Ethical and Policy Concerns pertaining to Rice Landraces in Asia

Abhik Gupta

Professor, Dept. of Ecology & Environmental Science, Assam University, Silchar 788011, India

Email: abhik.eco@gmail.com

Abstract: Domestication of rice (*Oryza sativa* L.) from the wild species *O. rufipogon* and *O. nivara* by Neolithic Asian farmers more than 10,000 years ago represents one of the most important events in human history, as this crop is the major staple food of over one-third of the world's population, meeting around 20 % of the global calorie intake. The Asian rice, *O. sativa*, which is grown worldwide, has three major "variety groups" or subspecies: *indica* varieties of the Indian subcontinent; *tropical japonica* or *javanica* varieties very common in southeast Asia and southern China; and *temperate japonica* varieties predominantly cultivated in northeastern Asia. Furthermore, cultivation and farmer selection over a long period of time have given rise to over 120,000 varieties or farmer's landraces of rice. These include glutinous and non-glutinous landraces, aromatic landraces; those taking different times to mature; with different levels of tolerance to abiotic stresses like cold, drought, submergence and salinity; and even differing in their resistance to pests and diseases. However, a few hundred "high-yielding" "improved" varieties have largely replaced these traditional landraces, with the latter finding their place of preservation in the rice germplasm banks. While it is true that various genes of the traditional landraces have been incorporated into many modern varieties, questions arise as to the ethical propriety of banishing 'live' and 'flourishing' life forms that are also integrally linked to the culture of many communities, to a 'synthetic, and overtly utilitarian existence. The present paper aims to discuss these issues in the light of ethical principles as well as policies pertaining to traditional knowledge and practices.

Introduction: Rice has two cultivated species of which *Oryza glaberrima*, the African rice is grown only in West Africa, while *Oryza sativa*, the Asian rice is grown worldwide and is the staple food for over one-thirds of the world population (Kush, 1997). In many eastern Indian languages such as 'Bangla' or 'Axomiya' (the former spoken in Bangladesh and West Bengal and parts of Assam in India; the latter in Assam, India) the word *bhat* which means steamed rice, is synonymous with food or meal. In fact, rice is one of the oldest domesticated crops – with archaeological evidence of its domestication by Asian Neolithic farmers some 9000-11,000 years ago (Olsen *et al*., 2006). Three major "variety groups" or subspecies of *O. sativa* are recognized: (i) *indica* group of varieties – typically found in the Indian subcontinent; tropical *japonica* (*javonica* varieties) in southeast Asia and south China; and temperate *japonica* varieties in northeast Asia (Kush, 1997). In terms of rice-production ecosystem types and agricultural technologies, irrigated lowlands occupying *c* 79 m ha of land produce 75 % of the world rice production; followed by rainfed lowland (54 m ha and 19 % of production); upland (14 m ha and 4 % of production; and flood-prone deepwater rice occupying 11 m ha of land with a production of 1.5 t ha^{-1} (Bouman *et al*., 2006).

The Landraces of Rice: Long period of cultivation and farmer selection has resulted in the production of a large number of varieties or landraces of rice, of which an estimated 120,000 are known to exist. About 80,000 are preserved in International Rice Research Institute (IRRI), Philippines, and about 40,000 and 25,000 in Chinese and Indian gene banks, respectively. Other countries, including Bangladesh, also have smaller national collections. These landraces show a wide divergence of properties, with some glutinous, others non-glutinous, some aromatic, fine grained, some fast growing, with deepwater varieties like *Rayada* taking longer to mature (Kush, 1997). However, the green revolution has resulted in the widespread introduction of around 300 high-yielding varieties in the rice fields all over the world, accompanied by severe erosion of the traditional landraces. Traditionally, a vast amount of genetic diversity was distributed among the numerous landraces in different parts of the rice-growing areas of the world. In Japan, for instance, more than 1000 landraces are conserved in the germplasm banks, but not found in their natural habitats any more. More than 100 *O. japonica* landraces once found in Taiwan are now confined to the laboratory. Similar erosion has occurred in the Mekong Delta of Vietnam, and in Thailand, where a high-yielding glutinous variety has replaced several traditional glutinous landraces. A study conducted there revealed that the 27 traditional varieties cultivated in a Thailand village in 1981 had dwindled to a mere 4 in 1991. The most pronounced erosion has occurred in China, Indonesia, India and Bangladesh, where several thousands of landraces conserved a high degree of genetic diversity, but are rapidly vanishing or drastically dwindling in the farmers' fields. In Bangladesh, this erosion is taking place in all the three seasonal groups of rice - *aus*, *aman* and *boro* (Morishima and Chitrakon: http://www.aseanbiodiversity.info/Abstract/ 53000315.pdf; IRRI, 1994). In India, rice is grown as early *kharif*, medium kharif and rabi seasonal crop (MacLean *et al*., 2002), and genetic erosion is evident in all the three ecotypes. In Jeypore in Orissa, India, which is considered to be a secondary centre of the origin of cultivated rice, especially its *aus* ecotype, about 1750 landraces had existed even in the 1950-'60s. However, only 324 varieties were found in 1995-'96, of which only 83 varieties were in cultivation, as revealed by a 1998 study by the M.S. Swaminathan Research Foundation, Chennai, India. Introduction of high-yielding varieties along with low productivity of the traditional landraces were inferred to be the main reason behind this erosion (MSSRF-FAO, 2002). A study conducted in the Seti river valley of Nepal, which is traditionally a rice-growing area, observed that of the 75 landraces known to have originally existed, only 11 were widely grown, 47 were under threat, while 17 were totally lost from the area. Besides other factors, introduction of HYVs was important in causing decline of traditional landraces (Rijal *et al*., 1998). In Garhwal Himalayas, India, diversity declined from 65 crop landraces before 1970s to 39 in 1990s. The area under traditional landraces, especially of paddy, also declined during the same period. The government promoted a high-yielding aromatic variety along with fertilizer subsidies. This led to farmers replacing their traditional aromatic *mukhmar* landrace with the HYV whose initial high yields declined after the fertilizer subsidy was withdrawn. The traditional landrace, however, became extinct in the process (Chandra *et al*., 2010).

Value of Agrobiodiversity: Protection of agrobiodiversity is considered important in the context of conservation of wild relatives of important crop plants as well as traditional and threatened landraces, especially those linked to traditional cultural practices (Phillips and Stolton, 2008). Erosion of the landraces of an important crop such as rice, therefore, assumes special significance. Besides the high "use value" (Pardey *et al*., 1998, quoted in Love and Spaner, 2007) by virtue of their contribution to the genetic variability of the species, the diverse landraces are also important in providing food security to poor and marginal farmers, and are integral components of many religious-cultural events in the life of the people. Farmers in India often harvest *aus* paddy landraces in certain months like September, when all rice from previous harvests get exhausted (Arunachalam *et al*., 2006). These landraces, therefore, are very important from a food security point of view, and linked to the collective-developmental human rights of the marginal and tribal farmers in many areas. The other aspect is the exclusive use of certain rice landraces in various religious rites and ceremonies. For example, in the Jeypore area of Orissa, India, some aromatic varieties were used in a broad range of festivals, while a few aromatic forms and non-aromatic but delicious landraces were earmarked for specific deities or religious rites (Arunachalam *et al*., 2006). The Iban tribe of Sarawak, Malaysia, practice a special ritual in the centre of the rice field, where a specific rice variety is planted (Bellon *et al*., 1996). In the Barak Valley region of Assam, India, a traditionally rice-farming community cultivated over 50 landraces including *aus*, *shali* and *boro* varieties, of which several were meant for religious occasions (Guha *et al*., 1999). Thus the traditional religious-cultural importance placed by the farmers and other members of the community imparts a kind of intrinsic value in addition to the instrumental or extrinsic use value of the landraces. This cannot be substituted by any HYVs. This is somewhat synonymous with "existence value", which is associated with the satisfaction derived by the people from the existence of biodiversity in their environment (Bellon, 1996, quoted in Love and Spaner, 2007).

The governments and national and international scientific organizations have tried to address the genetic erosion in rice and other crop species by resorting to various ex-situ conservation methods comprising maintenance of plants in open plots and glasshouses, followed by the sophisticated cold preservation facility emerging in 1960-'70s. In long-term gene banks, seeds preserved at -10^0 to -20^0 C can be stored for several decades or potentially up to 100 years, if maintained properly; in medium-term gene banks, up to 20 years at 0^0 to 5^0 C; and in short-term facilities, up to a decade or less at ambient temperature or cold temperatures above 5^0 C (Plucknett *et al*., 1983). This was a technology-dependent reductionist approach which only took into account the objective material aspect of rice landraces in terms of their genetic diversity and potentially useful characters that could be harnessed in future for the benefit of the consumers and society at large. Nevertheless, the gene banks are particularly valuable when it contains materials that have vanished from its original habitat or locality. For instance, a virus-resistant *Oryza* wild relative found in Taiwan is only available now in the IRRI gene bank and no longer found in its original place of occurrence; several Cambodian landraces were lost during the war there, and could since been reintroduced only because these had been previously stored in gene banks (Plucknett *et al*., 1983). The International Rice Genebank (IRG) at IRRI has more than 80,000 accessions of cultivated rice and wild species (Bellon *et al*., 1996).

Without undermining the utility of modern gene banks, it can, however, be said that they supplement, but do not necessarily replace in-situ – including on-farm - conservation and perpetuation of landraces. Compared to ex-situ conservation, in-situ conservation of rice species and landraces has received very less attention. One important aspect here is the conservation of the wild species of the genus *Oryza*. Ethically speaking, human societies in a large part of the world owe to these wild species the very basis of their survival and flourishing. The growth and perpetuation of human civilization in large parts of South, Southeast and East Asia have been possible due to the occurrence of these wild rice species, from which the numerous cultivars had evolved due to human ingenuity to feed the millions over ages. Apart from the fact that we need to conserve these species from narrow anthropocentric considerations of human health, nutrition and welfare, we also ought to pay attention to their 'intrinsic' value. On-farm conservation of rice varieties has received the least attention from established rice germplasm conservation programmes, although its importance is recognized by all in principle. The age-old practice of planting several varieties simultaneously by the Asian farmers represent an adaptation, a strategy evolved over a long time. It provides them security against uncertain weather, pest outbreaks and food shortage. Furthermore, it allows them to have some variety in an otherwise monotonous and often nutrient-deficient diet by having some aromatic or otherwise good-tasting, fine-grained rice. Some fine-grained aromatic landraces in Bengal (historically including the whole of present-day Bangladesh, West Bengal and parts of Assam in India), such as *Gobindobhog* in West Bengal, *Kalijeera* in Bangladesh and *Joha* in Assam, are made into *payesh* or *paramanno* after boiling with milk and addition of sugar, raisins, nuts, special jaggeries, etc. This is a very special food that brings joy to the members of farmers' families, especially children. At the same time, such special rice or the food items prepared from them are also offered to propitiate the Gods and in gratitude. These were also offered to the *Zeminders* (landlords) in Bengal to receive favours and to keep them in good humour. And not the least, the rice landraces find ample mention in the rich literature of Bengal, both in its early and modern forms. Thus rice and its numerous landraces in Bengal is more than just food, as it also stores the chequered history of its farmers, traders, landlords and the people in general. Conserving rice germplasm in refrigerated gene banks and ex-situ plots cannot respect or preserve or do justice to this history. The answer perhaps lies in on-farm conservation, which is a "dynamic" form of conservation in which the varieties that the farmers select and plant continue to evolve, thereby retaining their future adaptive potential (Bellon *et al*., 1996). The various programmes of rice landrace conservation cannot enjoy ethical fulfilment without vibrant on-farm conservation with full and voluntary farmer participation. It is essential that the ethical principle of informed choice and not the paternalistic imposing of rice varieties by the agricultural scientists and policy-makers should govern rice cultivation in Asia. To make the choice truly 'informed', great emphasis and effort need to be given towards education of farmers about the pros and cons of selecting a specific landrace. The extinction of a Himalayan aromatic landrace *mukhmar* described in the previous section, shows that while the scientists and policy-makers were insensitive to traditional knowledge and cultural legacy of the people in that area, their emphasis on production and development was also defeated in the long run, with the option of returning to the traditional landrace being closed due to its extinction. This is a typical case of paternalism where the 'enthusiasm' of agricultural scientists in introducing a new variety that combines high yield with aromatic property overlooked the long-range ethical and socio-cultural considerations.

The issue of on-farm conservation is further complicated by the land-holding size available with the farmers. It has been observed that when the farmers first took to cultivating high-yielding varieties, they also simultaneously planted some traditional forms in spare plots of land. However, this was not possible for many farmers with small land-holdings, and over time they continued to plant only the HYVs. This is an issue that needs to be addressed in a larger socio-economic context and has profound ethical implications.

Participatory Management: Participatory crop improvement has been proposed as an incentive for farmers to conserve crop diversity on farms and is a non-market or supply intervention. Two methods of participatory crop improvement have been outlined: 1) participatory varietal selection, where the farmers evaluate the different varieties available; and 2) participatory breeding, where the farmers select within highly variable populations (reviewed in Love and Spaner, 2007). Exchange of seed materials among farmers have greatly contributed towards maintenance and distribution of a wealth of agrobiodiversity, a process in which women's social networks played significant roles. This age-old scenario is fast changing though, and as Padmanabhan (2008) has shown, the traditional system of agrobiodiversity exchange and maintenance by the women of the Kurchiya tribe in Kerala, India, has lately been threatened by the newly introduced system of peoples' biodiversity registers (PBRs) maintained by the *panchayats* (local self-governments). This new system also diminished reciprocity with an element of altruistic act of the Kurchiya women towards each other. The ecological theoreticians and conservationists, who were instrumental in lobbying for and introducing PBRs, did not take into consideration the ethical superiority of the traditional system that was more participatory and led to improved social bondage among the members of the community and increased cooperation. Participatory plant breeding have been shown to be a possible methodology to resolve the conflict between introduced programmes promoting HYVs and the traditional small farmer, especially tribal farmer, preference of locally adapted landraces that satisfied taste and other cultural requirements and at the same time ensured food security under uncertain weather conditions. The latter also becomes particularly relevant under the scenario of global climate change.

Acknowledgements: I thank the Bangladesh Bioethics Society, which was kind enough to invite me to present a part of these thoughts at an international conference at Dhaka, and for kindly admitting me as an international member.

References:

1. Arunachalam, V., Chaudhury, S.S., Sarangi, S.K., Ray, T., Mohanty, B.P. and Mishra, S. 2006. *Rising on Rice: The Story of Jeypore*. M.S. Swaminathan Research Foundation, Chennai, India.

2. Bellon, M.R., Brar, D., Lu, B.R. and Pham, J.L. 1996. II. Rice genetic resources. In: Fisher, K.S. (Ed.): *Rice Production Systems in the Asian Region. Volume II. Caring for the Biodiversity of Tropical Rice Ecosystems*, pp. 252-283. Electronic conference on the Sustainable Development of Rice as a Primary Food organized by the The Pacific Basin Study Center. http://thecity.sfsu.edu/~sustain

3. Bouman, B.A.M., Humphreys, E., Tuong, T.P. and Barker, R. Rice and water. *Advances in Agronomy* 92: 187-237.

Chandra, A., Kandari, L.S., Payal, K.C., Maikhuri, R.K., Rao, K.S. and Saxena, K.G. 2010. Conservation and sustainable management of traditional ecosystems in Garhwal Himalaya, India. *New York Science Journal* 3: 71-77.

4. Guha, K., Gupta, A. and Dutta, B.K. (1999): Indigenous Conservation Initiatives in Barak Valley, Assam. In: Kharbuli, B., Syiem, D. and Kayang, H (Eds.): *Biodiversity: North-East India Perspectives*, pp. 42-46. North Eastern Biodiversity Research Cell, North-Eastern Hill University, Shillong.

5. I.R.R.I. 1994. *Safeguarding and Preservation of the Biodiversity of the Rice Genepool*. Report of an Action Plan Meeting at Los Banos, Philippines. International Rice Research Institute (IRRI), Manila, Philippines.

6. Kush, G.S. 1997. Origin, dispersal, cultivation and variation of rice. *Plant Molecular Biology* 35: 25-34.

7. Love, B. and Spaner, D. 2007. Agrobiodiversity: Its value, measurement, and conservation in the context of sustainable agriculture. *Journal of Sustainable Agriculture* 31: 53-82.

8. MacLean, J.L., Dawe, D.C., Hardy, B. and Hettel, G.P. (Eds.). 2002. *Rice Almanac*. International Rice Research Institute, Manila, Philippines.

9. MSSRF-FAO. 2002. *Rural and Tribal Women in Agrobiodiversity Conservation*. RAP Publication 2002/08. M.S. Swaminathan Research Foundation, Chennai, India and FAO Regional Office for Asia and the Pacific, Bangkok, Thailand.

10. Olsen, K.M., Caicedo, A.L., Polato, N., McClung, A., McCouch, S. and Purugganan, M.D. 2006. Selection under domestication: Evidence for a sweep in the rice waxy genomic region. *Genetics* 173: 975-983.

11. Padmanabhan, M.A. 2008. Collective action in agrobiodiversity management: gendered rules of reputation, trust and reciprocity in Kerala, India. *Journal of International Development* 20: 83-97.

12. Phillips, A. and Stolton, S. 2008. Protected landscapes and biodiversity values: an overview. In: Amend, T., Brown, J., Kothari, A., Phillips, A. and Stolton, S. (Eds.): *Protected Landscapes and Agrobiodiversity Values. Vol.I. Protected Landscapes and Seascapes*. IUCN & GTZ, Kasparek Verlag, Heidelberg.

13. Plucknett, D.L., Smith, N,J.H., Williams, J.T. and Anishetty, N.M. 1983. Crop germplasm conservation and developing countries. *Science* 220: 163-169.

14. Rijal, D.K., Kadayat, K.B., Joshi, K.D. and Sthapit, B.R. 1998. Inventory of indigenous rainfed and aromatic rice landraces in Seti River Valley, Pokhara, Nepal. *LI-BIRD Technical Paper No.2.* Local Initiatives for Biodiversity, Research and Development (LI-BIRD), Pokhara, Nepa