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A REVIEW

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Natural resource management and their conservation: Critical issues for nutitional security by hill agriculture

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Natural resources of an area are the gifts of nature that support all development activities. Soils, water resources and the natural biota comprise the basic primary natural resources that influence agriculture. These days, underutilization of natural resources is the case only when technological limitations restrict resource use. In most of the cases, where technology has been developed, natural resources have been exploited to the extent of creating severe environmental concerns. This is because the ever increasing population and increasing per capita consumption of natural resources with development which has created a situation where every bit of available resources are being exploited subject to technological and infrastructural feasibility. As technologies get upgraded, or newer technologies come into existence and infrastructural limitations are overcome, more and more natural resources become utilizable and susceptible to be overexploited. The objective of this composition is to highlight the critical issues in intermediate zone hill agriculture in Jammu and Kashmir that are of significance for conservation and management of natural resources.

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Issue I: Rainfed agriculture :

Less than 10 per cent of the cultivated area in intermediate zone of J&K is irrigated (Anonymous, 2011). Hence, the abundance and distribution of rainfall is of utmost importance for agriculture. The distribution of mean annual rainfall in Rajouri is presented in Fig.1, which indicates that annually there are two crests in the mean distribution curve coinciding with the *Kharif* (larger crest) and *Rabi* (smaller crest) seasons, respectively. Thus, the rainfall distribution pattern is very suitable for growing both the *Rabi* and *Kharif* crops. The mean annual rainfall for the period 2004-2014 in Rajouri was 902 mm of which average rainfall during the *Kharif* months (April to October) was 624 mm and during *Rabi* months (November to March) was 278 mm. However, as evident from Fig. 1, the actual distribution of rainfall during various years is erratic with non-uniform period of drought and rains in various months. At the same time, we see that there is no season with a complete drought as rains do occur at some point of time during the crop

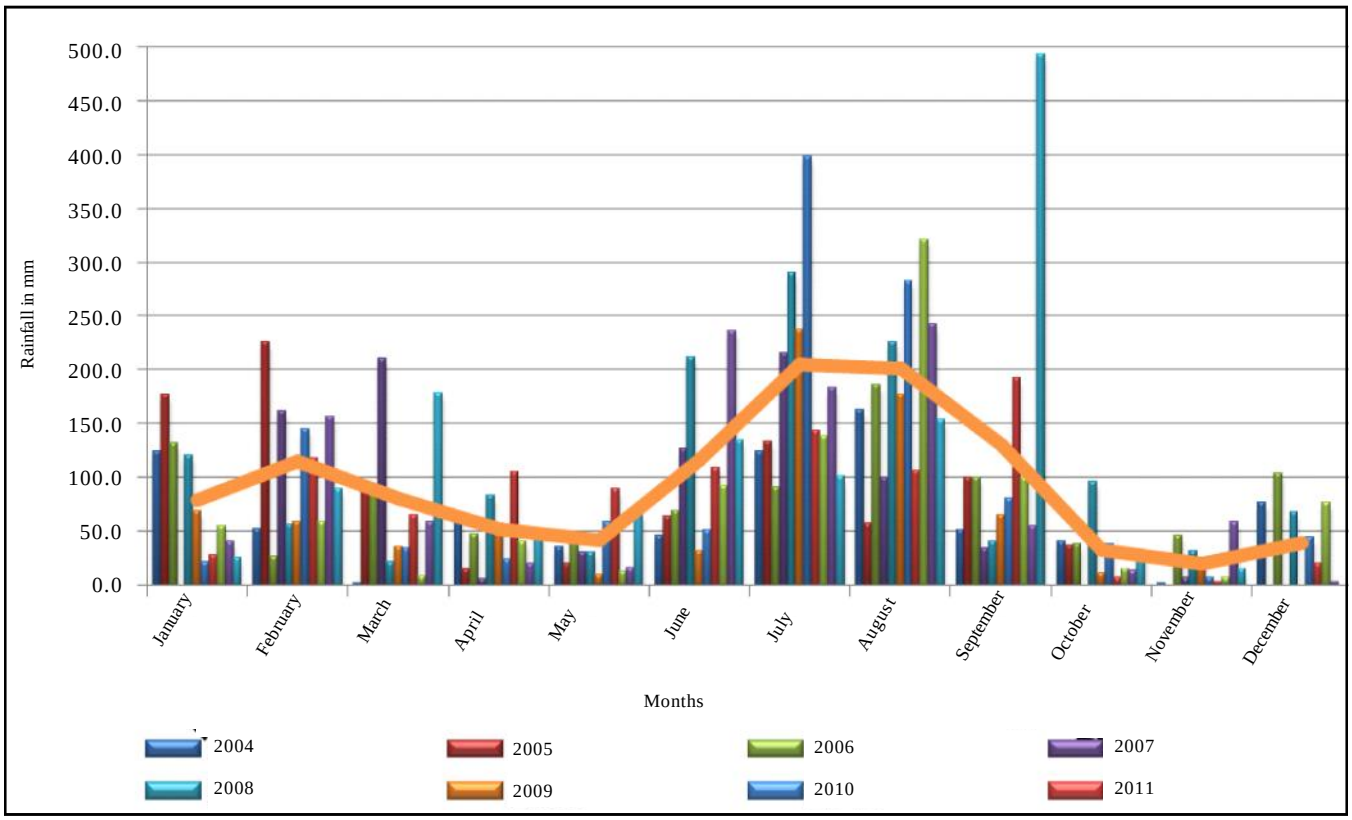

Fig. 1 : Monthly rainfall distribution Rajouri district from 2004 to 2014

growth.

Implications:

Green revolution has been possible due to the release of fertilizer responsive high yielding varieties. Without irrigation, fertilizer application would not have given the desired response. Given the difficult relief, development of irrigation in these areas is not a practical proposition. The conventional *kuhl* irrigation systems are declining but need to be preserved. However, the area that can be covered by the traditional *kuhls* is limited. So does it mean that agriculture has to be at the mercy of rains? The feasible option is to develop alternative and more remunerative agricultural enterprises with best possible use of available water resources. For instance, by rain water harvesting, it might not be possible to grow conventional water intensive crops like rice but harvested water might just suffice for non-traditional enterprises such as floriculture, mushroom cultivation and vegetable cultivation amidst traditional rainfed agriculture with a value added marketing perspective.

The gist of this concept is that an agricultural enterprise in a rain fed scenario has to be broad based and diversified to reduce the risk, but at the same time innovative and daring enough to reap the benefits of value addition. A diversified agricultural enterprise will not only reduce the risk but also lead to optimum utilization of the available biological resources.

Issue II: Biodiversity conservation :

A large variety of flora belonging to diverse families and species has been reported to inhabit this region. The availability of a large variety of edible and medicinal plants as weeds in croplands enriches the daily diet of rural families as well as provides advantages for basic health. Wild Pomegranate (*Punica protopunica Balf*) trees are widely scattered in the region and their fruit finds use in the production of anardana (Fig. 2). *Ficus palmata* Forsk. commonly known as 'Fegra Fig' belongs to the family of Moraceae or Urticaceae (Fig. 3). Found to be growing wild in abanotally. These trees are occasionally found in the forests, but grow well around the villages, in

Fig. 2 : Wild pomegranate

Fig. 3 : Fegra fig

Fig. 4 : Edible Morrel (*Morchella rotunda*) of *Guchhi*

Fig. 5 : Spiny Gourd (*Memordica dioicea*) locally known as Kakora

wastelands, fields bunds etc. It contains a very juicy fruit and is used for making various products such as squash, jam and jelly. The fruit contains mainly sugars and mucilage and are principally used as an item of diet in several cases of constipation and in the diseases of the lungs and the bladder. Edible yam (*Dioscorea befophylla*) locally called Tarad grows naturally in this region and is dug out and consumed by the local people as it is the part of a tasty traditional cousine. The edible morrel (*Morchella rotunda*) locally known as *Guchhi* grows naturally in the wild and is collected from the wild and sold at a premium price in the market (Fig. 4). Spiny Gourd (*Memordica dioicea*) locally called as Kakora is a rainy season vegetable fetching good local market (Fig. 5). Fruits of prickly ash tree known as timru in local parlance are used for preparation of tasty chutney (an edible paste made from a concoction of the fruit, salt and spices) used frequently in the traditional diet of the people in this region.

Weeding is an important activity in predominantly non-mechanized agriculture in the hilly terrains of this region. But as the weeds find diverse uses in the present agricultural scenario in the region such as fodder for animals, medicinal uses, as food for humans and as ornamental plants, there is a need to identify the critical impact of intensive weed control measures such as chemical weeding on the diversity and abundance of the indigenous weed flora before adopting these measures. Weed control measures should be fine tuned and regulated taking into account the dominant weeds and their uses. Blanckert *et al*. (2007) found that farmers' management intensity has its effect on local weed diversity. They reported that the dominant weed community within less intensely managed systems was more diverse than in the more intensively managed systems and asserted that the diminishing weed diversity with increasing management intensity represents a loss in biodiversity as plants form a basic keystone in the agro-ecosystem. So weed control must be fine tuned according to the crop production system, taking into account it's most dominant weeds and farmers' uses. Moreover, as reported by Maurer *et al*. (2006) changes in land use reduce plant species richness within parcels and at the landscape level, so in order to preserve plant species diversity at the landscape level a high diversity of land use types has to be maintained.

Implications:

Many of the weeds and wild plants growing on croplands and pastures are the wild relatives of the cultivated plants and as such possess the vital genetic resource for further crop improvement. Very little work has been done to exploit their genetic resources to trap their competitiveness which is all the more essential in the face of severe genetic erosion. The ever increasing need to enhance food security calls for a need to use a large array of plant genetic diversity, particularly of native land races, primitive cultivars and their wild relatives.

Issue III: Fragile ecosystem and indigenous knowledge systems :

The fragile ecosystem of hills allows only limited manipulation of natural resources. Soil erosion is widely recognized as a severe problem. The area under forests in the intermediate hill zone districts is about 10116 square kilometers. Out of a net sown area of 215775 hectares, the area under rice, wheat, maize, pulses, oilseeds, fruits and vegetables and spices and condiments is 27443, 105516, 174223, 7218, 8602, 1278 and 1245 hectares, respectively in the districts comprising the intermediate hill zone of Jammu and Kashmir. About 55521 ha of land in this region are under permanent pasture and other grazing lands. Another 44877 ha area in this zone is classified as area under miscellaneous tree crops not included in area sown whereas culturalble wastelands account for some 58977 hectares (Anonymous, 2011). About 40-70 per cent of the landholdings of the individual farmers are on steep slopes and hence, uncultivable (*Kohli et al.*, 2007). Probably that is the reason why, livestock rearing activity forms an integral part of the rural lifestyle of this agro climatic zone. The grasslands and permanent pastures in this zone are variously known as *Dhoke* (alpine and sub alpine pastures), *Rakh*, and *Ghodi*. *Rakh* refers to the private lands kept fallow round the year due to their uncultivable terrain. An integral character of *Rakh* and *Ghodi* lands in this region is that the top foliages *i.e.* trees, shrubs and grass forages serve as ruminant feeds. A large number of indigenous fodder trees such as black *Siris* (*Albizia lebbeck*), *Kikar* (*Acacia catechu*), *Mahrukh* (*Alianthus excelsa*), *Daman* (*Grewia optiva*) and *Khirak* (*Celtis austzaliss*) grow naturally in this region and can be found scattered on *Rakh* and *Ghodi* lands.

In order to enhance the biodiversity of the agro-ecosystems, agro-ecologists advocate the use of practices such as intercropping, crop livestock mixtures and crop rotations. These systems are in vogue in some form or the other in this region. The farmers lacking irrigation facility follow the maize-wheat crop rotation with chilies and garlic in vegetable garden. Those with irrigation facility go for paddy-wheat rotation or paddy-berseem (*Trifolium alexandrinum*) rotation. Mixed cropping of wheat with mustard and of maize with Rajmash (*Phaseolus vulgaris*) is prominent. Vegetables like cucurbits and okra are mainly grown for self consumption only. Another traditional crop rotation practiced in some villages nearing Chingus is Maize + amaranthus rotation. Maize is the staple food crop, while amaranthus leaves are used for making curry and as a green leafy vegetable. The seeds of amaranthus are used in some delicious preparations that are an integral part of diet of the locals during religious fasting. Another typical system of cropping prevalent in Sabzian, Dharal, Loran Mandi, Chandimarh and Buddhal (lying in the temperate zone bordering the intermediate zone of Rajouri) is mixed cropping of Maize + Potato + Rajmash. The unique feature of this mixed cropping is that potatoes are not planted voluntarily by the farmers. Potato crops once seeded way back (up to 20 years ago) are being harvested; the subsequent crops of potato regenerate on their own from left over tubers of the previous year's crop, year after year. In this region, farmers have traditionally followed animal husbandry as a subsidiary enterprise which often gives them some marketable surplus in terms of eggs, meat, milk and other milk products such as ghee, curd and kalari. In intermediate hill zone of Jammu and Kashmir, indigenous knowledge has the potential and capacity to blend with science and technology, which may explain the current interest in the interface of global and indigenous knowledge and its application in formal education and curriculum development. Indigenous knowledge is the local knowledge - knowledge that is unique to a given culture or society. Indigenous knowledge contrasts with the international knowledge system generated by universities, research institutions and private firms. It is the basis for local-level decision making in agriculture, health care, food preparation, education, natural-resource management, and a host of other activities in rural communities of the region. So it needs to be conserved and improved upon. The level of indigenous knowledge of the communities

should potentially be regarded as a baseline on which future development could rest upon.

Implications :

Indigenous knowledge is a part of the lives of the rural people in the intermediate hill zone; their livelihood depends almost entirely on specific skills and knowledge essential for their survival. This knowledge is dynamic and a result of a continuous process of experimentation, innovation and adaptation in response to routinely uncertain and risky situations faced by the farmers that require decisions on a daily, seasonal and annual basis. Cultural knowledge that is required for sound decisions comes from tradition and experience as well as from science. However, available, resources and personal preferences also affect the farm enterprise decisions. Today, many indigenous knowledge systems are at risk of becoming extinct because of rapidly changing natural environments and fast pacing economic, political and cultural changes on a global scale. Practices vanish, as they become inappropriate for new challenges or because they adapt too slowly. However, many practices disappear only because of the intrusion of foreign technologies or development concepts that promise short-term gains or solutions to problems without being capable of sustaining them. The tragedy of the impending disappearance of indigenous knowledge is most obvious to those who have developed it and make a living through it. But the implication for others can be detrimental as well, when skills, technologies, artifacts, problem solving strategies and expertise are lost.

Epilogue :

In an integrated scheme of development of hilly areas on a watershed basis, the issues concerning management and conservation of natural resources in agriculture include the predominantly rainfed character of farming, conservation of biodiversity, the fragile ecosystems and indigenous knowledge systems. These issues are not only of local significance but also of greater geographic implications because hills are the upper catchments of the watershed called India. The loss of soil and other biological resources in the hills will have its implications in the lower catchments and ultimately even in the plains.

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