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AGRI-DIVERSITY EROSION IN THE NORTH-WEST INDIAN HIMALAYAS — SOME CASE STUDIES

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There is a worldwide concern over the loss of diversity of plant genetic resources. In the past, hills were considered as natural harbour of biodiversity in general and agri-bidoversity in particular mainly due to their inaccessibility and less population pressure. But now the plant genetic resources even in these nature's treasures are being eroded at much faster rate largely due to habitat destruction/ alteration, over exploitation, urbanisation and increased population pressure. While conducting surveys in different parts if hills it was observed that two types of genetic erosion have occurred firstly is within the diversity of crop i.e. the substitution of a diverse set of genetically variable landraces by few genetically uniform modern varieties and secondly between crops i.e. the substitution of un-used/ under-utilised crops (amaranth, buckwheat, chenopod, small millets and barley by high valued cash crops like green pea, hops, potato and apple). Other associated factors such as changed food habits, depletion in the diversity of agricultural related animals have also been found responsible to narrowing the agricultural horizon. Several landraces, which were there in the farmer's field in 1977-78, were found totally eroded in the year 1997-98.

Key words: Agri-biodiversity, genetic erosion, Himalayas,

The species named *Homo sapiens* facing no major threat of extinction is changing almost all the ecosystems by adopting all modem developmental techniques, unethical and unscientific life style of consumerism. Consequently, the traditional and ages old floral and faunal diversity is no longer found in the accessible habitats. Obviously in doing so, the quality of life on the earth has been simply overlooked. It has resulted in living a poor quality of life, though we might have achieved the tantalising and debatable easy life style in the name of "Development in civilisation". In this context, the present study was undertaken to assess the present status of agro-biodiversity and its depletion over the years in different parts of N-W Indian Himalayas.

MATERIALS AND METHODS

The study was undertaken by conducting surveys in Kangra, Mandi, Shimla, Kullu and Kinnaur districts of Himachal Pradesh in the year 1997 and 98. The base year to calculate the per cent rate of depletion was kept as 1977 and 78. The rate of depletion was calculated over a span of 20 years. Twenty villages were selected from each district and 50 families in each village were randomly taken for collecting the data. The data were recorded as per the questionnaire prepared. A few important question asked from the interviewee were - i) name and age of the farmer; ii) name and number of the landraces grown in the base year (1977-78) and in the year of study (1997-98); iii) name of the crops grown/consumed; iv) number of approximate days

in a week for which a particular food crop is consumed; v) number and type of cattle rare and vi) if there is any change i.e. increase or decrease in diversity and reason thereof. While interviewing the people, it was considered that interviewee should have age not less than fifty years. Notes on socio-cultural value of landraces were also taken.

RESULTS AND DISCUSSION

The hills are very rich both in crops and cattle diversity. The landraces of cereals such as wheat, rice, maize and barley and local breeds of cattle have been a part of the hill agriculture systems and contributing to the sustainable livelihood of hill people. But with the advent of modem agriculture, traditional agriculture has almost extinct not only in the high intensive cropping areas but in the remote areas like Kinnaur and Lahaul & Spiti districts. Case studies conducted in the region support this view very strongly and it was found that present status of agro-biodiversity is not very encouraging even in traditional areas. A major shift has taken place in the number of crops being grown, breeds of cattle rare and the food habits of the people. The studies undertaken to assess the actual scenario of agri-biodiversity and changes over the years have been discussed below:

Landraces status in paddy and wheat: The introduction of high yielding varieties has caused and big shift in the cropping patterns involving wheat and paddy resulting into almost complete wipe-off of landraces that have been once grown over vast areas. With the result, landraces which were either highly competitive or have some special attributes were left in cultivation. During the surveys, data were recorded on the number, name of landraces, their cultivation and consumption status and other associated significance.

Paddy: Paddy forms a staple component of the diet of hill people and consumed as a part of daily diet. In this region, paddy is mostly grown as upland in Kangra, Kullu, Chamba, Mandi and Solan. The data collected on number and name of paddy landraces showed that prominent landraces grown in the year 1977-1978 were; *Madholu, Rodu, Rehdi, Cheena, Japani dhan, Rattu, Chhota parmal, Rodu, Jawas, Rangadi, Kaulpatash , Safed Fulpatsh, Lal Dhan, Ramjawain, Lal dhan, Kala dhan, Jhini, Pulpatasha, Ladheri, Bowru, Katheri, Tapta, Kodri, Sukul, Rangri, Jaldara, Jartai, Jawas, Matalu, Bowru, Jiri, Reesa, Vkhil, Jattoo, Jaldara Sukhdawas, Jhinjhini, Jaulia, Bathal, Begumi, Naknda, Achhain, Tiu, Dinu and Lal naknda, Ratuwa, Sunduru, Motadhan, Kolo, Mangoi* and *Jarati.* On the other hand landraces found under cultivation presently are: *Cheena, Japani dhan, Ramjawain, Lal dhan, Kala dhan, Jhini, Pulpatasha, Katheri, Rohdu, Jiri, Reesa, Jattòo, Rattu, Chhota parmal, Rodu, Jawas, Rangadi, Kaulpatash, Safed Fulpatsh, Lal Dhan, Jaldara, Begumi, Naknda* and *Lal naknda.* From the data collected, it was derived that the landraces, which are still in cultivation, are only mainly because of their special attributes such as aroma, long grain, medicinal properties, fast cooking, appearance etc. The overall depletion of landraces over the 20 years (1977-78 to 1997-98) was found to be 50-60%. This revealed that half or more landraces that were grown 20 years ago have now totally extinct. It was also observed that the depletion rate was much faster in the last decade than that of previous decade.

Wheat: It is also an equally important crop of the hills and grown right from the plains to the Trans-Himalayas. Generally, the spring wheat is grown in this region but winter wheat is also grown in some parts of Trans-Himalayan region such as Lahaul & Spiti, Kinnaur and Pangi areas. However, due to non-availability of superior varieties of winter wheat, the farmers in these areas were very reluctant to continue its cultivation. By growing winter wheat, farmers harvest two crops, which is not possible when they grow

spring wheat as the previous one is sown in October/November before snowfall and harvested in May/June and after that another crop of buckwheat can be easily taken. The land races grown during 1977-78 as told by the farmers were; *Shruin, Tarmori, Chiti kanak, Kankoo, Darmori, Misri, Lal puri, Brad kanak, Mandalu, Kasieun, Ralieun, Bhangru, Daru, Daron, Paluwa, Rundan, Latar, Kiawali, Trimudi, Safed Dharmori, Kali Dharmori, Keshwali farm, Bangla kalyan, Kanak, Keshwali Kanak, Linda farm, Lal Kanak, Gameun, Gasheun, Mundra Marodu, Lal kanak* and *Chawera.* The landraces, which were in cultivation under present conditions are; *Chiti kanak, Kankoo, Darmori, Brad kanak, Kasieun, Safed Dharmori, Kali Dharmori, Keshwali farm, Bangla kalyan, Kanak, Keshwali Kanak, Linda farm, Lal Kanak, Gameun, Gasheun, Mundra, Ralieun, Rundan, Latar, Kianwali, Trimudi* and *Chawera.* It was also noticed that most of landraces are being maintained by a handful of elderly people who have developed special affection to some of the varieties due to their special attributes. The new generation of farmers was not found very encouraging in maintaining these old landraces as they consider them poor yielders and wastage of resources. The data on per cent depletion of landraces in wheat showed that about 40-60% of the land races depending upon the area have been totally extinct over 20 years.

Erosion in the crops diversity grown/ consumed: In the past, many parts of this region were highly inaccessible and people had to sustain on the local crop genetic resources. With the changed agricultural scenario and developmental network, almost every village has better access to get every thing which they need if not round the year then at least for 8-10 months. Thus, an easy style of consumerism has been adopted by the people who used at one time used to grow/consume a variety of crops and now confining to a few crops. This has led to genetic erosion of not only landraces but also of many traditional crops and ultimately a very broad dietary horizon has become very narrow. In this investigation, information was collected on number and names of crops grown/ consumed in the year 1977 & 78 and 1997 & 98. The crops, which were used to consume and are being consumed given below:

a) Crops diversity grown/consumed in 1977 and 78

Maize, wheat, rice, finger millet, barnyard millet, proso-millet, amaranth, buckwheat, chenopod, barley, pea, *Lathyrus*, lentil, horsegram, urd, moong, beans, soybean, cowpea, chickpea, faba bean, garlic, onion, radish, turnip, potato, mustard, linseed, taramira, sesame, sugarcane, cotton, *Colocasia*, cucurbits, okra, tomato, suran (zimikand), chilli, brinjal and various naturally occurring plant species such as *Trichosanthes, cumeriana* (jangli chachinda), *Bauhinia variegata* (kachnar), *Ficus palmata* (fig, bruneee), *Momordica balsamina* (ban kakora), *Nastartium officnale* (water cress, Choonuli, chuchha), *Utrica dioca* (bichhu buti), *Nelumbo nucifera* (kamal kakri), *Diplazium polypodiodes* (lingru), *Rheum moorcroftiana* (Himalayan rhubarb, Chukri), *Cordia dictoma* (lasoora), *Selinum wallichianum* (Thoa, celery), *Portulaca oleracea* (purslain) *Asparagus* spp., *Basella alba, Cichorium* spp., *Ipomea aquatica, Artocarpus lakoocha* (bread fruit, daihun), *Arisaema* spp. (chamus), *Moringa oleifera* (horse radish), *Sagittaria* spp., *Allium* spp., *Bambusa* spp., *Chenpodium album* (bathua), *Lactuca* spp., *Spilanthes* spp., *Tragopogon* spp., *Citrullus colocynthis, Sechium edule* (Chow-chow, Lanku), *Perilla* spp., *Melilotus macrorhiza, Moghania vestita, Malva* spp., *Phytolacea acinosa* (jalga), *Cassia tora* and *C. occidentalis* (aelu) *Dioscorea sagittata* (Tardi), *Aloe vera* (Kuwar), *Opuntia* spp., *Agave americans, Boerhavia diffusa, Polygonum alpinum, Alocasia* spp., *Marsilea quadrifolia, Crambe cordifolia* and *Typha angustata* (jangli alu).

b) Crops diversity grown/consumed in 1997-98

Maize, wheat, rice, amaranth, barley, pea, lathyrus, lentil, beans, cowpea, horsegram, faba bean, garlic, onion, radish, turnip, potato, mustard, linseed, taramira, sesame, *Colocasia*, cucurbits, okra, tomato, chilli, brinjal and various naturally occurring plant species such as *Bauhinia variegata* (kachnar), *Ficus palmata* (fig, bruneee), *Diplazium polypodiodes* (lingru), *Rheum moorcroftiana* (Himalayan rhubarb), *Cordia dictoma* (lasoora), *Cichorium* spp., *Artocarpus lakoocha* (bread fruit, daihun), *Arisaema* spp. (chamus), *Chenpodium album* (bathua), *Sechium edule* (Chow-chow, Lanku), *Perilla frutesence, Melilotus macrorhiza, Rheum moorcroftiana* (Himalayan rhubarb, Chukri), *Phytolaca acinosa* (jalga), *Polygonum alpinum, Alocasia* spp. and *Typha angustata* (jangli alu).

The comparison of number of crops that people used to consume 20 years ago and now revealed that a sizeable number of crops have been eroded from the present cropping scenario. It is further mentioned that some crops that were consumed are still occurring naturally but due to changed food habits they remain neglected. The rate of depletion of the diversity comes around 53 per cent and it is still increasing at much faster rate. The rate at which we are dropping the crops from our cultivation and consumption, it appeared that day is not far when we will be consuming only a handful of crops viz. wheat and rice that too in the form of fast foods. This study clearly stated the basic fundamental of biodiversity that no biodiversity can be saved unless it is put in greater and wider sustainable use. Maximum sustainable utilisation of these valuable plant genetic resources is only possible if they are attached some value or economic gain either directly or indirectly. Therefore, our conservation and utilisation strategies must include a wide range of tools and techniques for their safeguard.

Change in the food habits: It is a well-known fact that when we don't put anything into use it looses its existence or bound to extinct. The same thing has happened with the agricultural biodiversity i.e., all the age-old varieties; crops and technologies, which were not in use since long, have been dropped from our system and got extinct. The people when interviewed say that when they are not consuming a particular crop or a variety then why that should be maintained and consider this as a futile practice. While interacting with a group of young boys and girls in Raksham and Sangla areas of Kinnaur district, I found that they don't take any of the traditional crops such as amaranth, buckwheat, chenopod and smaller millets in their daily diet, whereas their elders are still fond of such foods. They also showed reluctance in growing all such crops. Moreover, they don't want to deprive themselves from the economic benefits that they earn from cash crops. The data given in the Table 1 and interviews revealed a major shift from traditional foods to common foods viz., wheat and rice in both Kangra and Kinnaur district. It can also be concluded that even in Kinnaur where millets and pseuocereals were the staple food have been replaced by the recently introduced maize wheat and rice. In most of the areas, farmers are growing amaranth and buckwheat and selling in the shops as a part of barter system i.e. in turn they are getting equal amount of rice. It was therefore realised during the investigation that changing food habits is also one of the factors responsible for depletion of agri-diversity. The changes in the food habits of the people are given in Table 1.

Erosion in agriculture based cattle diversity: Cattle are also one of the most important components of agricultural diversity in the hills. Due to difficult terrain, the mechanisation of agriculture is difficult and the cattle, carry out most of the agricultural operation. Data on the number of cattle rare by a family in the year

Table 1. Consumption of different food crops by a family for number of days (average) per year

Food crops	Kangra		% ±	Kinnaur		% ±
	77-78	97-98		77-78	97-98	
Rice	205	350	+ 70	144	304	+111
Wheat	121	290	+ 140	258	103	+ 103
Maize	145	75	-48	21	85	+ 304,
Millets	30	10	-66	164	38	- 76
Amaranth	26	20	-46	246	160	- 35
Buckwheat	21	05	-76	320	201	- 37
Chenopod	18	04	-77	102	17	- 83
Traditional vegetables	142	65	-54	301	118	- 34
Pulses (own produce)	241	112	-53	276	98	- 64

1977-78 and 1997-98 were recorded. The emerging picture is again not very encouraging and depletion has occurred in number of cattle being rared. The replacement has occurred mainly for cows and buffaloes by the improved breed such as jersey and farmers who used to rare cows and buffaloes and even goats for milk are now satisfy with one cow or one buffalo. Similarly due to mechanisation of agriculture even in sub-mountainous areas and protection of forests, a drastic reduction has taken place in the number of bullocks and goat and sheep, respectively. The data in this regard is given in Table 2.

Major reasons for the depletion of agro-biodiversity: Several reason were emerged form the data collected through surveys and case studies. The important are:

1. Better access to the modem means of livelihood e.g. better transport facilities, communication facilities, availability of better technologies etc.

2. Lack of awareness and inadequate technical understanding of agro-biodiversity.

3. Shift in agriculture i.e. from traditional crops to cash crop. Farmers don't want to deprive themselves from the lucrative benefits they receive from high value cash crops.

4. Absence of economic valuation of agro-biodiversity - how much can it contribute to the economy of the community, nation, global community and on what terms?

5. Migration from rural to urban areas. Majority of the rural people has shifted form villages to cities in search of jobs, better education facilities and prospects for their children.

6. Agriculture considered as low social status profession as compared to other professions. In the hills any young chap would prefer to join as daily wages employee rather than to opt agriculture as occupation.

7. Agriculture occupation considered as highly risk oriented i.e. most of the agriculture holdings are small, and entirely rain-fed, thereby subjected to natural calamities.

8. Commercialisation of agriculture has led to the cultivation of only high valued crops and in the process many traditional crops and varieties have been ignored.

Table 2. Traditional cattle diversity rared by the people and depletion over the years

Cattle population	Buffaloes		Bullocks (pair)		Cow		Sheep		Goats	
	K	S	K	S	K	S	K	S	K	S
1977-78	46	50	42	46	56	72	116	25	218	30
1997-98	29	28	19	34	41	48	64	10	78	18
% Depletion	36	40	54	26	26	33	45	60	64	40

K - Kangra district; S - Shimla district

9. Shrinking of the dietary base of the people. Among cereals, only rice and wheat are being consumed by majority of the people and all the traditional crops even maize has been dropped from the normal diet. Majority of the young generation farmers does not relish traditional foods e.g. amaranth, buckwheat, chenopod, other coarse cereals etc. and also does not want to waste time in the adoption of traditional technologies as better substitutes are available.

10. Disintegration of joint families into nucleus families has resulted in the fragmentation of land holdings and reduction of working hands in the family, thereby some portion of land in the villages is left as barren and uncultivated. It is worth mentioning that in each village at least 4-5 families have left their land uncultivated and 15-20 families have given their land on lease basis to landless families.

11. Protection of community forests has caused fodder scarcity and thus leading to erosion in cattle population. The people used to keep a few goat and sheep herds in the village, which were entirely dependent on community forests. After the protection of village forests by the forest department, people had no other alternative but to sell out their animals. Many rural people were of the opinion that it has affected their socio-economic status as they were not able to fetch their basic needs viz., fuel, small timber and fodder from the forests and now had to opt for LPG, Kerosene and other costly means of living.

12. The menaces of wild animals in most of villages have also forced the people to sell out their domestic animals. Increasing incidences of attacking human beings by the wild animals had develop a negative sense in the people's mind and they are not ready to accept such challenges.

Future thrust for saving agro-biodiversity

1. Survey and collection of left over agro-biodiversity without further delay.

2. Thorough evaluation of already collected agro-biodiversity to make it worth using.

3. Both *in situ* and *ex situ* conservation of agro-biodiversity in various forms such as natural habitats, seed gene banks, *in vitro* gene banks, cryo-banks, field gene banks, botanical and herbal gardens etc. should be promoted and facilities in this regard should be strengthened.

4. Commercialisation of agriculture in order to derive maximum returns from the limited land resources has faded the ideas of *in situ* conservation at farmers' field. In order to conserve the age old landraces, crops and traditional technologies in their natural habitats, there is a need to develop a strategy or a kind of compensation mechanism where farmers should not be deprived from the economic benefits and simultaneously our efforts to allow the biodiversity to evolve continually to the changing environments should not be stopped.

5. Value addition to the agro-biodiversity. It can not be saved unless it is used and while in use, it can continue to evolve and be appreciated enough to be saved. The ultimate users and protectors of biodiversity i.e. farmers should be educated as it provides enormous direct economic benefits in the form of food, forage, timber, medicine (many pharmaceuticals are derived from plants), rural health care systems and industrial raw material, and has the potential for generating many more. It also provides an array of essential service to humanity like keeping air clean, modifying climate extremes, degrading wastes, recycling nutrients, creating soils, controlling diseases and scientific research etc.

6. Those plant species, which have not brought under cultivation yet, but are of very high value e.g. many medicinal plants should be promoted to cultivate in private lands. These plants are being extracted at a much faster rate from than ever before from their natural habitats.

7. Germplasm centres for the species that

are endangered or threatened should be developed in different regions/ zones i.e. save the most beleaguered species and ecosystem first.

8. In order to conserve landraces, efforts may be concentrated on people's participation for "on farm conservation", concept, on the basis of crop diversity occurring in a particular area.

9. Accelerated research and support on the fragmentation of biodiversity and ecological process, community restoration and rehabilitation of degraded lands and proper monitoring of biodiversity is needed.

10. Integration of biodiversity conservation programs into cultural diversity before it is irretrievably lost.

11. Enhance traditional systems of resource use rather than replacing them

12. Integration of various departments such as agriculture, forestry, irrigation, ground water development board, village industries etc. in drawing up village level programs interpreting conservation and sustainable use of biodiversity.

13. Keeping in view the pace of depletion of traditional technologies, knowledge and crops it is of utmost importance to document them as 'leads' for gene and drug prospecting

14. Enhancement in professional competence and HRD of those who are directly or indirectly involved in the promotion and conservation of biodivesity.

15. The need of agro-biodiversity in never ending, therefore, conservation/ management efforts will have to continue for better posterity.