

# TRADITIONAL ECOLOGICAL KNOWLEDGE (TEK) AND ITS IMPORTANCE IN SOUTH INDIA: PERSPECTIVE FROM LOCAL COMMUNITIES

HARISHA, R.P.<sup>1\*</sup> – PADMAVATHY, S.<sup>2</sup> – NAGARAJA, B.C.<sup>3</sup>

<sup>1</sup>*Ashoka Trust for Research in Ecology and the Environment (ATREE), Royal Enclave, Srirampura, Jakkur P.O., Bengaluru 560064, India*

<sup>2</sup>*Department of Botany, Nirmala College 641018, Coimbatore, India  
(phone: +04-22-222-3469; fax: +04-22-222-3222; email:rajpadmah@yahoo.com)*

<sup>3</sup>*Department of Environmental Sciences, Bangalore University 560056, Bangalore, India  
(phone: +91-80-2296-1365; fax: +91-80-2321-9295; email:nagenvi@gmail.com)*

*\*Corresponding author*

*email: hari@atree.org; phone: +91-80-2363-5555; fax: +91-80-2353-0070*

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**Abstract.** The study throws light on the challenges and complexities in the protection and promotion of Traditional Ecological Knowledge (TEK) in a semi-arid tropical forest area of South India. The community perception was used to examine the TEK patterns, drivers of change, and the components and interrelations of human well-being. Appropriate data was collected through semi-structured, open-ended questionnaire method and focus group discussions in eight villages. The study revealed that the TEK is playing a vital role in the livelihoods of local people in the study area. Regrettably, the present trend of drivers such as modernization, policy interventions, threat from invasive species, migration and occupation change, had a greater impact on TEK and pertinent traditional practices than ever before. An evaluation of the connections between TEK and components of human well-being showed that both the change in TEK and the drivers of change, affects six basic needs of human well-being of the local communities. The study has developed a conceptual framework, which will help to detect and minimize the drivers of change in TEK. The study outcome also helps policy makers and forest functionaries to manage the forest in sustainable manner by incorporating TEK.

**Keywords:** *Traditional Ecological Knowledge, human well-being, wild resources, MM Hills, South India*

## Introduction

Across the world, Traditional Ecological Knowledge (TEK) is well- recognized and defined as an intellectual activity in a wide range of social, cultural, and environmental contexts (Reyes-Garcia et al., 2006). Many researchers also define TEK as a design of people centered approach (MEA, 2005); practice and innovations that are distinctively associated with many indigenous communities by customary laws (Pieroni et al., 2011); a cultural heritage of the society which preserves and transmits between generations (Cocks, 2006). In the developing world, TEK is a key element of the social capital to produce food (Agea et al., 2012), health (Lockett et al., 2000) and in shaping local visions and perceptions of the environment and society (Sheil et al., 2006). Moreover, local TEK and management practices can provide ecosystem services and helps in understanding socio-ecological and adaptive management systems (FAO,

2014). In India too, TEK is a vital source to deal with health problems, food security, socio-cultural practices, environment and biodiversity conservation (Gadgil et al., 2000). Unfortunately, in many developing countries, TEK and its values are not accounted in the economic analysis of natural resources (Shackleton, 2003).

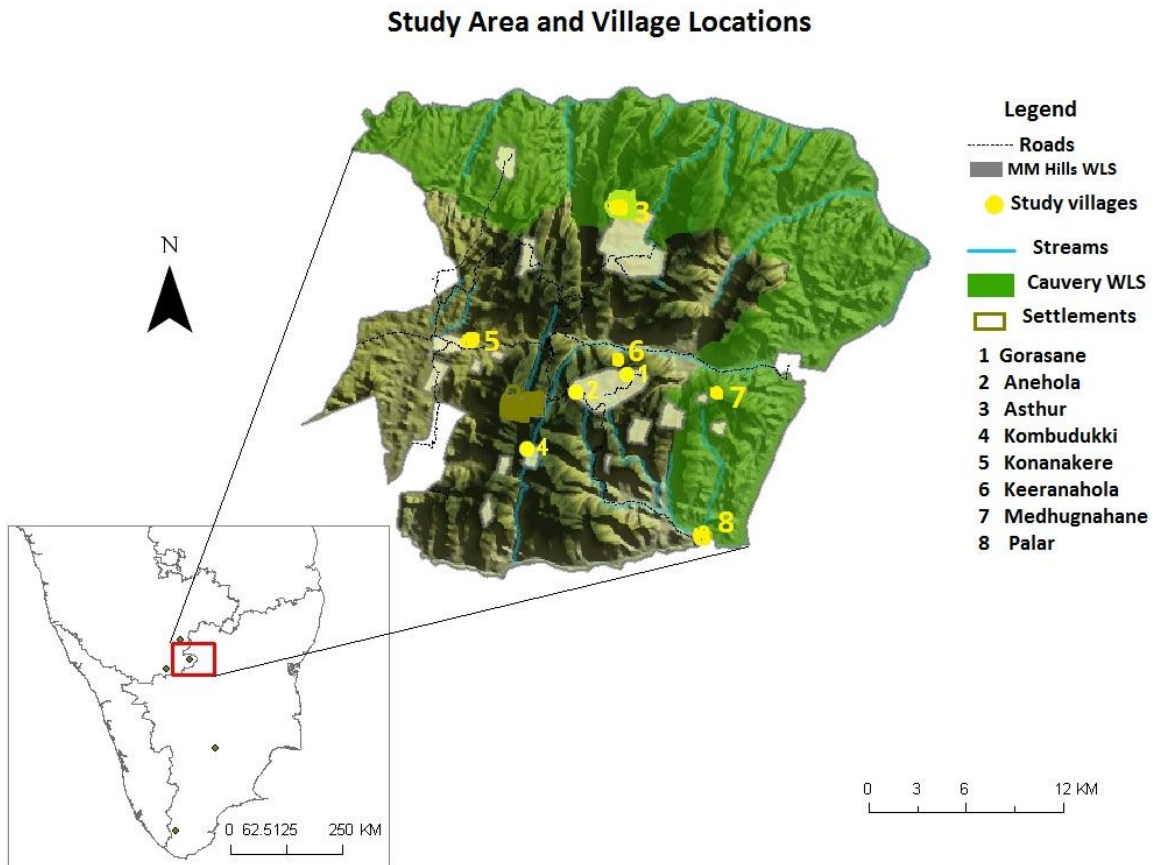
The globally growing recognition plays an important role in the link between TEK and sustainable development, however not much linkages were developed at national levels. The India's policies such as Biological Diversity Act, 2002; Forest Rights Act, 2006 and Intellectual Property Rights have been emerging for possessing TEK and sharing benefits to local community. The Traditional Knowledge Digital Library (TKDL) in India, which aspire a document to protect and promote TEK and indigenous cultural practices. Lots of effort has been made at the national and international level to document, protect, and promote TEK. But very little impact has been seen at the ground level (Pathak, 2000; Kalpavriksh, 2008).

In the study area, there are two dominant communities, namely, the Soliga and the Lingayat who are habituated to the forested landscape of Malai Madeswara (MM) Hills of South India. TEK has been a vital part of their food, medicine, culture, and ethnic practices from many generations, which led to harmony with nature (Harisha et al., 2013). Uma Shaanker et al., 2004 emphasizes that such practices are an important social activity which helps to define the participants' cultural identity and provides a link to their history, ancestors land and environmental philosophy. Moreover, quite a number of plants and animal species are significantly a symbol of culture (Gadgil and Guha, 1995; Madegowda, 2009). At the same time local people are in turmoil by the multiple rules and regulations on wild resources which are also a major reason for the change in TEK (Rao, 2003). The study aims to examine the importance of TEK in terms of local community dependency on wild plant resources; to understand drivers of change on TEK and, the role of policy tools in revitalization of TEK in the region.

## Materials and Methods

### *Study area*

The study was conducted in MM Hills Wildlife Sanctuary, located in Chamarajanagara district of Karnataka in south India, it lies between latitudes 12° 13' and 11° 55' N, and longitudes 77° 30' and 77° 47' E (*Figure 1*). This wildlife sanctuary connects the Cauvery Wildlife Sanctuary, at North-east, and the Biligiri Ranganath Swamy Temple (BRT) Tiger Reserve, at South-west (*Figure 1*). It receives rain from the South-west monsoon between May-August and from the North-east monsoon between September-November. The average annual rainfall is 920mm. Summer is usually dry from mid-March until May where the mercury level often rises to more than 40°C. The Sanctuary covers an area of 291 km<sup>2</sup> and has undulating terrain landscape and mosaic habitat, rich in plant diversity and comprises of different types of vegetation such as dry deciduous forest (64.34%), scrub woodland (20.50%), and scattered patches of moist deciduous and riparian forest (2.47%) (Champion and Sheth, 1967).



**Figure 1.** Study area and village locations

There are 31 villages scattered in and around sanctuary. These villages exert tremendous pressure on the forest for agriculture, non-timber forest produce (NTFP) and fuel wood collection, grazing, stone quarry, tourism and other developmental activities (Aravind et al., 2010; Harisha et al., 2013). The tribal communities were practicing shifting cultivation prior to 1901 and are now settled in different hamlets which were notified as revenue land in 1913 (Kollegal Forest Division Management Plan, 2000). They are also known for their rich traditional knowledge linked to their natural surroundings. The Lingayat migrated to MM Hills around 600 years ago from the plain areas of Mysore district and were mainly brought in as local priests. Though, they were brought here as priests, they depended on agriculture for their livelihood. Both the communities practice rain-fed farming in which they grow finger millet (*Eleusine coracana*) and hyacinth bean (*Dolichos lablab*) as subsistence crops, and jowar (*Sorghum vulgare*), maize (*Zea mays*), and sunflower (*Helianthus annus*) as cash crops. They also depend on NTFPs, stone quarries, and livestock for their alternative source of livelihood (Uma Shaanker et al., 2004).

### *Selection of study villages*

The eight villages coming within the sanctuary were selected based on socio-economic profile of the households, proximity to the forest and extent of forest dependency. Previous project database and recommendations were also referred to select the villages (CLP, 2011). The participatory rural appraisal, focal group interview and household survey were conducted using standard methods (Mukherjee, 1993).

### *Data collection*

The data was collected in three phases, viz. semi-structured interviews with knowledgeable individuals; open-ended questionnaire interviews with general public, and focus group discussion with village people. The relevant qualitative and quantitative data was collected from January 2012 to March 2014. Wild plants resources related to TEK were collected through a semi-structured questionnaire with two knowledgeable individuals from each study village. This included information on habitat, purpose of use, available season, and part(s) of plant used (*Appendix 1*). Prior informed consent was obtained from the participants in each village to re-examine the free list data on wild plants related to drivers that adversely affect wild plants resources. Each interview was also audio-taped; so as to maintain an exact record for future reference. The wild plants used by local people were identified with the help of local flora (Gamble, 1957) and were reconfirmed with the herbarium repository at Foundation for Revitalization of Local Health Traditions (FRLHT), Bangalore. The same were given a code and were preserved in ATREE field station.

A total of 184 household in eight villages were chosen for survey (Newing et al., 2011). From each study village 23 (10% of the total population) household were selected for the interview by considering the participants profile such as gender, age, education and occupation (*Table 1*). During the interviews, vernacular names and photos of the wild plants were used along with questionnaire to avoid confusion. The interviews were focused on wild plants known, distribution, usage, availability, perception on use of TEK and impact of policy interventions (*Appendices 2 & 3*).

**Table 1.** Population profile of the participants in the study site (N=184)

Population profile	Characteristics of the population profile	Number of participants from	
		Soliga	Lingayat
<b>Gender</b>	Male	46	46
	Female	46	46
<b>Education level</b>	No schooling	63	51
	Primary school	18	21
	Middle school	7	12
	High school	3	6
	College	1	2

<b>Occupation</b>	student	4	7
	Housewife	25	17
	Farmer	21	19
	Government employ	4	4
	Business	1	6
	Others(labor work in stone quarry, coffee estate and construction)	37	39
	<b>Age class</b>	Under 20	6
Between 21 to 30		16	14
Between 31 to 40		17	18
Between 41 to 50		16	15
Between 51 to 60		17	15
Over 61		20	20

Focus group discussions were conducted in all the eight villages with the participation of all household members. The reasons for change, and the challenges presented in the revitalization of TEK were discussed. During group discussion the village people responses on various forest and conservation policies were also discussed. Secondary information was also collected from the Forest Department, Statistical Department and revenue offices of Karnataka on implementation of policies and wild resource management. Both qualitative and quantitative data was tabulated on the Excel sheet. Later, the PAST software and Excel sheet were used to evaluate the data on drivers of change and the relation between TEK and the components of human well-being.

## Results

### *Traditional Ecological Knowledge on Wild Plants Resources*

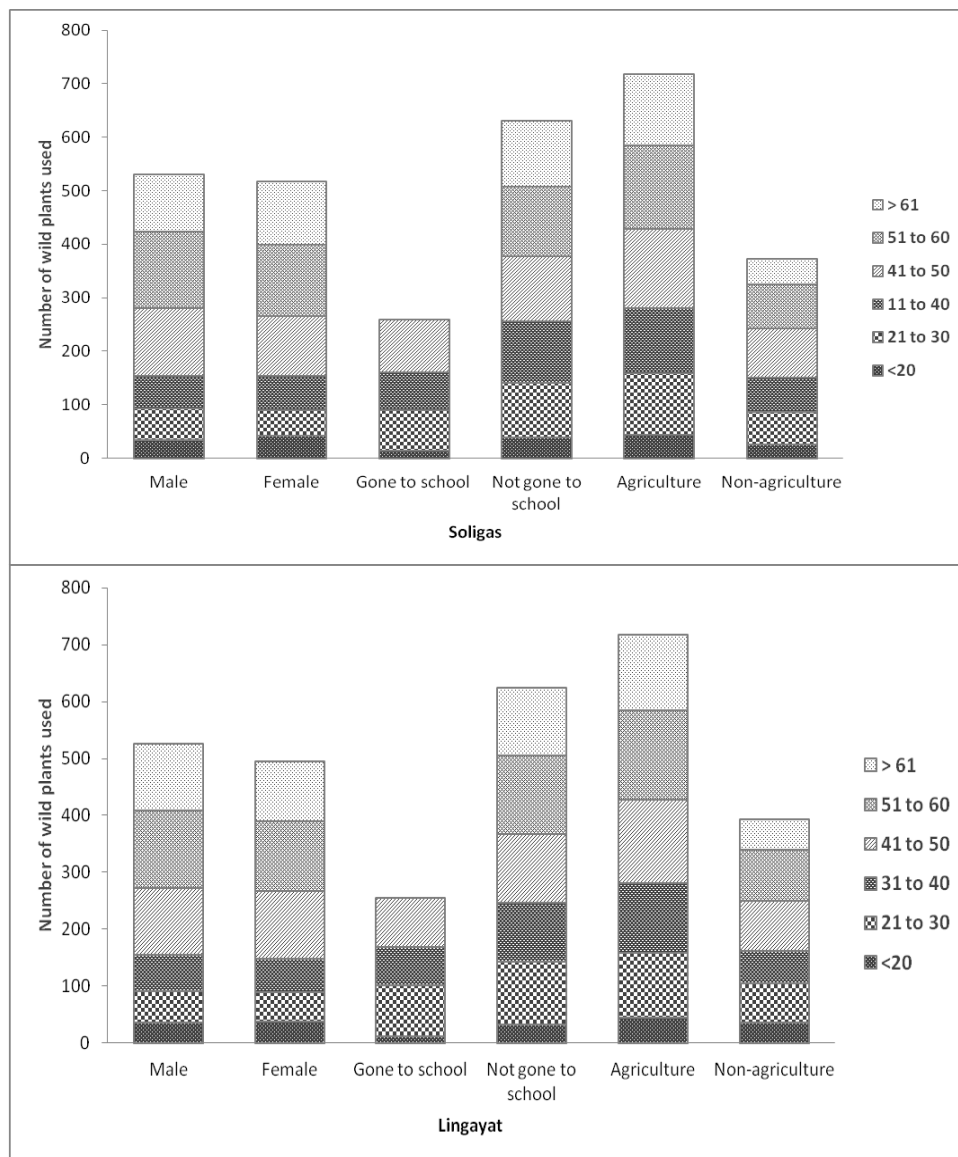
The results of the study revealed that, 96 wild edible plants, 118 medicinal plants and 26 plants are culturally important, 14 plants are economically important in the study area (Table 2). Following the TEK, wild plants are mainly identified by their bark, leaf shape and smell. Out of 96 wild edible plants, 68 plants were collected in rainy season, 14 in winter and 14 in summer season respectively. A total of 96 plant parts were collected of which 43 plants as leaves, 38 as fruits, 10 as tubers, 8 as bark and stem and 5 as flowers (Appendix 2). Around 70% of plants were processed through sun-drying and 30% of plants through shadow-drying. They are used in combination of different plants' parts or along with food. Aromatic leaves and smoke are used to preserve the wild plants.

The survey also revealed that 92% of plants known, collection, processing, preparation and prescription are widely shared across communities. However, there is a significant difference in TEK on usage of wild plants across age class (68%), and gender (32.6%). There is also a significant difference in TEK on usage of wild plants between educated and

non-educated people (38.5%) as well as farming and non-farming households (41.6%) in both the communities (*Figure 2*).

**Table 2.** Purpose of the collection of Wild plants and consumption (N=184)

According to Millennium Ecosystem Assessment (2005)	Components of human well-being	Number of plant species collected	Percentage of households use
“Basic material for a good life”	Food	96	94
	Income	14	68
“Good health”	Medicinal use	118	79
“Freedom of choice and action”	Cultural reasons	26	92
“Good social relations with other”	Social implications	18	89



**Figure 2.** Number of wild plants used by age class (N=184)

### The major drivers of change in TEK

Five major drivers such as modernization (developmental activities, change in lifestyle, and food habit), policy intervention and social welfare schemes, invasive and forest degradation, migration and occupation change were identified as the main causes for changes in TEK.

#### Modernization

The results of the survey revealed that developmental activities such as infrastructure, communication technologies, and exposure to the rest of the world are the major indirect drivers of perceived changes in TEK. Other major reasons for lack of concern with TEK were also examined by the survey. The study quantified the percentage of people response in terms of average and standard deviation. The study revealed that about  $89.5 \pm 2.3\%$  people expressed that communication gap between younger and older generation is the potential reason for the flow of the knowledge. Lifestyle change ( $84.5 \pm 1.8\%$  of people) and change in food habit ( $71.0 \pm 3.6\%$  of people) were the major reasons for declining of TEK (Figure 3). Moreover, in the minds of the younger generation, the use of wild plants results in a loss of respect in the society ( $44.5 \pm 4.4\%$ ), which is a sign of shame ( $29.5 \pm 2.4\%$ ), and poverty ( $51.0 \pm 2.9\%$ ).

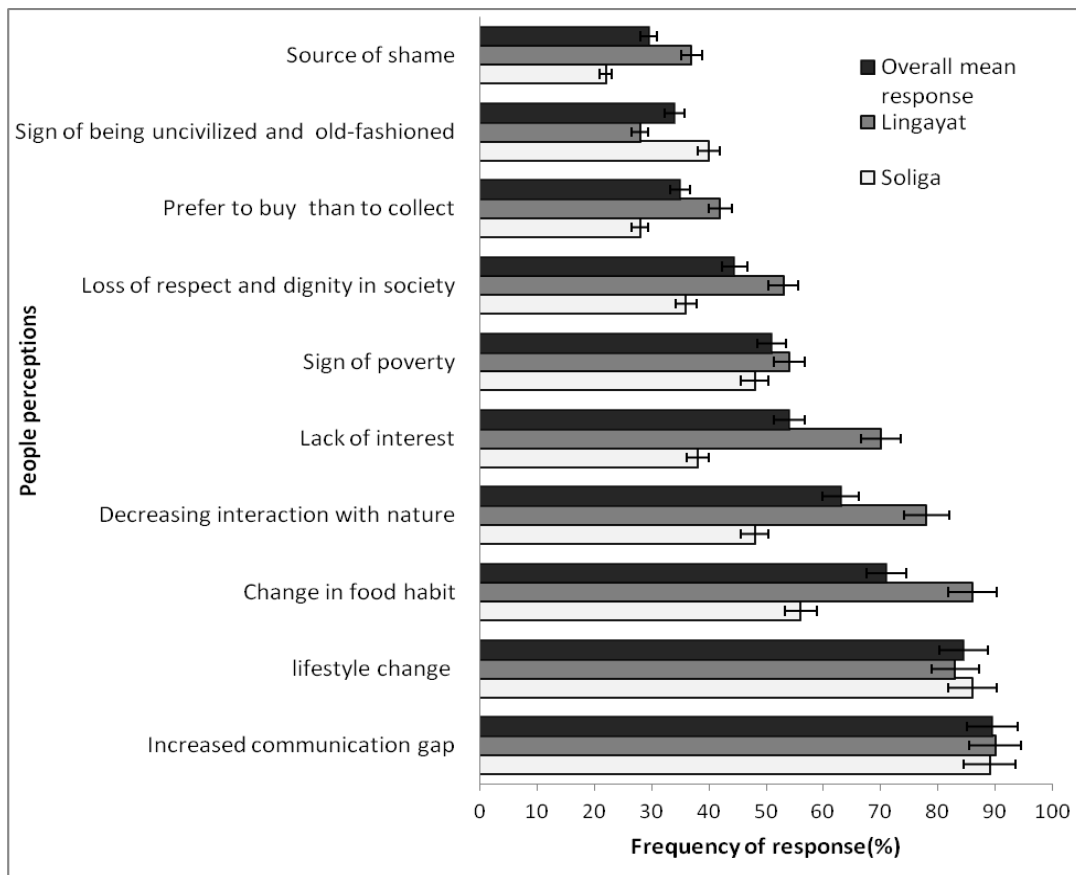


Figure 3. People perceptions on use of TEK (N=184)

### *Policy intervention*

In the study area, the local people's responses on the imposition of various policies were recorded. The people were greatly opposed to The Indian Forest Act, 1927, The Wildlife Protection Act, 1972, Forest Conservation Act, 1980, and the Declaration of Wildlife Sanctuary, 2013, which had affected their livelihood rights and undervalued their TEK. However, they were positive in their response towards the Joint Forest Management 1990, the Biological Diversity Act, 2002, and the Forest Rights Act, 2006 (*Table 3*).

**Table 3.** Community responses on policy interventions (n=184)

<b>Indian forest resource use and rights policy</b>	<b>Negative responses</b>	<b>Positive responses</b>	<b>Not aware</b>
The Indian forest Act 1927	89	11	84
The Wildlife protection act 1972	175	5	4
Forest (Conservation) Act, 1980	153	8	22
Joint Forest Management initiatives 1990	19	145	20
Biological Diversity Act, 2002	4	86	94
Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006	4	178	2
Declaration of WLS in 2013	154	17	13

### *Invasive species*

During the interviews, the local people stated that there was absolutely no *lantana* in three decades back. Now it has colonized all over the forest and hardly any food and medicinal herbs are growing besides *lantana*. Because of *lantana* invasion 10 species of grass, 9 wild vegetable plants, and 13 medicinal plants have become rare and hard to find them close to human settlements. One of the old age (85 years) tribal soliga man said that 5 medicinal herbs were frequently used to treat common fever, cold and cough in olden days, has disappeared now in the forest. He added that high proliferation capacity and adaptability of *lantana* has resulted in the loss of wild resources and related TEK, which are a vital part of self-sustenance.

### *Migration and Occupation change*

The survey shows that migration has increased in all the villages since 2001 (*Table 4*). This situation leads to the migration of 85% of younger people to cities seeking employment. Consequently, 40% of farmers have been shifted from forest and farm-based livelihoods to urban and urban-based livelihoods. The change of occupation has resulted in



less interaction with surrounding forest and less time to interact with elders leading to knowledge gap between younger and elder people. Thus, the current trend is towards a decline of TEK and changes in traditional lifestyle and diet.

**Table 4.** Percentage of migration from villages in the years 2001&2011

Name of the village	Percentage of migration in the years	
	2001	2011
Keeranahola	3.8	5.3
Gorasane	5.4	8.2
Medugnahane	7.6	15.2
Anehola	4.5	6.3
Kombudukki	2.5	3.9
Asthur	1.8	2.8
Konanakere	3.8	5.9
Palar	4.5	5.5

Source: Indian statistical department 2011

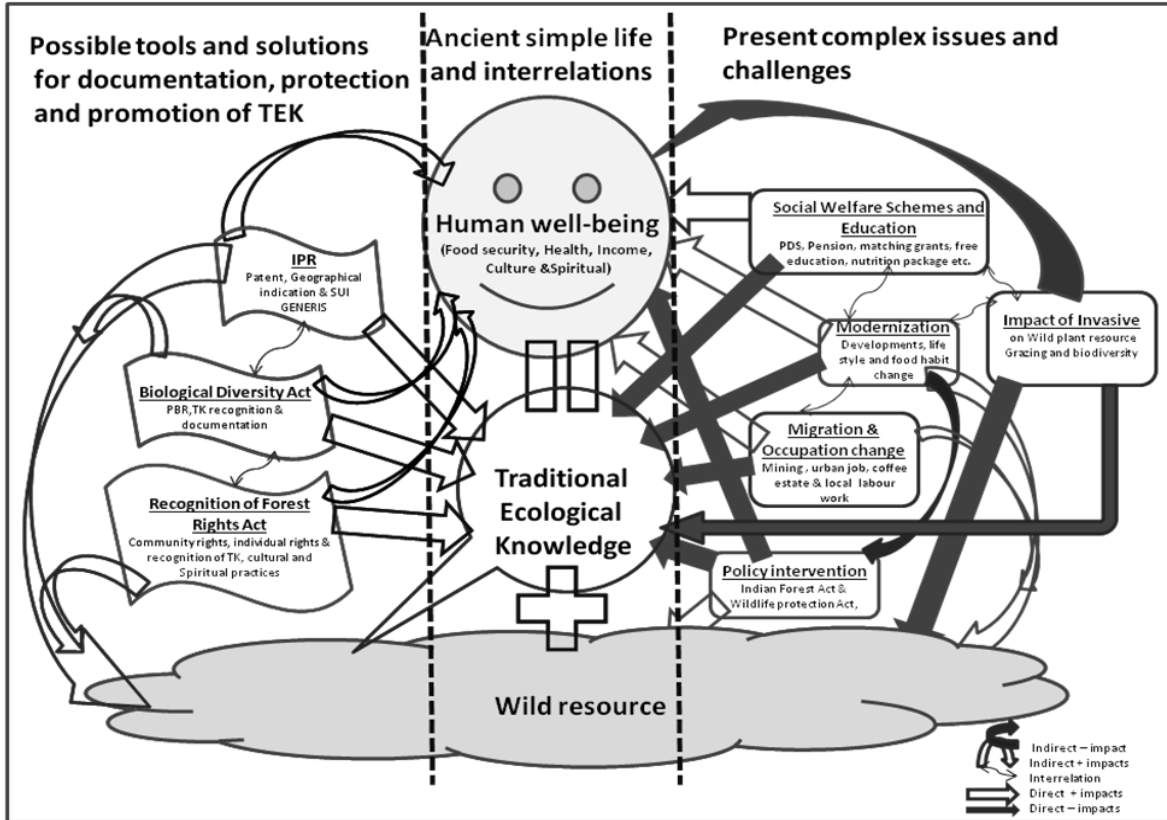
### ***Relation between TEK and components of human well-being***

The outcome of the focus group discussion shows that local communities collect wild plants essentially to meet their basic needs such as food, medicine for good health, income for good life, cultural and spiritual reasons for identity and pride. Irrespective of their wealth, 94% of the households in the local communities have been collecting 96 types of wild edible plants and using them as food throughout the year. About 68% of the households earn an income from 14 wild plants seasonally. Nearly 79% of the households still use 118 plants species as medicine, while the rest of them rely on allopathic medicine. Most of the households strongly believe and use wild plants for cultural (26 plant species) reasons. About 18 wild plants have been used to improve neighborhood relationship, as a sign of clan relation, as a sign of hierarchy and as a blessing material and gift to younger people during marriage (Table 2).

### ***Conceptual framework for fortification of TEK***

Until the neoliberal era, rural people had a simple linear integrated life with available natural resources and were satisfied with minimum components of human well-being. The bare minimums were fulfilled by natural resources using TEK, which had been passed through generations (Figure 4, central part). After liberalization and privatization, TEK was opened up to the global market, making an impact on rural livelihoods that became inter-reliant and complex (Figure 4, left side). At present, local people are enmeshed in developmental activities, regulatory policies, resources depletion, and modernization. These

factors are affecting their linear connectivity between natural resources and human well-being. Moreover, the above factors are affecting directly and indirectly on TEK and components of human well-being (*Figure 4*, right side).



*Figure 4. Conceptual framework for the revival of TEK*

## Discussion

### *Traditional Ecological Knowledge on wild plant resources*

The TEK is at risk of deterioration due to the impact of occupation change, education, and communication gap between elders and younger generation (Harisha, 2011). These directly cause changes in the components of human well-being in the study site. Researchers argue that TEK is a key element in sustainable development (Shrestha and Dhillion, 2006; Malhotra, 2001; Kumari, 2003; Andanda, 2012); it also offers solutions to problems arising due to globalization and changes in components of human well-being (CBD, 2003a; MEA, 2005; Pieroni et al., 2011). Many studies also suggest that TEK is progressively seen more as an efficient and viable tool for tackling forest sustainability by involving the local communities (Gadgil et al., 2000; Apte and Kothari, 2000; Pathak, N., 2009). Despite its crucial importance, efforts in conserving and promoting TEK at the ground level are still an imagination.

## ***Drivers of change in TEK***

### *Modernization*

Change in TEK is well- documented across the world, especially after globalization (Shackleton et al., 2003; Rao, 2003; Puri et al., 2004). This affects the development of good social relations which in turn affects the freedom of choice, values attached to wild resources as well as changes in the traditional land use system in a dry land ecosystem for example converting agriculture fields into fallow land, stone quarry, and commercial plantations. In addition, the changes in land use system can directly cause a decline in TEK in terms of use and conservation of wild resources. Change in the consumption behavior for example, what, when, and how much people consume. The awareness on land, resources, embedded knowledge, and traditional practices are declining especially in young generation. Change in food habit, health services and intrusion of technologies in agriculture, processing and preservation of domestic items in the name of modernization has changed the dependency of forest resources. The developmental activities and tourism has direct effect on biodiversity. It also affects indirectly on biodiversity-dependent ecosystem processes and services, which strongly influence the livelihoods of local communities (Cetinkaya, 2009).

### *Policy interventions*

In India, many policies concerning to natural resource management systems and conservation strategies are separating local people from their environments (Pathak, 2000; Kothari, 2013). Moreover, these policies fail to address the linkages between the local people and their TEK with ecosystem functioning, development, and human well-being (Sheil et al., 2006; Kalpavriksh, 2008). Similar experiences were reported from Africa and Southeast Asian countries (UNEP, 2013). After realizing the problem, they tried to rectify it by inclusive forest conservation policies, which recognizes and provides space for local people to participate and TEK to be incorporated in resource management. For example, under Joint Forest Management initiative, every house hold adult members are the member of Village Forest Committee (VFCs). It provides people to use forest resources and responsibility to conserve and manage the forest resources around the village. Similarly, Biological Diversity Act, 2002 provides people to document the local knowledge in People's Biodiversity Register (PBR) and decision making power on benefit sharing. Moreover, Forest Rights Act, 2006 gives legal rights to land and access forest resources across protected and non-protected forest areas.

The people are directly involved in the process and are aware of the benefits which they get from these inclusive policies. Whereas, the policies such as The Indian Forest Act 1927, The Wildlife Protection Act 1972 and Forest (Conservation) Act, 1980 excluded local people participation and resource use. From this people are well aware on the impact of their livelihoods. Therefore, people expressed that these policies affect their livelihoods.

The study revealed that policies which integrate and recognize local knowledge systems (scientific and indigenous) are vital for the conservation and management of natural resources. Effective implementation of such policies through local institutions is crucial and is the best tool to recognize the voice of the local people. It would greatly help in

maintaining ownership and transparency, in achieving holistic strategies to work cohesively for long-term sustainability in the region. Paying attention to the linkages and knowledge systems which exist between local communities and the government would be the best practice to successfully address the needs of the local communities and to achieve goals of sustainability in ecosystem management. At the same time, they were equally disappointed about the unsuccessful implementation of inclusive policies, since it proved to be misguided, misused, and created confusion among the local communities and other stakeholders who had eagerly anticipated justice in the study area.

### *Invasive species*

The forests have been used for wild edible, medicinal, timber, non-timber products, grazing and recreation among others for centuries. The interrelations between wild plant resources and TEK have been recorded in many studies across the world (Reyes-Garcia et al., 2006; Agea et al., 2012; Shackleton, 2003; MEA, 2005; Gadgil et al., 2000; FAO, 2014). Magnified use of natural forest during recent times has resulted in extensive loss of forest cover, which is dominated by weedy species such as *Lantana camara* (Ramakrishna, 2001). *Lantana camara* is a major invasive species, which badly affects the native plants by covering 75% of the forest and 80% of fallow land in the study area (Aravind et al., 2010). As a result, many wild plants which are important for food and medicine for local people are disappearing. In turn, knowledge related to wild plant use is disappearing. It is essential to study the level of decrease in TK related to wild plant resources and the impacts of lantana on wild plants resources.

### *Migration and occupation change*

The phenomenon of migration has brought several changes in the villages and communities. The major reason for this is the lack of employment opportunities in the study site (Harisha et al., 2013). According to MEA 2005, migration can adversely affect the components of good social relation and freedom of choice. When community dependency on wild plants is less, then it decreases interest in conservation and management and then youth population were attracted by outside market forces. On the other hand, developmentalists argue that migration and occupation change exposes younger people to learn new skills and acquire modern knowledge, which offers new livelihood opportunities and challenges, and helps them cope with the modern lifestyle (Vargas et al., 2008; Vinayagum, 2009).

The drivers which are discussed in the results clearly indicate the decline of TEK, traditional practices, and diet systems in the study area. In addition, the result gives us a sense that the social, economic and population dimensions (three fundamental components of sustainable development in terms of natural resource management) of the dry land ecosystems which have been neglected over the years. Consequently, social and cultural changes have occurred in the selected sites due to the indicated drivers. Thus, the changing attitude towards the use of TEK and components of human well-being needs to be considered in the agenda of sustainable development.

### ***Relation between TEK and components of human well-being***

The result supports the argument that wild plant resources and TEK is not just about subsistence and sustenance for the local people but it is more about healthy interrelations between biophysical, social systems, and customary values, which are deep-rooted in them (Jain, 1991; Pathak, 2000; Negi and Gadgil, 2006). The proportion of households which are using TEK system which have changed to modern system (changes in lifestyle, food habit, and occupation change) are 50:50. These deviations have both positive and negative effects on the components of human well-being and the ecosystem, which are strongly inter-related to each other. Therefore, TEK and related practices are the instruments for promoting cohesion between the ecosystem and human well-being. TEK is a tool for designing the framework and implementing it at the ground.

### ***Conceptual framework for fortification of TEK***

The conceptual framework ultimately emphasizes linkages and some of the possible ways to resolve the existing conditions and confusion. It highlights the retrieving of TEK system through the provisions provided in the inclusive policies at the national level, and is indicated globally in the CBD, MDGs, and MEAs. At present, there are three policy tools such as the Biological Diversity Act, 2002, Forest Rights Act, 2006, and the legal framework of the Intellectual Property Rights (IPR) Act. These can be used to discuss the ways in which TEK can be protected and promoted in the study area.

### **Implications**

The perceived change in TEK in the era of modernization and globalization is unfortunate. As it has an important role to play in biodiversity conservation and sustainability in an era of global climate change. Nevertheless, it is underestimated and not recognized in any of the conservation and sustainability issues. It is neglected in economic assessment at the state and national level. Numerous studies reveals that local knowledge derived from long-term nature-society interactions have been extremely useful in validating scientific hypothesis and suggesting new research directions. The combined potential of TEK and scientific knowledge should be harnessed to enhance the environment and human well-being.

Therefore, there is an essential need for empowerment and self-motivation among local communities, in understanding the status and scope of TEK in bio-resource management. Recognizing the customary values and determining the concept of knowledge ownership would be beneficial in benefit-sharing. For example, “the Jeevani (Aarogyapachha)” and decision-making process which would result in designing local tools to protect TEK based on customary laws and practices. Mechanisms for incorporating local knowledge into regional specific policy should be developed. The participation of local people and their knowledge in the process of sustainable development should be recognized and widely used. The TEK research community should undertake more studies at national or sub-national or regional level to evolve framework for TEK policy.

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## **ELECTRONIC APPENDICES**

***Appendix 1:*** Free list-wild plant resource

***Appendix 2:*** TEK on wild plant resources

***Appendix 3:*** Community perception

***Appendix 4:*** Questionnaire