Crop, Conservation, Creativity and Collaboration

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W.P. No.2007-07-08
July 2007

INDIAN INSTITUTE OF MANAGEMENT
AHMEDABAD-380 015
INDIA

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Abstract

Participatory plant breeding has attracted lot of attention in the recent past. However, most of the time, farmers' involvement has been restricted to selections from the material generated by plant breeders as a part of their institutional research.

In this paper, I share a few examples of varieties developed by farmers arguing in the process for creating a special window of opportunity at the national and international level for such innovations. A portfolio of monetary and non-monetary incentives aimed at individuals and communities will be necessary for the purpose. The incentives should also reinforce the synergy between technology, institutions and culture. The incentive should be not only for conservation function but also for augmentation; innovation and diffusion function so that a complete value chain of agro biodiversity develops. An argument is also made for modifying the passport data sheets of the gene banks which have practically no information on food processing knowledge about various germplasm generated by the local communities, in particular, women. This neglect is not understandable except as a mark of inertia, when the demand for processed food is increasing so much every day.

In the end, I suggest that taxonomy of farmers' selection criteria be paid special attention. Crop, livestock, craft and tree characteristics are looked at together while understanding the selection criteria. The breeding strategy for dryland be modified so that we do not continue to screen germplasm only or mainly on grain criteria (higher harvest index) to the neglect of fodder quality and quantity. The role of PPVFRA is crucial in bringing about the suggested changes.

Crop, Conservation, Creativity and Collaboration[1]

Anil K Gupta[2]

Human selection has been one of the dominant forces for genetic advance in various crops over millennia. While the selection criteria have changed over period of time, the relationship between technological choices and their institutional implications have not been studied carefully. The incentives for farmers, individually or collectively to make selections for characters that they prefer have not yet been provided adequately except through recognition by NIF (National Innovation Foundation), SRISTI (Society for Research and Initiatives for Sustainable Technologies and Institution), Honey Bee Network and of late, through the Protection of Plant Variety and Farmers Rights Authority. MSSRF (M.S.Swaminathan Research Foundation), Navdanya, Green Foundation and Gene Campaign have also made major contribution towards recognition of farmers' role in genetic advancement.

In this paper, I discuss the relationship between institutions, technology, culture and genetic resources in part one. The lessons of breeding by individual farmers are drawn in second part. The relationship between varietal improvement and other practices necessary for those improvements to sustain are also briefly discussed. The implications for policy and institutional reform are brought out in part three.

PART ONE

Institutional context of technological change: Crop, Conservation, Creativity and Collaboration.

Historically, most crop varieties were asynchronous in maturity. The implication was that family labour could suffice for staggered harvesting. Once the compulsions of mechanical harvesting began to arise with the advent of mechanisation, the need for synchronous maturity became obvious. The plant breeders may not have realised how the pooling of genes for synchronous maturity actually weakened the incentives for pooling of local labour for harvesting because of simultaneous pressure of work on all the farms. The migration started and changed the institutional conditions of work in such

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areas. The emigration of males from other regions had some impact on the choice of technology back home. The local varieties having high fit with the agro ecological variations continued to survive in the flood regions from where the labour came in medium upland irrigated regions having modern synchronous varieties.

Compared to the induced innovations as described above, the endogenous innovations by farmer breeders may also influence the institutional conditions in sometimes surprising and significant manner. When Thakarshibhai selected Morla variety of groundnut with strong peg and a very thin, if any, ridge on the pod surface, he offered a choice to the breeders as well as community members to overcome a major constraint in groundnut harvesting. The problem of pods being left in the field to be picked up by use of extra labour could be addressed to some extent because strong peg helped in pulling out most of the pods. The lack of ridges on the pod meant less attachment of soil on the pod and thus lesser weight and ease in pulling out. Since genes for these two characters had not been identified well in the formal breeding system, this was an opportunity for the breeders. But, instead of focussing on these genes, the breeders focused on yield and other such generalised parameters. The variety did not get through the screening process, these genes did not get incorporated in the other better varieties but for local farmers continued to grow it because of sweetness of taste and good oil recovery in addition to the advantage in harvesting. The community at local level was more appreciative than the institutions trained to look at genetic level.

There are many examples where local communities through modification of agronomic practices or other associated techniques may overcome some specific constraints of an otherwise desirable variety selected by farmers. Sinha, (2006) describes an interesting practice by Mr.Alibhai and his elder son, Mr.Nuruddin in case of chilly illustrating this phenomenon. They have selected a variety of chilly called as *rasham patta* which had good yield, deep colour and the pod did not crack on maturity. It was particularly suitable for pickles. During transplantation, it was noted that many seedlings were injured and thus died. They developed a practice of transplanting it by which this damage was avoided. The diffusion of the variety without this practice might have been lesser. With the increase in the salinity levels in coastal areas of Jamnagar district where this variety was developed, the area is getting reduced. Older *dwarka* variety from which it was selected is staging a comeback in some of the areas. Many farmers maintain variable

gene pool of both the varieties so that selection for emerging constraints may be made from the mutations as well as natural variations. Further studies are in progress to find out the directions in which future selections are being planned. By developing another technique of irrigation, multiple pickings for longer duration became possible. The labour for the purpose comes from outside. How labours observe the variation in the crop is another issue that is being studied. In most studies of farmers' perception and decision-making, the knowledge of labourers is ignored, though they may have the most dispassionate knowledge of different farms.

Maintenance of local germplasm, particularly of cross pollinated crops may require considerable community cooperation. *Zacharana* variety of bajra could not have been maintained in the *Zacharana* village, had people not cooperated with each other. During last three years, we made an interesting experiment in collaboration with colleagues from University of Guleph and supported by IFPRI, CIDA and SRISTI. In the first year, we nearly ascertained the names of those local farmers varieties which had disappeared but for which demand existed in three areas of eastern UP, western Rajasthan and Gujarat. About 15 years ago, we had mapped plot-by-plot cultivation of local varieties in a few villages of eastern UP. Mapping the same plots after more than a decade provided rich insights about the erosion of agrobiodiversity in different micro ecological regions. In the second year, the seeds of the demanded local varieties were provided so that we could observe whether articulated demand was actually the real demand. In third year, we observed the diffusion of the varieties of which seeds were given in the previous season. In some regions, the diffusion was extraordinary indicating that despite all the games of high yield varieties, there were areas and socio-ecological conditions in which many of the local varieties still had lot of potential. Genetic diversity managed by communities could be augmented through institutional process of lateral learning and exchange. The cost of this experiment is so low that replication should not be difficult. In addition, farmers were provided support to travel in different regions around their village and make selections on the spot of the varieties that might be useful for them in future. Compared to the enormous resources that are spent on institutional research, not even a fraction is spent on strengthening farmers breeding and conservation efforts. There are hardly any projects on *in-situ*/on-farm conservation of agrobiodiversity.

Communities which maintained genetic resources create different kinds of social and public goods.

Patel (2003)[3] has made a forceful plea for highlighting certain unique features of agro biodiversity as a class of good; (a) Human use is necessary for these goods to be developed and sustained. Unlike most other natural resources where human use may cause stress or decline in the availability of resources to others. In the present case, the use in fact, adds the value and therefore, increases the supply of resource. Left to itself, resources have no way of being replicated. To some extent, similar condition applies in many of the natural or human made lakes in which desilting (i.e. extraction of the resource), is necessary for a resource to be sustained. (b) The cultivation of a resource by community is not a necessary condition for sustaining the resource, though it is indeed a desirable condition. Even one farmer could cultivate specific landraces and sustain their availability for others in subsequent years. (c) Social sanctions may not often apply with regard to the decision to grow or not to grow these landraces or exchange these with others. There are however, exceptions[4]. (d) The institutional conditions for production, reproduction, and diffusion of agro biodiversity may follow both episodic and concurrent rules (Maitreyi, 1993, Gupta, 1992), i.e., some rules which only operate during crisis may be called as episodic rules whereas those which are in operation in normal times are concurrent rules. During floods or droughts, the norms of using or sharing resources may vary. In case of agro biodiversity, the leftover nursery of paddy when used for late transplantation due to early floods may give rise to conditions favouring selection for older nursery plants. In Bangladesh, farmers had selected land types within IR 8 variety, which could be transplanted almost with 90 to 100 days nursery, reducing the risk for the crop in field. The normal age for nursery is about 45 to 50 days.

The institutional conditions play an important role in certain cases where farmers may have to follow (a) specific sowing periods to coordinate general maturity time, attack of birds and management of pest and diseases, (b) synchronized water management including pre-sowing channel cleaning and repairing, (c) norms regarding farmer to farmer seed exchange to avoid seed from one plot, even of the same variety being sown on the same plot next year to avoid accumulation of soil based pathogens, (d) isolation

[3] Kirit Patel, 2003, personal communication
[4] It is said that a community of growers of a particular mango variety pierce it with a needle before sending it outside so that no body can grow its seed.

distance in case of cross bred crops, (e) restrictions on diffusion of seed outside the community (f) specific cultural norms requiring conservation of certain companion plants (also called as weeds) in main crop (for instance, *Echonoloa colona* in paddy field. This companion plant is recommended to be eaten in specific festivals as a food permitted during fasts), (g) private rights in trees growing in common lands to allow individual selection and thus generation of diversity, (h) ecological and productive linkages among cultivated and wild relatives on an on-going basis so as to allow population level robustness, and (i) domesticated knowledge and norms about harvesting wild grown plants for consumption.

To understand the role of various incentives including the ones offered by the Intellectual Property Right regimes, I have recently argued that we need to understand the relationship between the technology, institutions, and culture[5]. The technology is like words. Institutions like grammar, and culture is like language. The technology provides the means to change the ratio of inputs and outputs or production function. The institutions provide the rules, norms and values under which, (a) choice of inputs to be transformed may be decided[6], (b) the means through which transformation is sought to be achieved[7], (c) the scale of exploitation[8] and various other ways purposes of social existence are achieved. Thus technology provides the building block of resource transformation, institutions provide the norms and rules by which this transformation is achieved through collective choice, and culture defines range of choices which are sanctioned by the community and which are not.

[5] Gupta, Anil.K., 2003, Will Patents Preserve the Experimental and Innovative Spirit and the Conservation Ethic at the Grassroots, Geneva, UNEP, forthcoming.

[6] If communities have institutional norms about not extracting biological resources from sacred groves or sacred waters, even though technology for doing the same might exist, communities and individuals might decide against drawing upon such resources. Thus institutions determine the rules by which technology might be used.

[7] The birds are known to be one of the major pest of crops particularly at maturity, and farmers have develop bird scaring devices around the world. They would rather sit on a raised platform under the hot summer scaring birds or using various other means of scaring birds but not kill them either by mixing poison with grains and scattering the same around the field or shooting them. Means of achieving the end, of saving the crop is as important, if not more, as the end itself. This is an institutional issue, which determines the choice of technology.

[8] In Bhutan, shingle wood for repairing roof of the houses is supposed to be collected on a particular day by the community together so that every one can monitor each other's collection, ensure that wood is also collected for some one who could not come due to sickness or otherwise and identify the sites for repair of watershed damaged due to landslides or other natural actors, save each other on steep slopes if any one fell down and perform many other functions. The scale of harvest is determined by the norms about collective interest in social welfare as well as sustainability of the resources.

Incentives will thus need to be tailored to the contingent conditions of the interplay between institutions, technology and culture. The other variables such as market conditions, socio-economic endowments and other infrastructure are expected to mediate their effects through the evolution of institutions, technology and culture. The transaction costs to be incurred by the conservators of agro biodiversity will also reflect this interplay. Another investigation by the author based on the study of the same villages at the interval of ten years in eastern India has shown very serious level of decline of local land races.

What is less well appreciated is the freedom and autonomy that many individual farmer innovators enjoy in selecting off types of plants leading to development of new varieties. There is no doubt that farmer breeders are able to make contribution only because previous generations have conserved so much agro biodiversity. But, if incentives are tailored only to conservation function and not for augmentation, innovation and diffusion function, then the value chain of agro biodiversity will not develop. To illustrate this issue, the gene banks were never expected to take into account the knowledge, values and institutions of the communities, which conserved agro biodiversity. Accordingly, none of the gene banks used descriptors for cataloguing germplasm, which included columns for this kind of information. So much so, the culinary information, which could provide tremendous insights about the food processing potential, was also not collected from the women manager of agro biodiversity. The gene banks did not define the food processing industry as their clients. There were no incentives for them to do this because they did not have to justify servicing any client other than breeders. It is a different matter that breeders also did not take into account medicinal and processing uses very many times.

There are four kinds of incentives, I have suggested (Gupta, 1989, SRISTI, 1993, Gupta 1995) which can be put together while developing portfolio of incentives for rewarding individuals and communities that conserve, augment, innovate and diffuse new varieties and related technologies. These are material-individual, material-collective, non-material-individual and non-material collective. Honey Bee newsletter and Knownetgrin database (sristi.org/knownetgrin.html) and list of awardees honoured by National Innovation Foundation (NIF) (nifindia.org) provide details of the inventors and innovators at grassroots who have developed new varieties and other innovations without any outside help. Our contention is that if so much could be done without external incentives,

wouldn't the scale and scope of creativity, conservation and collaboration for augmenting agro biodiversity increase if properly conceptualised incentives were put in place.

The case for incentives exists more strongly when we do not consider agro biodiversity as a completely public domain good. Since human use is a necessary condition for development and reproduction of agro biodiversity, it is a different kind of a utility good. For present, we might call it quasi-public – quasi-common good. In some cases, the publicness is more pronounced and in some cases commonness is more pronounced. There are also cases where private proprietary rights in the development of the variety are considered most vital. Even in those cases, the private rights will be restricted to the improved characters and not to the entire germplasm. The germplasm, in general, will be governed by the national sovereign rights as per the CBD.

The specific incentives could be :

(i) material-individual

a. Conservation: individuals who undertake the responsibility of growing few lines of different landraces in a limited area may be given incentive price for the purpose and the seed may be procured for distribution to other farmers. Alternatively, if there is no demand, they may be paid premium price for an acre of land in which 10 – 15 landraces may be conserved so that farmer concerned does not suffer any loss. This way, he or she would not have any regret for not having grown high yielding varieties instead of local landraces in one acre.

b. Augmentation: Farmer individuals who characterize local landraces with some new properties, or validate the traditional knowledge which was collected through folklore documentation but for which evidence did not exist, contribute through augmentation. Apart from meeting the experimental costs, such farmers can be granted travelling scholarships, research projects and other financial and non-financial incentives to provide such knowledge which

scientists would find much more difficult to develop and also will spend far more resources.

c. Innovation: Development of new varieties through selection, crossing, grafting or other techniques would constitute innovation. Apart from the coverage under Plant Variety Protection and Farmers' Right Act (in which Indian government not only recognizes individual and community rights but also provides for compensation from the gene fund if such varieties have been used to develop commercial varieties), such farmers could be given venture capital support for setting up their own seed companies or licensing their technologies to third party entrepreneurs or setting up join enterprises. They can also be given grants to develop specific varieties for disadvantaged regions and people. It is natural that if such farmers were given the privileged access to the germplasm bank of the farmer institutions they could develop much better varieties at far lesser costs. Unfortunately, much of the international research which passes under the name of participatory plant breeding scrupulously avoids partnership with such farmer breeders (probably, because like any other innovator they generally are headstrong, assertive and not easy to get along with). Innovators can also be given financial support for hiring scientists and students to work under them.

d. Diffusion: Farmers who contribute to the diffusion of agro biodiversity through recipe competitions, varietal fares, barefoot extension workers, sharing seeds freely or at very low costs, organizing farmers fare at their farm, etc., deserve compensation for their contribution.

There could be many other incentives which can be provided by the state, private sector and even the international institutions. The large multinational seed companies could help such farmer breeders discover international markets for their creative products and generate wealth for individual as well as community

development. Unfortunately there are no examples where large companies have used their infrastructure to support such innovators and other individual and community knowledge holders.

(ii) Material-collective

The insurance funds, micro venture capital funds, risk funds, grants to village councils or communities for conservation, augmentation, innovation or diffusion, grants for village to village diffusion, organization of village fare and granting of awards to the village conserving most landraces, etc. Special procurement centres could be set up in such villages which have high agro biodiversity and which are likely to switch to high yielding varieties if they were not given premium prices.

(iii) Non-material individual

Honour, recognition, invitation to institutions of higher learning at national and international level, etc., are some of the ways in which non-material rewards can be given to the individuals. One could name important buildings, streets or even varieties after such farmers who may have made unique contribution to any of the four functions of agro biodiversity, viz., conservation, augmentation, innovation and diffusion.

(iv) Non-material collective

Organisation of exhibitions where outstanding villages can showcase their efforts, bringing about changes in the curriculum and educational policy to represent the efforts of the communities properly and with honour, changes in the public policy for other sectors including procurement, storage, public distribution.

In this short note, the argument essentially is that incentives can indeed be tailored to specific conditions for both individuals and groups and various stakeholders including national and international, private and public institutions as well as NGOs can play very specific role. The less we consider the task of *in-situ* conservation, philanthropy, higher will be the chances that we will make progress.

The urban demand for niche products whether organic or otherwise can indeed provide a great stimuli for conservation. But this will require different kind of mediation and different kind of dialogue between private sector entrepreneurs and public agencies concerned about conservation. Conservation is too serious a business to be left to the breeders alone.

PART TWO

Breeding by farmers: lessons for learners

Breeding is not only science but also an art. Some of the best breeders have always followed an intitutive approach which at times, counteracted, contradicted or complemented their more rational and quantitative approach. Farmers, both men and women have followed interesting dimensions in deciding selection criteria.

1. *Taxonomy of selection criteria:*

   We need to develop systematic inventory of the criteria that farmers have used while selecting and maintaining local germplasm as well as the improvements in the same through development of new varieties. Recently, during 17th Shodh Yatra in Koraput in Orissa, we came across a lady farmer who explained her breeding goal.

   In a public meeting at Mali Marila, a lady breeder, Laxmidei Hantala was felicitated for her keen spirit of experimentation. She observed that in kankada (spine guard) after two female flowers, one male flower appears. She is experimenting with her breeding technique, so that she can produce ten female flowers in proportion to one male flower to increase the production of the spineguard. What kind of support system is available to enable her to pursue her breeding goals more systematically? Why should that not be possible? How do we compare different breeding goals across space, season, sector and species?

   When Dhulabhai selects pink to red flower pigeon pea mutant and discovers that the red flowers do not attract as much pests as conventional yellow flowers do, how do we give primacy to such a breeding goal in the wake of current crisis in plant protection. Thousands of farmers attempting suicide

because of increasing cost of cultivation particularly due to ineffective chemical pesticides don't seem to disturb and reorient our breeding goals of varieties in future.

2. *Characterisation of indigenous germplasm from food processing and nutriceuticals perspective:*

I have failed to persuade ICAR and NBPGR yet to recognise the potential that exists in a mammoth urgent exercise for creating proper passport data sheets of germplasm from the point of view of emerging opportunities in national and international markets. The communities have maintained tremendous knowledge with regard to unique properties of different germplasm used in different recipes or nutriceuticals. This is an area where a major participation can take place between people and professionals to augment our capacity to both conserve and reward the creativity and traditional knowledge.

3. *Integrating crop, livestock, craft and tree characteristics in the breeding programmes:*

The farmers don't grow just crops. They have other species and occupations. It is natural that they would try to forge some synergy at the portfolio level. Can community knowledge about genetic resources be understood and analysed from a portfolio perspective to generate new insights about selection criteria, sustainability and synergy with market goals wherever possible.

4. *Reorienting breeding strategy in drylands:*

Despite the fact that majority of the dryland farmers survive during droughts through livestock, the appraisal of the varieties in the coordinated research project continues to be on the grain yield basis. This contradiction was identified through three-tier workshop on the subject organised through IIMA in collaboration with CRIDA and ICAR in 1988-89, but the lessons have not yet been learnt. When foreign consultants will advise this at great cost to the country, learning might become easier. Just as after decades of research and so-called participatory appraisal, ICRISAT learnt that farmers preferred different harvest index in rainfed crops.

PART THREE

I have mentioned some of the key ideas that need to be taken into account while learning from farmer breeders at individual or collective level. Honey Bee Network and NIF have been awarding farmer breeders in various annual as well as plantation crops. But we do not have any arrangement through which either NAAS or ICAR will take a systematic critical look at this knowledge pool and try to build links between peoples' knowledge and the institutional knowledge. In the process both suffer. Recent report of the Farmers Commission demonstrates this diffidence quite eloquently. There is not much willingness in the system to give a fair trial to farmers' knowledge and rather than seeing them as a threat or a competitor, make them a partner. NIF has MOUs with CSIR, ICMR, NBRI and BSI already. It is quite possible that ICAR may also see the merit in near future for a partnership with NIF in building bridges between excellence in formal and informal science. I had recently argued in my B.D.Tilak Memorial Lecture at INSA that scientists should consider interacting with informal scientists because the grassroots knowledge could help in extending frontiers of science in some cases. It is not so much to help farmers but to help themselves that scientists should pay attention.

I must put on record my deep appreciation for the interest that the PPVFRA is taking in the subject and I hope very soon we will have a system in place for according respect, recognition and reward to the farmer breeders. The support from several agricultural universities, particularly in south (Kerala, Tamil Nadu and Karnataka) is greatly appreciated. In due course, we may have lessons from the farmers breeding experiments as a part of curriculum and pedagogy of plan breeding and genetics in the country. I recall the dialogue that we had between the farmer breeders and the scientists at Crop Science Congress at Vigyan Bhavan more than a decade ago. We need to have such dialogues at national level in various coordinated research meetings so that a healthy respect can be created for what farmers do under tremendous constraints.

The contribution of farmer breeders in conservation, augmentation and innovation is evident from the database that Honey Bee Network has built over the years. There is no doubt that in near future we will have a healthy and synergistic partnership between farmers and scientists for mobilising new gene combinations for improving productivity, reducing costs and external physical inputs and maximising knowledge inputs in agriculture.