200/500gm	
8	Bidiru gala	*Bambusa bambos*	Shrub	Young shoots	Pickle	125/100gm	123.75
					Canned	182/250gm	
9	Ajjigida	*Asparagus racemosus*	Herb	Root	Powder	200/100gm	18
10	Medikalu gadde	*Curculigo orchioides*	Herb	Tuber	Powder	210/100gm	450

whereas *Mangifera indica* fruits are also dried and used as pickles.

Many of the species have other uses, which include meeting the communities' needs for timber (*Toona ciliata*, *Erythroxylum monogynum*, *Syzygium cumini*, *Diospyrous montana*); fuelwood (*Acacia nilotica, Mangifera indica*); medicine (*Wrightia tinctoria, Canthium parviflorum, S. cumini, Flacourtia indica, Solanum anguivi*); Rhizomes (*Bambusa arundinacea*, *Dendrocalamus strictus)*

and cooking oil (*Schleichera oleosa*). *Mangifera indica* dried and powdered and used as a souring agent while *Terminalia chebula* and *Terminalia bellirica* were powdered and consumed mainly for their carminative properties. *Terminalia bellirica* is used as a medicinal traditional remedy; the seed of this plant is eaten by the local people for curing gastric problems and stomach disorders (Seal 2011). *Syzygium cumini* is used in Toothache (Sathyavati and Janardhanan 2011).

Assessment of fruit production and wastage of Wild edibles available in the study Area

The average annual fruit production per tree was calculated for some important wild edibles on the basis of local expertise and forest officials' estimation. The highest fruit - producing tree is tamarind (*Tamarindus indica*), bearing 300kg of fruits annually, followed by jamoon (*Syzygium cumini*) at 150 kg, edible shoot production in bamboos (*Bambusa arundinacea*) is the least at 6 kg

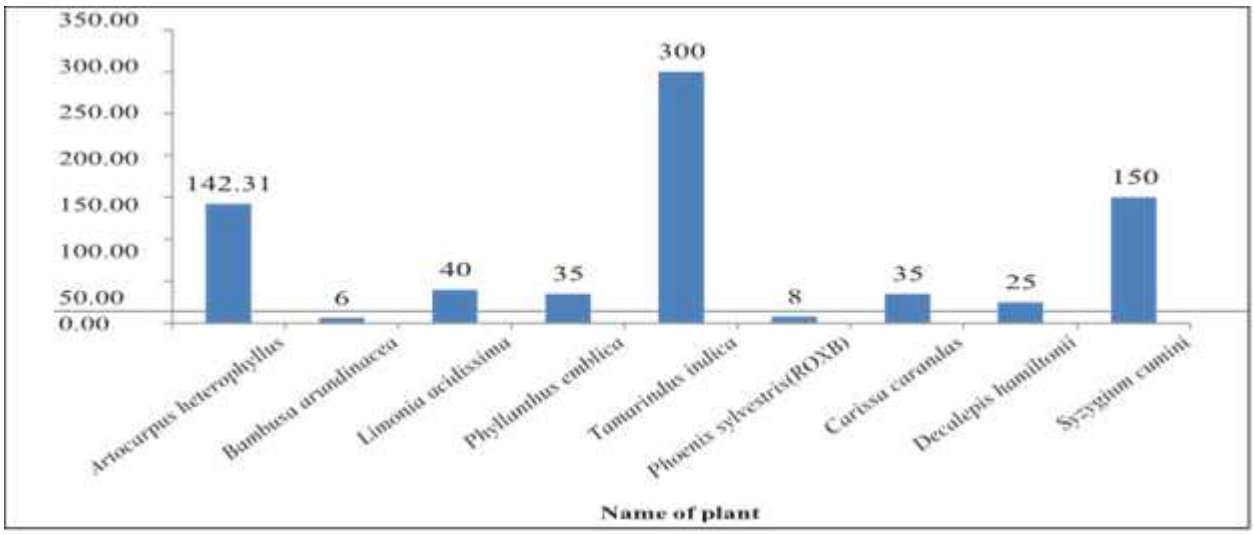

Figure 3. Average annual fruit production per tree of selected wild edibles of MM Hill

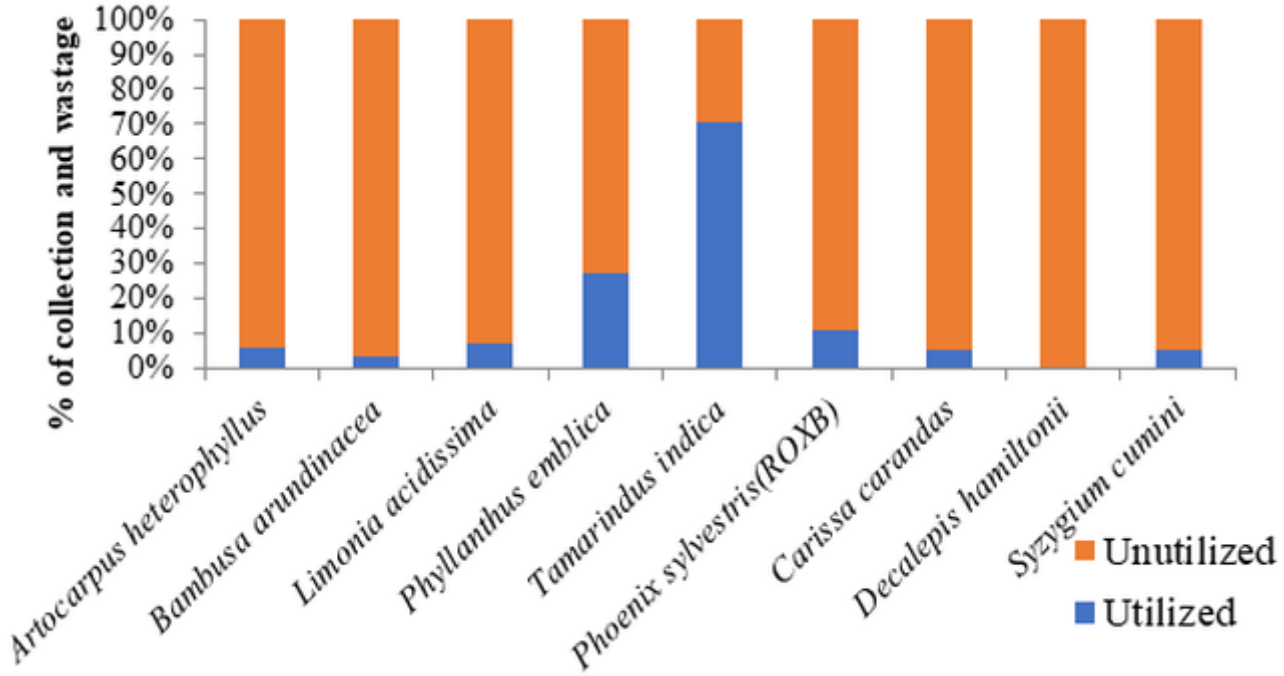

Figure 4. Utilized and unutilized wild edibles (as percentage of annual production) for selected species of MM Hills

of edible shoots annually (Fig. 3). Another important species *Phyllanthus emblica* has a yield of 35 kg per tree/annum.

A significant portion (75.03%) of the overall fruit production of all the nine selected wild edible plants was found to be wasted (Figure 4). The wastage was the highest (96%) in case of *Bambusa arundinacea*, which was followed by *Syzyzium cumini* (94.59%) and *Carissa carandas* (94.42%).

Following the workshop conducted for the local community on value addition of wild edibles and market linkages, a survey was conducted to assign an index of economic importance for 20 WEP species abundant in the study region. Villagers became aware about the scenario of the market for wild edibles and economic benefits of value-added products. Based on their feedback/perception, market survey and expert opinions, the index values obtained for the 20 species which is on a scale between 0-10 (Table 3). Among these, *Tamarandus indica*, *Phyllanthus emblica* and *Syzygium cumini* were found to have the highest potential for value addition. Further, ten wild edibles that could be prioritized for value addition based on the current study are mentioned in Table 4, which provides an overview of a simplified cost-benefit analysis.

According to some important criteria like ease of availability in the vicinity of the tribal people, the feasibility of WEP for making products, traditional knowledge among tribals of WEP from the past, ease of producing value added products, optimum abundance and density of WEP in the forest, good economic returns from the processed products we prioritized ten wild edibles for value addition and carried out a cost- benefit analysis. The results are presented in the Table 4.

DISCUSSION

During our field investigation and workshop, it was found that there are many wild fruit tree species yielding substantial quantities of fruits but not being utilized by the local people resulting in a net loss to the economy. The tribal community although interested in conserving and cultivating the wild edibles do not have the access to market for this perishable commodity. There is a need to educate them about the potential of WEPs to uplift their socio-economic status and equip them with the means to do so.

MM Hills is a rich storehouse of wild edibles. This was reflected by the fact that the use of most of the documented edible species were very low. Only four tree species (*Azadirachta indica, Murraya koenigii, Pavetta indica* and *Tamarindus indica*) and one shrub species (*Sapindus laurifolia*) have better use among the communities. Among these only *Tamarindus indica* found a position among the most abundant wild edibles in MM Hills. In other words, the locals did not utilize the most easily available plants and their preference was not determined by abundance. *Artocarpus heterophyllus* and *Tamarindus indica* was mostly traditionally utilized for self-consumption. In order to determine the reasons for preference towards certain wild foods and traditional vegetables, social, economic and cultural factors should be considered, because these might be more important than biological factors such as richness and abundance of wild edible flora (Pardo-de-Santayana et al. 2007). Household income, acculturation and previous experiences of food scarcity are important determinants that influence food knowledge and selection (Ong and Kim 2017).

There have been remarkable changes in lifestyles in the rural areas of these countries, which have severely affected the knowledge and customs associated with the utilization and management of most wild resources (Pardo-de-Santayana et al. 2007). The alterations in the pattern of the use of wild plants vary across different regions and are influenced by changes in lifestyle, urbanization, large-scale farming, extent of contact with nature and so on (Luczaj et al. 2012). The same is evident in MM Hills. Lack of knowledge and interest are the main reasons for this fact. This indicates that the local indigenous knowledge has not been properly handed down to the contemporary generation which in turn has led to the loss of interest in wild edible plants. In Ethiopia, the knowledge of wild food plants is transferred through songs, folklore, and riddles in local languages (Berihun and Molla 2017).

Apart from being a food source, wild edibles can also provide economic opportunities to supplement household income (Uprety et al. 2012). The locals of MM Hills were not properly aware of this aspect and thus, tend to overlook the importance of this

resource. Consequently, a major of the production of the wild edibles is not utilized. This is the wastage of a valuable natural resource of tremendous importance. Moreover, the most abundant wild edibles of MM Hills also have medicinal values, which makes them all the more important. Thus, these plants have the ability not only to provide food security, but also fulfil their health care needs. Therefore, awareness should be created among people so that they are encouraged to utilize the benefits of wild edible flora in a sustainable way.

In addition, initiatives should be taken to create markets so that the economic potential of this resource could be harnessed and used for the socio-economic upliftment. Simultaneously, steps should also be taken to train villagers about sustainable gathering and conserve the plants by preventing their over exploitation. This is because over exploitation of economically important species is caused by unsustainable harvesting and unhealthy competition to obtain more resources among gatherers (Uprety et al. 2012). In fact, the method of harvesting exerts a serious consequence on the survival of wild edible plants as well as ecology (Teklehaymanot and Giday 2010). Value addition of these plants could also provide tremendous benefits to the villagers in terms of deriving economic benefits through sustainable use of this natural resource. For this to be effective, proper hands-on training should be provided to the locals and an adequate system for access and benefit sharing should be designed so that wild edibles are properly and sustainably utilized without any ecological damage.

Wild food is an iconic and important ecosystem service (Schulp et al. 2014) and hence, must be conserved. For the sustainable management and use of wild edible fruits, ecosystem services, economic incentives, market innovations, and stakeholder synergies should be incorporated into their conservation strategies (Sardeshpande and Shackleton 2019). This is crucially important because wild edible resources can provide alternative livelihoods and thus can contribute to climate change resilience. If the potential of these resources is adequately harnessed, then these can increase the adaptive capacity, especially in the rural areas. In fact, the vulnerability of local communities to food insecurity is reduced by wild food resources, which provide a buffer in times of food shortage (Misra et al. 2008, N'danikou et al. 2011). However, in the study area, this resource is wasted rampantly.

CONCLUSION

Hunger and malnutrition are one of the most important factors contributing to extreme deprivation, globally. One way to overcome this deficiency is by not only including WEPs in the diet but also using processed WEPs for income augmentation. The present study showed that the indigenous knowledge on the use of WEPs is still available amongst the ethnic communities of the study zone. Conservation and promotion of this traditional knowledge, requires relevant interventions for management of the resource and its proper utilization. Lack of scientific understanding for the conservation of wild edibles coupled with restrictive forest policies for accessing them, makes the collection and utilization of these economically important species difficult for the communities resulting in wasting away of the resource. During our study period, it was noticed that the indigenous population has significantly shifted their livelihoods from wild edible collection to other agricultural and allied activities. We found that this area is endowed with an abundance of wild edibles that have the potential to sustain rural livelihoods but the people are deprived of harnessing it, especially because the area was declared as a wildlife sanctuary in 2013, which means that the local people do not have free access to these areas, unlike in the past. Thus there is a need for recognizing the potential that WEPs have, not only for nutritional security of the local community and as a means of income generation by value addition and marketing the products to consumers outside but also as an important tool to meet the larger goal of conservation of the habitat and adaptation to climate change.

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