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Traditional Ecological Knowledge and Community Based Biodiversity Conservation in Eastern Himalayas: Learning with *Monpa* Tribe

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ABSTRACT

The present socio-environmental research is based on conventional and participatory research observations. It demonstrates the dynamics of traditional ecological knowledge (TEK) of using *paisang* (*Quercus griffithii*) trees' leaves in cultivation of indigenous crops under rainfed agroecosystem. Research highlights the role of community in conservation of forest species and agrobiodiversity by the *Monpa* community in the West Kameng district of Arunachal Pradesh, eastern Himalaya. A study area was selected purposively while respondents were selected randomly from Dinarng West Kameng district. Results indicated that for *Monpa* community, local cultures, traditional values and beliefs, social and ethical norms tied with local ecosystems and are the essence of their social capital. For economically poor people living in remote areas, the TEK and their strong cultural capital plays a pivotal role in conservation of *paisang* tree and indigenous agrobiodiversity. The indigenous agrobiodiversity are conserved under rainfed conditions and varying microecosystems for the subsistence survival. *Monpa* have rich and diverse socio-cultural, economic and spiritual perceptions about *paisang* and its related landscapes. The diverse knowledge systems about *paisang* trees biodiversity and location specific microecosystems significantly help in management practices pertaining to conserve the indigenous agrobiodiversity, thus help in fulfilling the food and nutritional security of *Monpa*. The strong cultural ethics and social capitals governed through the traditional institutions are still in vogue and valuable property of *Monpa* which contribute to the livelihood system and subsistence survival in rainfed ecosystem.

Traditional ecological knowledge (TEK) is a body of knowledge built-up by a group of people through generations of living in close contact with nature. It includes a system of classification, a set of empirical observations about the local environment, and a system of self-management that governs resource use (Berkes, *et al*., 2000 and Turner, *et al*., 2003). The quantity and quality of TEK varies among community members, depending upon gender, age, social status, intellectual capability and profession (Singh, 2004 and Singh and Sureja, 2006a,b). The importance of TEK in the conservation of biodiversity has been recognized by many scientists working on ethnobiological knowledge and learning (Turner, 2005 and Berkes, 2009). It has been considered as a most significant resource for the conservation and monitoring, and understanding of ecological processes in resource management (Posey 1999, Berkes *et al.* 2000, Long and Zhou 2001 and Pretty 2003). It is emphasized that TEK needs to be analyzed and understood at inter and intra scale level so that appropriate management practices that build on both scientific and local knowledge may be developed (Berkes and Folke 2002; Ramakrishnan, 2007).

Conservation of biodiversity and other natural resources in Arunachal Pradesh over a long period of time has been possible because of the rich TEK known and practiced by the diverse tribal communities. The TEK of these communities and related social institutions have guided their relationships with accesses and

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sustainable conservation of natural resources (Singh 2004, Singh and Sureja 2006a,b; Ramakrishnan, 2007). The local community of state use TEK for conservation of biodiversity and other natural resources for their food security and nutrition, and subsistence survival in mountain ecosystems of Arunachal Pradesh (Singh *et al*., 2009). However, the TEK and its related practices of state communities are under threat due to the changes in socio-political systems and ecological dynamics (Singh and Shrivastava, 2009). Despite the richness of TEK among tribal communities, such knowledge is often neglected in research agendas, being regarded either as insufficiently 'scientific' or not relevant to modern 'development', especially by the state government officials (Singh and Sureja 2006a,b and Ramakrishnan, 2007). Maintaining effective and sustainable ecosystems for the future will require greater scientific respect for, and enhanced collaboration with, those who possess the wisdom of generations of locally-based farming and resource conservation (Singh *et al*. 2009).

Looking to the importance of TEK in biodiversity conservation by local community, the present study was carried out in Arunachal Pradesh to learn with *Monpa* community about conservation system of *paisnag* tree and use of this tree in conservation of indigenous agrobiodiversity.

METHODOLOGY

With 26 major communities, 110 ethnic groups and hotspot of unique biodiversity, Arunachal Pradesh is considered one of the best socio-ecological regions of India. In this state still majorities of local tribes have their own customary rights over use and management of natural resources (Mibang and Choudhuri 2004; Singh and Sureja, 2006a,b). Rich social capitals and collective action maintained by traditional institutions to govern access and conserve the natural resources, are unique features and make these regions different from rest of the Indian communities. The types of resources and their access pattern highly vary due to the vast diversities in ecosystems, climate, traditional communication and ecoculture (Singh, 2007). The high degree of dependency on natural resources is primarily determined by the types of ecosystems.

Arunachal Pradesh is divided into 16 administrative districts of which West Kameng district is well known for its temperate and sub-temperate climatic ecosystems. The Bomdila subdivision of the West Kameng district is divided into three circles: Dirang, Bomdila and Thembang. These circles are predominantly inhabited by the *Monpa* tribe, who are followers of Buddhists religion and have close cultural and religious affinities with the Bhutanese. The economy of the *Monpa* is basically agrarian and rural. The people practice both permanent and some extent shifting (*jhum*) types of cultivation practices. The major crops cultivated by *Monpa* community are: maize, paddy, millets, buckwheat, wheat, barley, soybean, French bean, chilies, potato, cabbage, cauliflower and apples.

The Dirang circle was selected purposively from West Kameng district. To carry out this study, 10 villages were selected purposively from Dirang circle based on the degree of ethnicity, types of agriculture, remoteness, forest cover and extent of dependency of *Monpa* community on their local natural resources. From each village, 12 farmers (6 men and 6 women, thus totaling 120) each over 50 years were selected randomly from a list provided by the *Gaon Burha* (Customary Chief) and Anchal Samithi Member (ASM). Looking to the nature of study, qualitative approach of research was chosen to learn with local farmers regarding how they use, perceive, conserve and value the environment and natural resources based on their years of experiences (Huntington, 2000; Reyes-Garcia *et al*., 2003 and Berkes and Berkes, 2009). The qualitative approach of learning with respondents allowed the researcher to discover the means and considering the choice of methods for this study.

In this study, we adopted a number of anthropological and ethnographical tools such as interviews, case history, life histories and direct observations to explore relationships between *Monpa*'s TEK and *paisang* (*Quercus griffithii*) conservation in relation to agrobiodiversity maintenance through use of dry leaves of *paisang*. Tools of PRA like transect walk, focus group discussions, resource-flow map and seasonal calendar were also exercised to ascertain the use pattern of natural resources at village level. These tools also helped in knowing the historical events related to *paisang* trees use in the study areas. Personal interview method with open-ended questions was applied to the PRA tools to have the qualitative information about the ethical aspects of ecosystem and conservation of *paisang* trees and indigenous agrobiodiversity. The micro-ecosystems were determined using framework developed by Singh and Shamra, 2004 with slight modifications in indicators. The ethics of farmers towards conservation of *paisnag* trees was defined as the set of positive moral attachment and belief towards cultivation, rearing and saving the trees of *paisang*. This definition is supported with ethical definition of ethics given by Small et al., 2005. Ethics was quantified using guidelines of Small *et al*., 2005 by

assigning score 3 for high, 2 for moderate, 1 for low and 0 for no ethics. The ethical statements towards conservation of *paisang* trees were identified in an open ended session in the study areas where community leaders (5), *Gaon Burha* (4) and knowledgeable farmers (10) participated for discussions. The cultural perception of respondents towards *paisang*'s conservation was quantified using guidelines developed by Reyes-Garcia *et al*., 2003 with the use of self framed original statements. A score of 3 for high degree of positive response, 2 for moderate, 1 for low degree and 0 for negligible degree of response were assigned. A reverse score was done in case of negative response received from respondents. Socio-ecological system was defined using concept given by Berkes and Berkes, 2009. It was defined as the degree of interconnectedness and complexity of *Monpa* community with varying microecosystems (MESs). The basic parameter to create variability and identify different socioecological systems in relation to *paisang* trees conservation was altitude. Using descriptive statistics and 'Z' test the inference from study has been drawn.

RESULTS AND DISCUSSION

1. *Paisang* in agroecosystem management

A key finding of the research was the high importance of the leaves of *paisang* (oak, *Quercus griffithii*) in enhancing agricultural crops, as a major organic manure and mulch for a range of indigenous crops in the rainfed zone. Anthropological enquiry indicates that formerly, poorer *Monpa* people who did not own any *paisang* trees would customarily go to the village *Zamindar* (landlord) to purchase dry *pasiang* leaves. In payment, the purchaser had to give one bottle of *rakshi* (a fine quality local beer prepared from indigenous barley/finger millet/ maize processed through distillation).

In Namsu village of Dirang circle, before anyone is allowed to collect *pasiang* leaves, the oldest *paisang* tree (> 100 years) is worshiped. All the villagers participate in this *puja* (spiritual function) and offer milk, fruits and other food to the spirit of the tree. This spiritual practice is evolved to avoid conflict and to promote an equitable sharing of dry leaves of *paisang* among the users. The women collect dry *paisang* leaves from their private and community's *paisang* groves. The leaves are then stored in the agricultural fields in specially made bamboo structures. Later on, these leaves are used as mulch and organic manure to cultivate more than 32 local crops, fruits and vegetables. Some of the crops are maize, soybean, wheat, barley, apple, chilli, cucurbits, finger millets, foxtail millets, beans, rice, etc.

There have been some changes in the way the dry leaves of *paisang* are processed and used. In earlier times, until the 1980s, the leaves were piled tightly and left until the onset of the rains. With the rains, the leaves start to decompose. Partial decomposition is indicated by the secretion of a reddish liquid from bottom of the piled leaves. At this stage, the leaves were considered ready to apply to maize and other local crops. More recently, now the dry leaves of *paisang* are used directly after being collected (as an organic mulch on newly sown maize seeds), without partial decomposition. In some of the villages, such as Namsu and Thembang, *Monpa* people try to construct their houses close to *paisang* trees to ensure a steady and convenient supply of the leaves. Thus, in the *Namsu* valley, the cultural landscape is integrated with the *paisang* trees, which provide an ample source of organic compost. This "green manure" is applied as an eco-friendly input for local crops, including the commercially cultivated *solu* (local chili pepper). *Solu* is cultivated in the Namsu valley and is processed (used fresh, matured or boiled in an immature state) and marketed (Rs. 60-70/kg fresh, Rs. 100-120/kg matured and Rs. 150-200 immature boiled) in both West Kameng and Tawang districts. Thus, it provides a good amount and stable source of income to the local farmers.

2. Community-based paisang forest management

At the village level, the communities divide the *paisang* forests between them with stone markers. Each village has access to a minimum of three types of *paisang* forest: private, community and government-reserved. The villagers themselves manage their *paisang* groves, called *mang-permang*. Each *Monpa* member is expected to follow the rule established by village elders and *Chhopa* (informal rural social institutions) concerning the date for collecting their *paisang* leaves. Violating this rule invites a fine imposed by the village *Chhopa* leaded BY *Gaon Burha* (customary chief of village). For illegal cutting of one *paisang* tree, a fine of Rs 500 [originally payments in *kongpu* (finger millet), wheat and silver coins were made] is imposed by the *Gaon Burha* or *Thummi* (a village where the GB post does not exist or is vacant, villagers select an experienced person as GB, and called the *Thummi*).

Paisang trees are valued not only for the application of their leaves in agriculture but also as high-quality firewood and as a material for making traditional plough-shares. Optimum leaf yield is obtained after the tree reaches 6-7 years of age. Fifteen- to 20-year-old *paisang* trees are coppiced (*chutatu*) to improve leaf

production. When the trees are coppiced, a plant parasite called *seng alla* (*Loranthus* sp., mistletoe) is also removed. The collection of dry *paisang* leaves starts in November-December. In the case of private *paisang* groves, harvesters wishing to collect the leaves must pay Rs. 200-250 per year as a royalty to the owner of tree. If a leaf harvester is not able to pay the royalty in rupees, as an alternative, he has to work for three or four days in the agricultural fields of the *paisang* grove owner.

Farmers suggested that the present size of their private *paisang* groves should be expanded by an average of 5 acres to meet growing agricultural needs and they are interested in the conservation of *paisang* in the community forest groves. As a means of ceremonial protection and conservation of *paisang*, as well as of pine trees (*Pinus wallichiana* and *Pinus roxburghii*) and local crops, the *Monpa* villagers celebrate a famous festival, *chheskaran*, during the month of March, said to protect these resources from insect pests and other evils. This festival reflects considerable cultural and spiritual importance that the *Monpa* accord to biodiversity conservation, over and above any commercial benefits. The use of *paisang* leaves thus not only helps to meet the needs of agricultural production but also plays a pivotal role in managing and sustaining the ecosystem.

3. Micro-ecosystems, paisang leaves and conservation of location specific indigenous crops

In different landscapes, indigenous crops are selected and cultivated according to the fertility gradient, type of soil and the demands of local ethnic groups. Great variation exists in the selection of crops to be grown due to the diversity in ecological edges and variations in topography, soil texture, colour of soil, depth of soil, moisture holding capacity of soil and percentage of organic matter present in the soils. Based on the variability in these factors (Singh and Sharma, 2004), three major micro-ecosystems (MES) were found in which indigenous crops species (Fig. 1) are conserved using dry leaves of *paisang* tree. In MES-1, total 33 crops species could be observed which are conserved using *paisang* leaves followed by 22 and 15 corps species in MES-2 and MES-3, respectively (Fig.1).

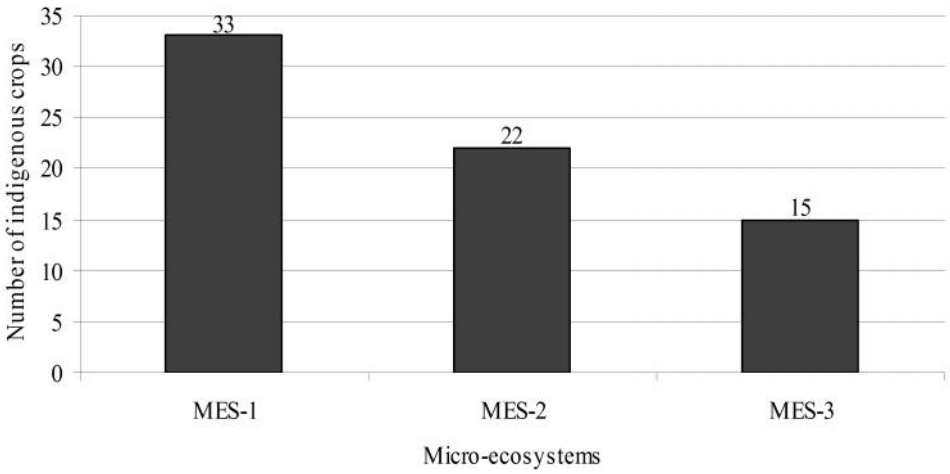

Fig. 1. Conservation of indigenous crops species in varying micro-ecosystems using *paisang* leaves
MES = Micro-ecosystem

For such ecosystems, unique informal experimentation is maintained by the *Monpa* tribe, which seems to be scientific in approach. For example, inter cropping and mixed cropping of *bathua* (*Chenopodium album* L.) with buckwheat is done in the shallow black to brown soil in sloppy land under rainfed situations (MES-1). In such situations, leaves of *paisang* are used as mulch to conserve the soil moisture, maintain the soil temperature and optimum plant population. The seeds of *bathua* are eaten after roasting while the leaves are used as a green vegetable. Similarly, in the “V” shaped Namsu valley (MES-2), famous for cultivation of *solu* (local chili), slope and fertility gradients are defined with reference to crop production and *paisang* leaves use level. Soil with a moderate percentage of sand and high per cent of organic matter (15-20 %) is chosen for *solu* cultivation where more amount of *paisang* leaves is applied. While, the surrounding areas rich in silt per cent (20-30) are planted with local rice with fewer amounts of *paisang* leaves, and the upper stream where gravel

and stones predominate is chosen for cultivation of finger millet but *paisang* leaves are used here in manure form. Under the soil which is very hard and land is highly undulating with more per cent of gravels (25-30%) and less depth of soil crust [(< 5 cm) (MES-3)], farmers cultivate local land races of buckwheat. In MES-3, the maintenance of mixed cropping of finger millet with *bundagmo* (*Amaranthus*) and maize with the help of *paisang* tree leaves are popular. Thus, the role of *paisang* tree leaves in conserving indigenous agrobiodiversity is tremendous. It can be said that *paisang* tree is backbone of indigenous agriculture systems and maintenance of micro ecosystems.

4. Gender and conservation of *paisang* trees and crops species

The role of gender and their contribution in biodiversity conservation are clearly demarcated and known in *Monpa* community. Result depicts that, in management of seedling of *paisang*, methods of traditional healthcare practices of plant, identifying the harvest and leaf-fall stage, leaf collection technique, leaf storage methods, preparing the manure from leaves, using the leaves as mulch and manure and knowledge in celebrating the *paisang* related ceremonies are more sound and higher in women than the men (Fig. 2). Empirical enquiry indicates that the conserved crops

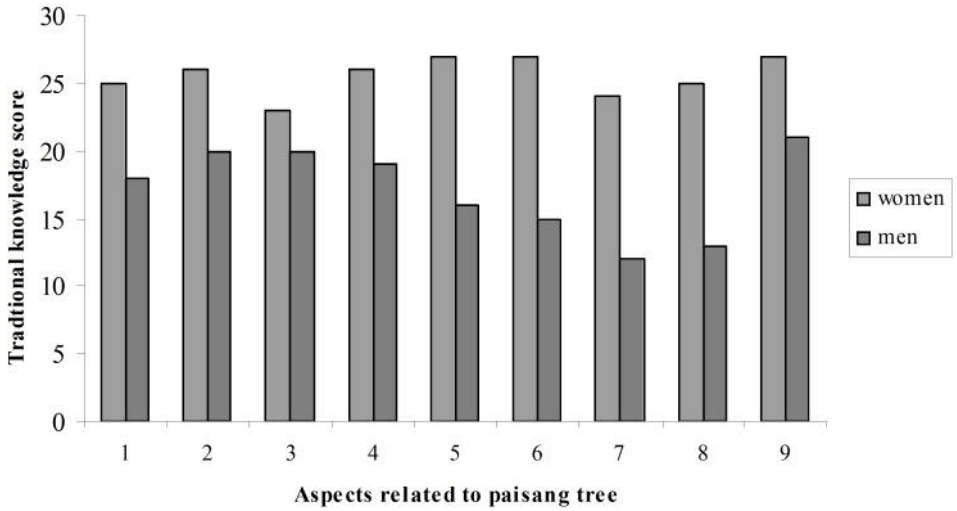

Fig. 2 Variability in traditional knowledge of men and women related to paisang

1= Seedling management, 2=Planting methods, 3= Trees healthcare & management, 4= Leaf-fall stage, 5= Leaf collection technique, 6= Leaf storage Methods, 7= Preparing the manure from leaves, 8= Leaves use in mulch & manure, 9= Knowledge in celebrating the paisang related ceremonies

species through the *paisang* trees needs further assistance and incentives on farmers' part to sustain the knowledge, ecosystem and biodiversity. Women were observed to have more opinion in terms of percentage for various dimensions of conservation of indigenous crops species (Fig. 3). They demanded number of incentives to keep continue the system of conservation. It is globally acknowledged and empirically tested that women posses more cultural and traditional knowledge about the local biodiversity use and their management practices than the male gender, nevertheless, they have neither been given proper incentives/benefits nor their creativity and knowledge has been formally incorporated in biodiversity research and policy matters (Possey, 1999, Laird, 2002; Turner 2005, Singh and Singh, *et al*., 2009).

5. Cultural perception towards conservation of paisang trees

Further, the cultural perception associated with *paisang* trees was quantified to understand the gender-based perceptional variability (Table 1). The mean score reveals that there was difference in perception of men and women about each statement. And this difference was significant (<0.01> probability level). As the 'Z' value indicates, for every listed statement, female were having high degree of positive perception towards conservation of *paisang* trees than men. Overall, women were significantly (<0.01> probability level) better in perception towards conservation of *paisang* trees than men ('Z' value of 6.37). This difference might be on account of

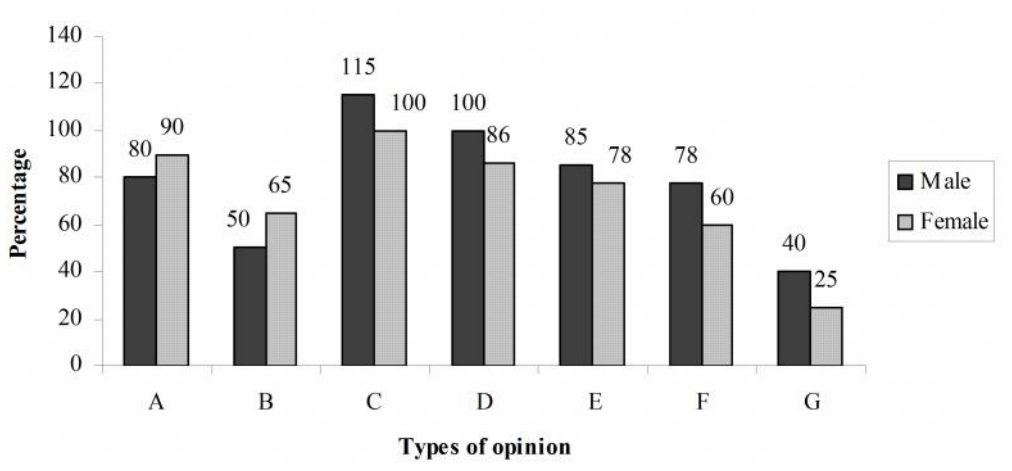

Fig. 3. Gender opinion about the indigenously conserved crops' species

* The figures in percentage shown against each content is multiple response

A= Conservation through village seed bank, B= Conservation through group approach, C= Promotion of food products based on endangered crops species, D= Incentive to the farmers from government side, E= Protection of IPR in community's name, F= Equitable benefit share over indigenous genetic resources of crops, G= Acknowledgement to the farmers in research and development

the gendered variability in degree of cultural ethics and variations in the altitude and social systems associated with biodiversity and livelihood (Singh *et al*., 2009 and Singh and Shrivastava, 2009).

6. Size of land holdings, ethics, and diversity in socioecological systems and conservation of *paisang* trees

The investigation reveled that percentage of land holdings required for conservation of *paisang* trees was more with the small and medium farmers (Fig. 4). This is because these groups of farmers have very less dependency on marketed fertilizers for maintaining agriculture and securing livelihoods as compared to large farmers (Fig. 4).. It means that with small land holding, small and marginal farmers are more concerned for conservation of *paisnag* trees population and thereby they secure the cultivation of local crops species under rainfed MESs.

Table 1. Cultural perception towards conservation of *paisang* trees

Statements	Mean score of perception		
	Male (n1=60)	Female (n2=60)	'Z' value
Paisang tree leaves are important for the conservation of indigenous crops species	2.51	3.00	5.27**
Paisang tree leaves are important for the cultivation of indigenous crops species under rainfed situations	1.23	2.48	4.98**
Paisang trees are culturally important and attached with belief systems of *Monpa* community	1.90	3.00	5.65**
Paisang trees are important for the fire wood	1.50	2.90	6.86**
Paisang trees are important for maintaining the ecological edges	1.35	2.39	4.96**
Paisang trees are historical property of *Monpa* community	1.41	2.48	6.19**
Paisang trees are symbols of cultural heritage of *Monpa* community	1.27	2.80	5.21**

By using the dry leaves of *paisang* tree, per unit cost of cultivation for various crops is minimized significantly	1.56	2.65	7.87**
Paisang trees are important for ecofriendly management practices in agriculture and overall ecosystems management	1.64	2.78	6.43**
Cultivation packages and livelihood systems of *Monpa* are tied with the traditional ways of using *paisang* tree leaves	1.69	2.50	7.28**
'Z' value for overall aspects	6.37**		

*= Significant at 0.05 per cent probability level **= Significant at 0.01 per cent probability level

Empirical data revealed that in general, women had more stronger cultural ethics than men in relation to conservation and use of *paisang* in both remote and transitional villages (Fig. 5). This variability occurs with the changing socio-ecological systems (altitude) of villages even in both genders. People (men and women both) living in remote socio-ecological systems at medium altitude (6000-7000 feets MSL) were having high degree of cultural ethics associated with conserving the *paisang* trees than the people living in transitional social systems and lower altitude [(5000-6000 feets MSL) (Fig. 5)]. It is a clear indication that though women may be marginal in economic terms but are rich cultural ethics to conserve the *paisang* trees, thus, maintaining the agroecosystem. These trends infer that indigenous biodiversity conservation vary according to the level of altitude, types of social systems and gender too. The findings are in agreement with the result reported by Gupta *et al.* 2003 and Turner, 2005. There is a global consensus about the relativity of altitude and types of social system in shaping the biodiversity conservation and subsistence survival of livelihood (Berkes *et al.* 2000, Berkes *et al.* 2003, Turner 2005, Singh and Sureja 2006a,b; Singh, 2007). This finding further validate the earlier results reported by Laird 2002 that bulk of world's biodiversity is found in developing societies tropical ecosystems, and the traditional communities- who are politically and economically marginal, sustain biodiversity.

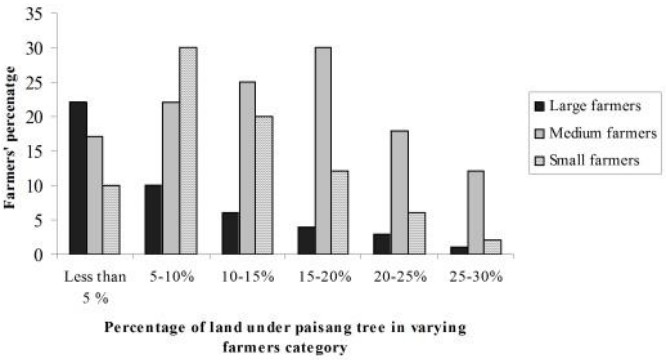

Fig. 4. Area of land under paisang trees for maintaining agriculture and securing livelihoods

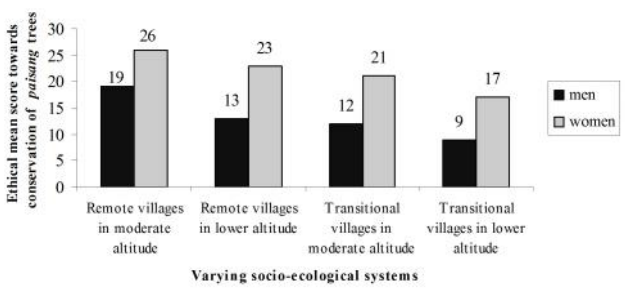

Fig. 5 Level of ethics in conserving the paisang trees among different user groups at varying altitudes and social systems

Lower altitude= 5000-6000 feet MSL, Moderate altitude= 6000-7000 feet MSL.

Remote villages: Villages situated in far-flung areas with poor communication system and less dependency upon marketed inputs and access.

Transitional villages: Villages situated near town, passing from social and economic change with better communication facilities and moderate level of access and dependency upon the markets for inputs

CONCLUSION

The TEK and cultural ethics that engender conservation of *paisang* trees and indigenous crops species, are complex and intermingled. This is reflected in *Monpa* social institutions, ceremonies, festivals, cultural sanctions and day-to-day activities. This is engendered from an ethic of conservation and responsibility to the environment. Such institutions are socially constructed,

vary from place to place (as in our case also) with normative and cognitive dimensions, thus they embed values. The cultural perception associated to *paisang* trees are psychological process associated to an object and socially mediated and directed which guide and determine the action of its users. People living in varying ecosystems and altitude in close proximity to their environments are capable of observing, identifying, monitoring and reacting to variations in *paisang* and agrobiodiversity conservation. Such capabilities have only made them possible to use location specific crops using *paisang* tree leaves and balancing the ecosystems. Such knowledge systems are affected by various socio-political and cultural factors thus the degree of their effectiveness in terms of preserving indigenous biodiversity and ecosystems vary significantly from systems to system.

Local socio-environmental dynamics are complex and require an integrated approach to understand the services and functions they support to conserve *paisang* trees and indigenous agrobiodiversity. Historical and cultural perspectives of *paisang* trees and its contributions to ecosystems and local communities play a key role in bringing them to the forefront to shape and conserve biodiversity (Singh, 2007). As part of a framework to accommodate indigenous cultural uses and values within resource management, cultural and spiritual values need to be made tangible enough for biodiversity conservators to recognize and consider in their decision-making (Singh and Sureja 2006b; Singh, 2007). This will facilitate better policy and planning, based on a shared understanding of the salient physical, spatial, and visual requirements associated with particular TEK, cultural practices, beliefs and their enabling ecological resources (Berkes, 2009a,b). The challenge lies in incorporating this form of knowledge and sensibility into the formal research and extension services, professional education curricula, and ultimately the formal and scientific views of resource managers. Incorporating these aspects of TEK can offer insights into how people use their environment as a forum through which broader social issues can be considered and elaborated (Singh et al., 2009 and Berkes 2009a,b).

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