

MAIZE LANDRACES OF KASHMIR: PRESENT STATUS AND FUTURE PROSPECTS

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Globally maize is the third most important crop. It is most important crop of United States and Mexico as primary centre of origin. From this centre crop spread to other non traditional areas and even to temperate belts of world and got established as a new crop. Mexico has the highest diversity of maize germplasm (Ortega, 2000), a large number and high percentage of *campesinos*, and the highest direct, per capita, maize consumption in the world (Warman, 2001; FIRA, 1998). In contrast to the situation in the United States, where hybrids were essentially introduced in the early 1930s and occupied virtually all maize farmland by 1945, the varied ecology in Mexico has greatly discouraged such universal adoption of hybrids (Frankel et al., 1995; Ortega, 2003a; Perales et al., 2003a). In Mexico, the proportion of maize land surface sown with landraces (80%) is far beyond both the average world value (48.5%) and the average for Latin America (55%; Morris, 2001), excluding Argentina, which now only plants hybrids. In developed countries it is primarily used as a poultry and animal feed, while as in developing regions of the world maize grain is produced for human consumption, besides poultry and animal ration which get the secondary importance.

Development of number of modern high yielding hybrids and synthetic in maize has replaced all the elite landraces and has posed a big threat in terms of loss of valuable genetic variability and potential genetic vulnerability. Genetic diversity created in the farmers' field over millennia complemented by genetic diversity present in the wild relatives of crop provide the raw material for improving crop productivity through plant breeding. These landrace populations are finite and vulnerable to losses due to development of new crop varieties, growing urbanization, natural hazards etc. These valuable resources contribute enormously towards the millennium

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development goals of food security, poverty alleviation, environmental protection and sustainable development.

In the State Jammu and Kashmir(India), maize is second most important crop after rice and is a staple food of some tribal areas such as Gujar and Bakarwall (nomadic race). The main maize crop is generally grown as rainfed and on marginal lands particularly in hilly terrains of the Kashmir valley. It is situated at longitude and latitude of 73.0-76.2E and 32.50-36.0N respectively. The Kashmir Division is agroclimatically a typical temperate region. In Kashmir Valley maize is grown as a sole crop at an altitude range of 1850-2300m above mean sea level. However it is also found to occupy plain belts of the valley in few pockets where irrigation facility is either absent or inconvenient. In fact the plain belts of the valley (1450-1650m amsl), maize is usually grown as backyard crop/kitchen garden crop. The plants are not allowed to go to seed development. The crop is usually consumed just before dough stage as roasted or boiled cob.

Exploitation of maize heterosis through the development of modern high yielding hybrids and synthetics has gradually replaced the low yielding maize populations at a faster rate in maize growing regions of the world. However little impact was realized in Kashmir in the form of area enhancement under these modern varieties. The most important reason behind the fact was that hybrids are developed for more favourable environments and add a non significant gain in the marginal environment. The expensive seed cost further aggravate the situation. In some cases diminishing returns were realized because of their poor adaptability under cold temperate conditions of Kashmir. Some land race populations of maize are still popular with the farmers of Kashmir. A number of landrace populations of maize have been documented from Kashmir valley but presently few are in the farmers' domain. They are grown from very early times and are very much popular because of one or another factor. The Table gives a list of important landraces of maize with their salient features. These are grown as sole crops and in some cases intercropped with pulse crops such as beans, green gram etc. to increase the cropping intensity. The farmers go for intercropping because through traditional knowledge system they know the positive impact on compatibility of two crops and soil health aspect. The main reason of their popularity even in the circumstances of availability of high yielding varieties bred by public and private sector are:

- Good adaptation:- Their adaptation to specific agroecologies and have usually assumed a niche status. They have very good population buffering.
- Wide resistance to natural factors:- These land race populations have wide range of genetic variability and adaptability. They possess the genes for tolerance to various biotic and abiotic stresses. Most important to mention are drought, cold, insect, pest resistance etc.
- They are early maturing and thus vacate the field early and escape the cold injury risk at later stages of crop growth. Snowfall is likely to be expected in the month of September particularly in the hilly terrains when the crop is under dough stage.
- Their very good culm quality usually thin and succulent stems are highly relished by the cattle in the lean season when there is no other fodder crop available.
- As maize is grown usually on marginal lands and under low input environment and the areas where irrigation facility is absent. Since these landraces have much specific adaptability, they thrive best even under low input conditions.

Known, locally-adapted, open-pollinated maize with its more variable flowering times is often a "safer" crop under marginal farming conditions (Farr, 2001; Ortega, 2003a).

- Good grain quality:- Because of very good grain quality they are mostly preferred over hybrids and synthetics bred by Mountain Crop Research Station (SKUAST-K) meant for the purpose for different agroecologies of Kashmir and from outside sources of equivalent ecologies.
- Food and fodder value: These land races usually serve as a staple food of 15% of the population of Kashmir valley. The maize kernels are ground to fine flour (locally called *Makai atta*). The unleavened bread is finally prepared of this flour which is much liked by the local people even the rice consumers of Kashmir. The bread is usually supplemented with locally prepared ghee which adds taste and aroma to the unleavened bread. The byproduct of the grinding process is rough maize flour (locally called *Satoo*) and is consumed with salt tea. It is used throughout Kashmir valley as a breakfast food and is cheaper alternative to bread made up of wheat for low income families. In some cases maize is consumed just like rice. After boiling maize grains a sticky dish is prepared and is supplemented with curd. This is highly relished by elderly people in the hilly areas and locally called *makai wart*. In the local system of medicine it is recommended to diabetic

patients and those having urinary problems. The Photographs-1 provide the information about the broad spectrum variability about cob characters, colour variations, cob sizes and textures. Photograph-2 shows the products of maize directly consumed by local population. *Satoo* (rough flour) used as breakfast food, *Atta* (fine flour) for bread making and *Makai wart* (boiled kernels of maize just like rice)

- The roasted and boiled cobs of local land races fetch a very good market rate because of very high taste and good sugary content. When fodder values of these landraces are concerned, their thin and succulent stems (culm) are highly relished by cattle and do not leave any part of it unconsumed. Since during winter the valley remains cut off for months together from outer part of the world and these hilly terrains have no alternative except to use maize stover as cattle fodder.

The maize farmer growing maize for home consumption often has little reason to choose hybrid maize over locally-adapted open-pollinated maize. When maize is a main food source, texture, flavour and even appearance may be more highly valued than absolute productivity under rarely-achieved, optimal conditions (Anderson, 1952; Hernández, 1993; Ortega, 2003a). Local prices for local maize can be several times higher than for common, yellow imported maize (Barkin, 2003), but at the national level, with current governmental policies, there is pricing discrimination against native, open-pollinated maize (Ortega, 2003a).

- Conservation of biodiversity:- Since farmers are continuously growing these landraces over years, they are conserving and utilizing the maize biodiversity.
- Resistance against climate change:- Landraces of maize are best weapons to combat the challenge of climate change. These cultures conserve the tremendous genetic variability which can serve as wealth for overcoming future challenges like new biotic and abiotic stresses in the scenario of climate change. There shall remain no weapon, besides these allelic resources for the crop development.

These landraces with so many potentials are losing their popularity and are gradually going out of farmers' domain and becoming extinct. These are facing a tough competition from newly developed hybrids and synthetic varieties. The main reasons of losing the farmer's expectations and few challenges before these erstwhile popular landraces are:

- Low yielding potential:-Since maize landraces populations are generally low yielders when compared top modern varieties. As a result they are being replaced by high yielding hybrids and synthetic varieties although at a slow rate.
- Low resilience to some biotic stresses:- These farmers varieties are showing low or no resistance to worldly famous maize diseases such as *Turcicum* leaf blight and common rust which are taking a heavy toll of the crop. In disease favourable years there is significant damage in terms of low yield production and reduction in straw quality.
- Lower sensitivity to inputs:- These land races are highly stable and adapted under specific agro-ecologies. These respond at a very slow rate to favourable environments and to costlier inputs such as inorganic and bio-fertilizers.
- Socio economic plight of the farmers: - People engaged with maize production are resource poor farmers and are socially and economically backward. They are not growing their landraces on modern scientific lines. It is the need of hour to conserve these maize landrace populations. There is much probability of these maize cultures to become extinct by the very near future. Big challenge before plant breeders is therefore to collect conserve, genetically enhance and to utilize these populations so as to get themselves prepared for forthcoming challenges.

Improvement of maize landrace populations.

- Since landraces are having wide genetic variability. Their genetic enhancement for yield and other morphoagronomic traits can simply be obtained by mass selection. Few selection cycles can give a significant genetic gain over the base population. Thus various economic traits can be improved through this method.
- Population improvement programme: - Few simple recurrent selection cycles can genetically improve the base population of these landraces because they possess broad spectrum genetic variability within the population for various economic traits. This not only improves the population *per se* but improved inbreds can be derived from the populations for hybrid development.
- Initiating the hybrid development programme: Development of some elite inbreds from these improved population for hybrid development programme and using one of the parents

from exotic sources can exploit the heterosis. Because the two lines would be genetically dissimilar and this wide diversity between the lines is the raw material for heterosis.

- Biotechnological interventions:- Few economic traits of these landraces can be rectified by using the latest tool of biotechnology such as molecular selections and other tools.
- Innovative approaches for crop improvement:- New scientific management technologies can be popularized in the farming community like proper crop husbandry practices for better production which in turn can improve socioeconomic plight of the farmers.
- Participating plant breeding (PPB) approaches: PPB will work with farmers aspirations and needs and develop the varieties as per the priorities of clients. This is because in formal breeding programme varieties are generally developed at favourable environments but are proposed for different environments. The released variety is in real practice not in multiplication chain and is thus not available. The expensive cost and long lag phase from development of variety and actual availability to farmers also play a role in slow adoption of good varieties. The resource poor farmers particularly in maize are generally located at marginal environments and such conditions are not being given due consideration. It is here these landraces can be popularized after genetic enhance and genetic purification right in the farmers fields. The community seed production units can be established for informal seed multiplication chain. Thus participatory role is needed where farmers can be directly involved and agroecology specific varieties can be designed. This will economize time and resources viz-a-viz maintain the maize genetic diversity in-situ

Conclusion:- Landraces are the reservoir of important allelic resources of a crop, such is the case with maize crop also. Nature has bestowed them the genes with wide resilience against many kinds of stresses such as cold, drought spells and some disease and insect pests. They have the genes for adaptability, besides grain and straw quality. These populations are the reservoirs of useful genes which can combat the new coming challenges and other socio-economic issues. Hence their conservation on farm, in situ, ex-situ on scientific lines and their usage by exploring these useful gene banks for maize breeding and its development program.

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Table: List of important landrace populations of maize of Kashmir with salient features

Name of landrace population	Colour	Salient features	Remarks in terms of usage/market value
Anantnag safed	White	Semi dent, Medium maturity, good straw quality	Bread ,sattoo* ,poultry ration, low market value
Anantnag lader	yellow	Semi dent, Medium maturity, good straw quality	Bread, poultry ration, medium market value
Pahalgam wuzg	Deep orange	Semi dent, Medium maturity, good straw quality	Sattoo,cattle feed, high market value
Pahalgam safed	white	Semi dent, early maturity, good straw quality	Bread ,sattoo,poultry ration, low market value
Vailoo local	yellow	Semi dent, early maturity, good straw quality	Bread, poultry ration, medium market value
Gowran wuzg	Deep orange	Semi dent, extra early , good straw quality	Sattoo,cattle feed, high market value
Matihundi safed	white	Semi dent, small cob,early , good straw quality	Bread ,sattoo,poultry ration, low market value
Matihundi wuzg	Deep orange	Semi dent,plant and ear characteristics poor, early maturity, good straw quality	Sattoo,cattle feed, high market value
Gurdamn wuzg	Deep orange	Semi dent,plant and ear characteristics poor,extra early, good straw quality	Sattoo,cattle feed, high market value
Gurdamn lader	yellow	Semi dent,plant and ear characteristics poor, early maturity, good straw quality	Bread, poultry ration, medium market value
Tangwin safed	White	Semi dent,plant and ear characteristics poor, early maturity, good straw quality	Bread ,sattoo,poultry ration, low market value
Khreti wuzg	Deep orange	Semi dent,plant and ear characteristics poor, early maturity, good straw quality, low yielding	Sattoo,cattle feed, high market value
Aru wangan	purple	Semi dent,plant and ear characteristics poor, early maturity, good straw quality,Very low yielding	Bread, poultry ration, medium market value
Aru wuzg	Deep orange	Semi dent,plant and ear characteristics poor, early maturity, good straw quality,Low yielding	Sattoo,cattle feed, high market value

Satura safed	White	Semi dent,plant and ear characteristics poor, early maturity, good straw quality,Yield potential medium	Bread ,satoo, poultry ration, low market value
Paner lader	yellow	Semi dent,plant and ear characteristics poor, early maturity, good straw quality	Bread, poultry ration, medium market value
Nagbal wuzg	Deep orange	Semi dent,plant and ear characteristics poor, early maturity, good straw quality	Satoo,cattle feed, high market value
Ganderbal safed	White	Semi dent,plant and ear characteristics poor, early maturity, good straw quality Good yielding	Bread ,satoo, poultry ration, low market value
Gund wuzg	Deep orange	Semi dent,plant and ear characteristics poor, early maturity, good straw quality	Satoo,cattle feed, high market value

*= **Satoo**= rough flour of maize kernels used as breakfast food



Photograph-1:P1-P34 are 34 maize populations collected from several places of Kashmir valley and only one co per population has been shown in photograph



Photograph-2: Different products made from maize and consumed by local population