Traditional Rice Landraces of District Bageshwar, Uttarakhand and their Conservation

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Farmers select varieties to suit their environmental, socio-economic and ethnic needs The selection criteria and naming of folk varieties is based on certain desirable characteristics. Adoptability of these landraces to specific micro- niches provide the subsistence to the communities living in the remote areas of hilly region. In the present article, the importance of traditional rice landraces for sustainable development and their on-farm conservation by the farmers in district Bageshwar of Uttarakhand is discussed.

Key Words: Traditional knowledge, Traditional rice landraces, Farmers selection criteria, On-form conservation

Introduction

Rice is the single most important food crop and 90% of it is grown and consumed in Asia (Khush and Brar, 2005). It contributes 26% in the world's food production (FAO 1996). It is well known that rice emerged as staple food in South-East Asia that proliferated and subsequently dominated the world food bowl along with other food crops (Paroda 2004).

Rice is the major food crop of the entire Kumaun region in general and particularly in Bageshwar district during *kharif* (May/June to September/October). Rice is grown since time immemorial in the region. Despite the spread of improved varieties, local landraces are still grown in the region because of their well adaptability in various agro-climatic conditions (Bisht *et. al.* 2005). More than 80% of the cultivable area in district Bageshwar is under rainfed. Local rice landraces are mainly confined to rainfed as well as semi-irrigated areas in the region. Farming communities in the interior localities are completely dependent on local cultivars, which are also suitable for their environmental, socio-economic and ethnic requirements.

Bageshwar is a remote district in Kumaun hills of Uttarakhand state and it is endowed with rich cultural heritage along with diverse vegetational wealth. It has a diverse geographical scenario comprising of rivers, valleys, medium gentle slopes, higher Himalayan peaks and glaciers. According to its diverse geographic and climatic conditions, farming communities have selected the diverse types of landraces of rice suitable to local conditions. The district Bageshwar is divided into four development blocks namely Bageshwar, Garur, Kapkote and Kanda. Rice is the most important crop in the entire district. The old traditional rice landraces are also well documented in the Gazetteer of Himalayan provinces (Atkinson 1882). He had described 48 of them in the Uttarakhand Himalayas. Some other studies undertaken on old local cultivars are scattered in the literature (Pant and Negi 1992; Tiwari and Das 1996; Bhatt and Chauhan 1999). No systematic study has been undertaken. In order to document the traditional rice landraces in Uttarakhand, the district Bageshwar was selected in the first phase of our study since in the Bageshwar district, completely traditional farming is still practiced. Throughout the world , traditional farming system have served to preserve the diversity of local varieties along with the human knowledge and cultural practices that have shaped this diversity (Bellon 1996). Traditional farming systems are important *in-situ* conservation sites of crop diversity in the the United Nations Convention on biological diversity *in-situ* conservation "the conservation of ecosystems and natural habitats and the maintaining and recovery of viable populations of species in their natural surroundings and in the case of domesticated or cultivated species in surroundings where they have developed their distinctive properties." The present study was therefore undertaken with emphasis on utility of landraces for future needs vis-à-vis their conservation status (both *in-situ* and *ex-situ*) by farming communities themselves and government agencies.

Materials and Methods

Data on rice genetic diversity was collected from primary sources with the help of planned structured and un-structured questionnaires / interview schedules at

individual farm households level during 2002, 2006 and 2007 cropping seasons. Sample households were randomly selected from all four development blocks- Bageshwar, Garur, Kanda and Kapkote of Bageshwar district. Five to six villages were selected from each development block representing the distinct agro-ecological niches. In each selected village 5% households were randomly selected for interview. Lottery system was adopted for randomization. Thus, a total 58 respondent households were interviewed for documentation of rice landrace diversity. The detail of the number of households interviewed area wise is given in Table 1. During the survey of the district a non-participant observation method was also applied while recording the information.

Using Participatory Rural Appraisal (PRA), information was obtained on the erosion and shift in landrace diversity and changes in farming system. The collected information on current status of the landrace diversity was validated through observations on the fields under cultivation. The respondent households were also asked to fill a questionnaire for extracting information on their knowledge regarding distinctive properties and system of folk nomenclature of rice landraces etc.. All possible care was taken to determine the consistency in farmers naming and describing rice landraces by comparing information from farm households and different social groups. Information obtained was authenticated from knowledgeable elderly farmers and other secondary sources.

Results and Discussions

In the area under study, cropping pattern was built around two crop seasons, *Kharif* (April to October) and *Rabi* (October to April). Rice was the major crop of *kharif* sown in both conditions irrigated as well as rainfed. In the hill region, practice of mixed cropping was very common, however rice is grown as mono crop. More than 80% of the agricultural land was rainfed in the region. Rainfed rice in contour terraces on hill slopes was sown in the month of April by using broadcast method of sowing, however irrigated rice was grown with transplanting method. In the present study it is revealed that more than 50 traditional rice landraces / cultivars were grown by the farmers three decades ago (Table 2). On the basis of irrigation requirement these landraces was classified into three groups – irrigated, rainfed and common (suitable for both irrigated as well as rainfed condition). A total of 44 landraces were still grown by the farmers of which; 14 were grown under irrigated conditions, 16 were grown under rainfed conditions and 14 were suitable for cultivation under both conditions. The landraces common for both agro- ecologies were widely adopted in the region. After the invent of the green revolution, some high yielding varieties (HYVs) entered into the region namely Tichung Native-8, China-4 and IR-24, consequently some of the traditional landraces were replaced by them (Table 3). Thus, the introduction of high yielding varieties was one of the major factors of the erosion of broad genetic base of crop diversity in the region. Over a period of three decades 13 (5.117%) traditional landraces of rice have eroded as replaced by 3 HYVs (Table 3). In this region, heterogeneity of topography, altitude, water regime, environment, temperature, soil type etc. was observed to be very high. This heterogeneity has created a large number of micro-eco-niches which in turn were responsible for creation of a large number of local landraces to suit varied environments. As the HYVs were adoptable to a wide environment they did not cater to the needs of the micro-eco-niches prevailing in such a heterogeneous environments. Perhaps, that is why, 81.03% of farm households still depended on traditional landraces in spite of the introduction of HYVs. The

Table 1. Number of development blocks, villages and households sampled for the study

Development blocks	No. of villages sampled	No. of households sampled
Garur	6	19
Bageshwar	4	12
Kapkote	6	17
Kanda	5	10
Total	21	58

Table 2. Local rice landraces still grown by farmers of district Bageshwar, Uttarakhand

S.No.	Common landraces/ cultivars grown in both irrigated & rainfed areas	Irrigated landraces/ cultivars	Rainfed landraces/ cultivars
1	Bakua	Baneti	Askoti
2	Banbasa	Ghesu	Banpas
3	Chotia/chotu	Jamali	Biraiya
4	Dalbadal	Jhadua	Boran
5	Dallu	Kashmiri	Chamadia
6	Jaulia	Katyuri	Dan nauli
7	Kapkoti	Muthmala	Jhumaria
8	Kavthuni	Panil	Jungai/Jungal dhan
9	Khazia	Prasad	Kavdhan
10	Madguri	Pyolia	Musoli
11	Nandhani	Punjabi	Paktoli
12	Naulia	Ratan	Patari
13	Sudia	Roti	Syont
14	Thapachini	Talpak	Taknoi
			Uskar
			Ut

cultivation of HYVs was confined to irrigated areas only. This has been noted elsewhere also that the large diversity of rice was managed by the farmers as an adaptable strategy to cope with heterogeneous and uncertain ecological and socio-economic environments including different soil types (Das and Das 2004). The adaptability of different landraces of rice to different agro-eco-niches was a major factor responsible for on-farm (*in-situ*) conservation of large number of landraces in the region. Another important factor responsible for cultivation of traditional landraces was land holding size of farm families. Around 66% farmers in Kumaon hills were marginal holders, holding with an average <0.5 ha. land (Bisht *et. al.*, 2005) scattered in different eco-niches, which compeled farmers to grow different landraces for different kind of lands. Since HYVs were successful only in valley areas, where assured irrigation facility was available, presently there was no serious threat to the remaining traditional landraces . Despite losing several landraces, the farmers were growing sufficiently large number of landraces. In the situtation a meta population study would be interesting as the lost landrace populations though may be extinct locally, but be found again in the net work (Hanski and Gilpin 1996; Louette 2000).

The selection criterion applied by the farmers were influenced by different socio-economic and geographical factors viz., yield, quality, biomass yield, drought and damage by animal etc. Farming communities after a long observation and testing of landraces identified some of them to meet the subsistence needs. The landraces *Thapachini* and *Chotia* were found good yielding. However, *Jamai, Thapachini* and *Bakua* were considered good in taste. Hill agricultural is interlinked with animal husbandry and fodder is an important by-product of crop yield. *Thapachini* and *Uskar* were high biomass yielding landraces. Agriculture in the area was affected by the vagaries of rain, hence the drought tolerance was a major criteria of selection for rainfed cultivation. *Thapachini, Uskar, Chamadia, Kavthuni, Bakua, Boran* and *Dannauli* were identified by the local farmers for rainfed cultivation. The damage caused by wild animals was also very common in the fields surrounded by forests. There were some awned and hard threshable landraces identified to minimize the damage. Traditional landraces-*Dannauli, Chamadia* and *Jungalidhan* are found suitable for this purpose. The most frequent landraces *Thapachini, Jamai* and *Chotia* occupied substantial area under rice cultivation in Bageshwar district of Uttarakhand for the last several decades (Table 4). A popular landrace *Thapachini* was the only variety, which was preferred for all purposes and suits to climatic conditions of the region.

Table 3. Effects of HYVs on traditional landraces in district Bageshwar, Uttarakhand

HYVs introduced	Traditional landraces replaced by HYVs	Percentage of traditional landraces replaced
Tichun Native-8 China-4, IR-24	Jiruli, Mangraj, Naulia Simanjari, Dhur basmati, Akadi Rajmati, Anjani, Musmar Kalpar, Hat, Makhur Sanwdhan	5.17

The farmers often named the local landraces of rice, based on certain characteristics, which they possessed. (Lando and Mark 1994). In Bageshwar district of Uttarakhand 37.78% local varieties were named on the basis of morphological characters such as plant height, seed colours, vegetative traits, 28.89% named after environmental adaptation, soil type, micro-eco-niches, tolerance to biotic/abiotic stresses, cropping system etc., 8.89% based on agronomic traits viz. flowering and maturity time, earliness, growth habit, grain yield, 17.77% on the basis of their origin-region, village, farmer and 6.67% were named after their uses like type of recipes, taste ethno-medicinal values etc. The naming pattern of local landraces was much scientific since they possess and carry certain traits reflected in their names, and the landrace could be easily identified by such names (Table 5).

In rice, kernel characters were very important for determining its yield and market value. It is noticeable that there was a large amount of variability found in the kernel length, breadth and 100 kernel weight. The kernel length ranging between 0.56 to 0.88 with an average 0.69 cm and similarly breadth ranging between 0.22 to 0.37 with an average 0.29 cm and coefficient of variation (cv %) 9.53 and 9.80% respectively was numerically significant. The weight of100 kernel also varied significantly between 1.63 to 2.99 gm with coefficient of variation 11.06% which was statistically significant (Table 6).

Traditional seed exchange and conservation system

It is evident from the study that there was no formal exchange system in the district, which was the limiting factor for continuous survival and on-farm conservation of local landraces, especially those grown by marginal farm holders. However, some seed flow of local landraces had taken place as farmers exchanged seeds among

themselves within the same village, procured seeds or collected from other farmers or friends or relatives while visiting them or traveling. It is also observed in the study area that sometimes a married daughter would carry the seeds from parental house to her in-laws house and vise-versa. Similarly some service personnel like military men collected seed from far-flung areas like Kashmir, Punjab, Jorhat etc. after observing their performance. *Punjabi*, *Kashmiri*, *Kapkoti* and *Askoti* landraces were examples of such landraces in the study area. In the study area, 77.58% farmers arranged the seed material from their own harvest of last season. If, it fells short, 17.24% is arranged from neighborhood farmers or relatives and 5.18% procured from seed agencies (Table 7).The loss of the seed by the farmers was attributed to crop failure (particularly under rainfed condition) and consumption needs of the household in excess of production (Trip 2000). Several studies have documented the flow of local seed of different landraces among small farmers (Sperling and Loevinshon 1993). Farmers on the basis of performance and preference selected the varieties to be stored for the next season. Selection of seeds was done by old women folk from healthy crop fields. With their life long experience and testing, they were well equipped, to collect and store the seed material. Old women folk also imparted this traditional knowledge to their daughter–in-laws. It is carefully harvested and sun dried before storage. For safe storage, the leaves of Bach (*Acorus calamus*) and Timur (*Zanthoxylum armetum*) were mixed with cow dung ash and added so as to protect seeds from insect damage. Storage of each landrace was done separately to facilitate their identification and collection from specific fields. The storage containers were made airtight by covering the mouth with straw and cloth plastered with cow dung and mud. Such storage systems have served farmers as their own gene banks, which have helped them to conserve the genes from centuries.An urgent need was felt to strengthen such community gene banks already occurring at the village level for *in-situ* (on-farm) conservation of crop diversity (Swaminathan 1998). Such repositories conserve the genes, which are adaptable in various agro-eco niches.

The Himalayan highlands, possesses various agro-climatic conditions and fragmented land holdings. For these various agro-eco-niches, local landraces of the crops were the only option for sustainability and subsistence of local communities. The various types of landraces and other local resources such as animal husbandry, surrounding, vegetation, soil types and traditional knowledge provided a complex production system in the region. Such regions were the reservoirs of traditional crop landraces and the farmers particularly marginal women farmers were the managers of the crop diversity for the centuries. For the sustainability of people the genes of traditional cultivars must be conserved for future generations so as to maintain the continuity of human society as well as the fragile environment in such areas.

Acknowledgement

The authors thank Dr. S.K. Sharma, Director, NBPGR; Dr. A.K. Singh, Former Head, Germplasm Conservation Division and Dr. (Ms.) Roshini Nayar, Head, Plant

Table 4. Selection criterion and ranking of local varieties in Bageshwar district of Kumaun Himalaya

Ranking	Farmers criteria for variety selection					
	Area share	Good yield	Rice quality / taste	High biomass yield for fodder	Drought tolerant	To control animal damage
1	Thapachini	Thapachini	Jamai	Thapachini	Thapachini	Dan nauli
2	Jamai/Jamali	Chotia	Thapachini	Uskar	Uskar	Chamadia
3	Chotia	—	Bakua	—	Chamadia	Jungai
4	—	—	—	—	Kavthuni	—
5	—	—	—	—	Bakua	—
6	—	—	—	—	Boran	—
7	—	—	—	—	Dan nauli	—

Table 5. Farmers criterion for naming local rice landraces

Category	Agro-morphological criteria	No. of landraces (%)
Plant morphology	Plant height, seed colours, vegetative traits	17 (37.78)
Environmental adaptation	Type of soil, micro – econiches, tolerance to biotic/abiotic stress, cropping system	13 (28.89)
Agronomic traits	Flowering and maturity time, earliness, growth habit, grain yield	04 (8.89)
Origin/Source of material	Region, village, farmer	08 (17.77)
Uses	Type of recipes, taste, ethnomedicinal value	03 (6.67)

Table 6. Range, mean, standard deviation and coefficient of variation for kernel characters in rice germplasm collected from district Bageshwar, Uttarakhand

Characters	Range	Mean	Standard deviation (SD)	Coefficient of % variation (CV)
Kernel length (cm)	0.56-0.88	0.69	0.07	9.53
Kernel breadth (cm)	0.22-0.37	0.29	0.03	9.80
100 kernel weight (g)	1.63-2.99	2.38	0.26	11.06

Table 7. Sources of the seed material of farming communities in district Bageshwar, Uttarakhand

S.No.	Source of seed material	No. of farmers	Percentage (%)
1	Own field	45	77.58
2	Neighborhood farmers and relatives	10	17.24
3	Own seed agencies	3	5.18
	Total	58	100.00

Exploration and Collection Division, NBPGR, for providing facilities to accomplish this work.

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