Community knowledge and biodiversity conservation by *Monpa* tribe

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Received 30 May 2005; revised 7 November 2005

Community knowledge is the essence of social capital of the poor people and plays a significant role in conservation of biodiversity. Local culture, spirit, social and ethical norms possessed by local people has often been determining factors for sustainable use, and conservation of biodiversity. In the present paper, an effort has been made to explore the dynamics of using *Paisang* [*Quercus rex* (Hemsl.) Schottky, Oak tree], *Roinangsing* and *Lenthongsing* (pine tree spp. *Pinus wallichiana* A. B. Jacks. and *Pinus roxburghii* Sarg.) leaves in different crops by *Monpa* tribe of Arunachal Pradesh. To achieve this objective, *Monpa* tribe dominating villages from Dirang development block, West Kameng district of Arunachal Pradesh, Northeast India have been selected. Study indicates that *Monpa* tribe is having their location specific life-long experience and indigenous strategy for sustainable biodiversity use and management at community level. This has been built up through regular practice and observations of local practices related with use of dry leaves of *Paisang* and pine trees. The use of dry leaves of these trees as mulch and organic matter helps the farmers to increase the soil fertility, control soil erosion and conserve soil moisture, thereby, helpful in diversifying the local cropping systems and reducing the risk.

**Keywords**: Community knowledge, Biodiversity, *Monpa* tribe, *Paisang*, Oak, *Roinangsing*, *Lenthongsing*

**IPC Int. Cl.** A01N3/00

Conservation of biodiversity and other natural resources over a long period of time has been possible because of the cultural, spiritual and other social institutions that have guided the relationship of local communities with resources1,2. The community knowledge holds potential for preserving biodiversity and ecological function, but also cultural diversity3,5. Even in a context where deforestation is high, there are forests, streams, old trees and lakes, which have been conserved by the people extremely well. It is not just resources but also the knowledge about these resources, which have been conserved through practice and innovations1. Community knowledge is rooted in tradition, contemporary in nature and is constantly evolving as individual and community responses to the challenges posed by their environment6. Biodiversity provides a foundation for ecologically sustainable development and food security. The unknown potential of unexploited genes, species and ecosystem is of inestimable but certainly high value7,8. The cultural value of biological diversity conservation for present and future generations is another reason for conserving today. It is important to build up indigenous knowledge on which resource-poor farmers including tribes have conserved many crops and ethnobotanical species based on years of informal experimentation and understanding of a particular production system and ecosystem9,11. Rapid changes in the way of life of local communities and consequent loss of community knowledge coupled with the increasing awareness that indigenous knowledge/community knowledge can play an important role in enhancing development, have led developmental workers in both Governmental and non-Governmental organizations to collect and incorporate these resources in process of sustainable development12.

Women folk play a significant role in collecting and using the dry leaves of these local trees. Maize is a staple food crop in which use of dry leaves of *Paisang* and pine tree is predominant. In other crops like barley, wheat, beans, buck wheat, finger millet, coriander, bottle gourd, cucumber, soybean, pumpkin, bitter gourd, spinach, field pea, mustard species, garlic, onion and chilli the dry leaves of *Paisang* and pine trees are also applied as mulch and source of

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with the village. In the first step rapport building was established to learn and document the indigenous knowledge/community practices associated with agriculture and natural resources.

Methodology
The study area is situated at 2438 m above msl and comes under rainfed agro-ecosystem of eastern Himalayan region (Fig. 1). In this temperate region, beside the agriculture farmers rear pig, poultry, yak and some cattle to meet the needs of food security. Most of the farmers have small land and grow cereals, pulses, vegetables, and fruits as a source of sustainable livelihood. The agricultural lands are almost undulating with light textured shallow black to brown in colour. Settled cultivation is more popular with some extent Jhum cultivation done for finger millet and rainfed paddy. Besides, paddy, maize, barley, wheat, finger millet and fox millet are the major crops, which are grown by Monpa tribe to meet their day to day needs of ethnic foods and beverages. Monpa tribe dominating villages, viz. Leach, Dirang basti, Yang basti, Cchug basti, and Rama Camp basti of Dirang development block, West Kameng district of Arunachal Pradesh, North-east India have been selected for the study. Both conventional and participatory methods have been adopted complementarily to document community knowledge. Looking to the nature of study, participant observations complemented by anthropological approach have been used to explore the information.

In the first step rapport building was established with the village Goan Burha, primary school teachers, extension workers and village priests. After this, 5 outstanding wisemen having wide knowledge of natural resources from selected villages were selected for conducting the focus group discussions to reach at the consensus result of community practices associated with Paisang tree [Quercus rex (Hemsl.) Schottky, Oak tree] and using pattern of local biodiversity. After establishing the rapport building with key communicators and wisemen of selected villages, focus group discussions and personal interviews were conducted with selected respondents (men and women) of respective villages to explore the community practices associated with Paisang and pine tree and its conservation. With an intent to have equal representation of community knowledge from each gender, 60 (30 men and 30 women) respondents, 6 from each village (3 men and 3 women), each having more than 50 yrs of age have been selected randomly for conducting the interviews. A well-tested schedule has been designed with the set of open-ended questions to explore the indigenous practices associated with the use of Paisang tree.

Results and discussion
The observations revealed that local farmers are quite aware about the importance of biodiversity and natural resource management. Monpa tribe has developed their location specific indigenous strategy for sustainable biodiversity conservation and overall natural resource management at community level. They follow many practices for conserving the indigenous forest trees and thereby agrobiodiversity. Maize is a staple food crop, managed, produced and conserved with the natural dynamics of indigenous species of Paisang [Quercus rex (Hemsl.) Schottky, Oak tree] and Roinangsing and Lenthongsing (pine species, Pinus wallichiana A. B. Jacks. and Pinus roxburghii Sarg.). Leaves of Paisang, a deciduous woody perennial tree found in the sloppy hilly terrains fall from last week of January and continues up to last week of February. This is the peak period when women folk make the group called Mila to collect and carry the dry leaves of Paisang from community based groves/forest (Fig.2) and private land. A complete indigenous package based on utilization of dry leaves of Roinangsing and Lenthongsing (Pinus wallichiana A. B. Jacks. and Pinus roxburghii Sarg.) and Paisang helps the farmers to sustain the agro-ecosystem and get stable organic production.

Local varieties of maize are grown in the last week of April to first week of May. Dry leaves of Paisang (Figs. 3, 4) and pine tree are collected by women folk. The dry leaves are kept either in shade behind the foothill against the direction of wind to avoid direct sunlight on leaves and save from speedy wind, respectively. In sloppy areas having light textured soil, pine leaves are preferred as mulch and source of organic matter because oil of leaves helps in binding the soil particles, thereby keeping the soil intact, preventing soil erosion and protecting the leaves from speedy wind. Interestingly, the rate of weed suppression (allelopathic effect), improvement of soil fertility and total biomass from the local varieties of maize, rajma bean, soybean and cucumber is 30-40%
more in the land where *Paisang* leaves are applied compared to the fields where such practice is not
followed. It has been found that during ancient time, the poor people of Monpa tribe use to go to the village Zamindar (landlord) for Paisang tree dry leaves for using in agricultural crops. For this, they had to give one bamboo made bottle of Rakshi, fine quality of local beer prepared from indigenous barley or maize, showing importance of Paisang tree.

Monpa tribe has developed the location specific indigenous practices for conserving the indigenous crop varieties, grown by only using the dry leaves of Paisang and pine. Seeds of local variety of maize are spread in the fallow land, ploughed using the bullock drawn local plough, then the collected dry leaves are spread uniformly over the soil primarily by the women folk. There are three indigenous varieties of maize, namely Fenthina (dwarf variety, duration 3 months), Thinasheru (tall variety, duration 5 months) and Baklangboo, [medium tall variety sown in Lohsar festival (January to February), duration 4 months]. These indigenous varieties are location specific in nature and grown under varying micro-farming situations by applying the dry leaves of Paisang. Fenthina is grown in most fertile soils near kitchen gardens, Thinasheru is grown in main agricultural land where soil is black to brown and land is undulating, while Balangboo is cultivated in gentle slope and shifting land. Less quantity of dry leaves of Paisang are used in black soil than in light textured and undulating lands.

The selection of crop species and types of cropping (mostly mixed) is decided by whole community of village based on amount of Paisang tree leaves to avoid the crop loss and sustain the crop productivity. If maize is grown after using the dry leaves of Paisang and pine as natural mulch, then there is a better opportunity to increase the productivity of crops by diversifying the cropping systems. When ample quantity of dry leaves of Paisang is available as organic manure, then the indigenous varieties of black gram, soybean and rajma bean are incorporated as mixed crop. Paisang and pine leaves are also a integral part in the sole cropping of local wheat, barley (Bong, with or without awns), Phapda teeta (buckwheat), Phapda meetha (buckwheat), finger millet (mandua), Indian bean (Lablab purpureus (L.) Sweet), rajmabean (Phaseolus vulgaris Linn.), millet (Bundagmo, Panicum psilopodium Trin. var. psilopodium, Panicum psilopodium Trin. var. coloratum), coriander (Ush), bottle gourd (Lau), cucumber (Manthong), soybean (Lee), pumpkin (Broomsa peela & Broomsa saphed, Cucurbita moschata Duchesne ex Poir.), bitter gourd (Kaibandu), indigenous spinach (Taktak), field pea, mustard species (Lai Saag , Leme and Penche, Brassica spp), garlic (Lamn), Mann bada (Allium spp.), Mann Chhota (Allium spp.), onion (Chong) and chilly (Solu). The local varieties conserved by local people using dry leaves of Paisang are compatible to the customs, culture, socio-economic conditions, and biophysical parameters, spirit, food habits and ethnic values of Monpa tribe.

To conserve the Paisang, pine trees and local crops, Chheskaran festival is celebrated during March for the spirit to protect them from insect pests and evils. With the passage of time, some changes have been seen in the methods of use of Paisang leaves. About 20 yrs back, semi decomposed leaves of Paisang tree were used in the standing crop of maize and other crops to increase the fertility, control soil erosion, conserve soil moisture and suppress the weed intensity. The women folk collect the dry leaves of Paisang from private and community forest and store in the agricultural fields in a specially made bamboo structure. The leaves were piled tightly and left till the onset of rains for decomposition. When the reddish solution is secreted from the bottom of stored leaves, it indicates that leaves are partially decomposed and are ready to apply in maize and other local crops. Now a days the dry leaves are directly collected and used (as mulching material cum organic matter just after sowing of maize seeds) without partial fermentation.

For the effort of informal in-situ indigenous agrobiodiversity conservation, Monpa deserves reward and honour. The agro-ecosystem is rainfed and most of the farmers are economically poor. Besides these factors, the biophysical condition of this area does not allow them to apply the inorganic fertilizers, thereby making them dependent on the dry leaves of Paisang and pine. During the study of exploring the dynamics of community knowledge associated with Paisang tree and its conservation, most of Monpa tribe felt that the Paisang conserved on the village community land should remain. This land should not be allowed to convert into orchards of temperate fruits, showing their interest in protection and preservation of Paisang tree than the commercial benefit obtained from temperate fruits. Majority
(70%) of Monpa tribe are interested in either expanding or preserving their Paisang tree land.

The changes in governance and over exploitation of Paisang tree had a negative impact on the environmental and socioeconomic sustainability. These impacts can be characterized in terms of size, sustainability and soil fertility of crops. During early period, local people were totally dependent on the leaves of Paisang and pine. But with the passage of time, rate of using the leaves of these trees have decreased considerably among the newer generation. Therefore, a measurable degree of cultural diversity has been lost from Monpa tribe5. Some of the commercial growers of fruit crops have converted their private Paisang land into apple orchards, resulting in loss of ecological and cultural benefits. Some of the influential people of the locality have encroached upon community land of Paisang tree and cut many trees. The fragmentation of land holdings also makes a community vulnerable to losing control over the portion of community Paisang forest that is distant from villages. Paisang tree is the backbone of local people’s culture and the loss of this resource system may eventually precipitate a decline in Monpa tribe’s cultural diversity. Small and marginal farmers still conserves the Paisang trees, thereby maintaining the local biodiversity. Changes in the pattern of forest utilization including the Paisang tree use have aggravated the depletion of forest resources. Use of Paisang as timber and the increasing rate of loss of Monpa tradition among new generation have served to catalyze the pace of degradation of Paisang tree. Monpa people living near towns or degraded forest are less observant of the restrictions on plant use usually imposed by the community institutions and their tradition.

Looking to the importance of Paisang tree the community institution called Chhopa have developed some local norms and rules to sustain its population and avoid conflict. The private and community Paisang tree lands are demarcated separately using stones. This helps to avoid any conflict between the owners while accessing the leaves. If someone is collecting leaves beyond the demarcated areas assigned or overexploiting the paisang tree, then fine is imposed by Chhopa headed by Gaon Burha (chief of the village selected by villagers based on age and experience). In this process, the Gaon-Burha files a case before the Chhopa and guilty person is called for giving explanations. If he is found guilty, a fine is imposed. In earlier days, the fine was imposed in terms of yak, cow, pigs and sheep. The size and age of animals given as fine is decided according to the nature, productivity and age of the cut the Paisang tree. If the fined person is not able to bear it, then fine is given by his close relatives. The Chhopa reserves the right to reduce the fine depending on economic status of the guilty person. The collected money from the imposed fine is used by the community for social welfare, managing natural resources like plantation in community land, hillside and roadside to avoid landslides. Everybody honours the decision made by the Chhopa. But with the passage of time some changes have taken place in this local institution.

Conclusion

Community knowledge plays an important role in food security, resource management, and environmental and biodiversity conservation. The study and research concerning indigenous knowledge/community knowledge need not be restricted to medicinal plants or other forest resources that are potentially profitable to the developed world15,16. Instead, research should also focus on other ecological implications, which would prevent the misuse and abuse of forest resources17,18. During last 5 yrs, the infestation of stem parasite Loranthus on the Paisang tree (Fig. 5) has increased dramatically in Monpa inhabited area and forests of West Kameng district in Arunachal Pradesh, thus posing a threat to Paisang population. There is need to formulate policies and devise control measures together with local officials and village leaders in a participatory mode for controlling the Loranthus population. Scientists need to keep an open eye for opportunities to learn from local people, especially given that financial resources and the scientific toolbox are often inadequate in addressing the complex natural and human interactions19. Indigenous knowledge/community knowledge is the area where there is need to cultivate a bottom-up approach to development building upon the resources and strength of indigenous people, their experiences and diversified knowledge systems20-22. Self help groups of the local farmers can be formed and need based training should be imparted to them for controlling Loranthus.

Acknowledgement
Authors express their gratitude to the wisemen Shri Tashi Norbu, Mrs Pem Dolma, Shri Lobzang and Jambe Tsering for their kind cooperation in rapport building process and in providing firsthand information for the study. Authors also gratefully acknowledge the financial support provided by National Innovation Foundation, Ahmedabad, Gujarat to carryout the study.

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