PARTICIPATORY PLANT IMPROVEMENT

PROCEEDINGS OF A WORKSHOP

organised by

M.S. Swaminathan Research Foundation

and

ICRISAT

Proceedings of the workshop on
Farmer Participatory Methods in Research
and Development for the Semi-Arid Tropics
ICRISAT, India

27-28 October 1998

Organised by

International Crops Research Institute for the
Semi-Arid Tropics, Hyderabad
and
M.S. Swaminathan Research Foundation, Chennai

Citation : Participatory Plant Improvement : Proc. MSSRF - ICRISAT Workshop. 1998. MSSRF, Chennai

Cover Photo : A tribal farmer from Malkangiri, Orissa

Contents

Preface

The Convention on Biological Diversity (CBD) adopted at Rio and since ratified by about 180 nations is designed to promote **Conservation of biological diversity, Sustainable utilisation, and Equitable sharing of benefits and transfer of technology**.

In spite of the three meetings of the Conference of Parties to CBD held so far, progress in developing agreed methods of benefit sharing has been slow. Genetic erosion is still severe in many countries. In India, habitat destruction of biodiversity-rich areas in northeast India and the Western Ghats is extreme. Hence, many economically important species of these regions are in the Red Data books.

The primary conservers remain poor, while those who utilise their knowledge and the material conserved by them become rich. Tribal and rural women and men are still observing their traditional conservation ethics, thereby serving the cause of public and commercial good at personal cost. This situation may not continue for long, and preservation of biodiversity may become a lost cause unless the local population develops an economic stake in conservation. Such an economic stake can be created only by implementing the equity provisions of CBD, both in letter and spirit.

A MSSRF project proposal incorporating the yet-to-be-implemented provisions of CBD was accepted and funded by the Swedish Development Corporation (SDC) for the period 1998-2001. The project titled 'Conservation, Enhancement, and Sustainable and Equitable Use of Biodiversity' has a major componental activity - **Participatory Plant Breeding** (PPB) of location-specific varieties of economic plants. The primary aim of this activity is to enable tribal and farm families to initiate PPB in collaboration with scientists. The farmers' agro-biodiversity conservation and improvement system will be given explicit recognition as an autonomous breeding system. Participatory breeding will help to convert on-farm conservation to on-farm management of agro-biodiversity. Such participatory breeding work will be linked to training in seed technology, including aspects of post-harvest technology.

The project, initiated in June 1998, took into account the tribal and farm family status and environment and chose the crops for PPB in three target sites: Jeypore Tract of Orissa (rice), Wayanad district of Kerala (medicinal rice, pepper), and Kolli Hills of Tamil Nadu (minor millets). Working infrastructure, including the appointment of a Research Associate in each of the areas, has been organised. Participatory farmers have been identified in the locations. In Orissa, the farmers have grown their rice crop along with small PPB experimental plots. Preliminary data could, therefore, be collected and evaluated to provide the base pre-PPB situation.

It was felt desirable to have a dialogue at this stage with scientists involved in similar participatory research programmes. ICRISAT has done important participatory research in pearl millet and other crops in their national and global participatory centres. They were kind enough to support the dialogue by organising a two-day workshop at Patancheru, Hyderabad on 27 and 28 October 1998. Papers presented on relevant areas of participatory research provided a platform for fruitful discussions and reorientation of PPB programmes where necessary.

This compendium provides the papers presented at the ICRISAT workshop along with a review of the PPB programme and a comprehensive coverage of the discussions and suggestions. The assistance of Geetha Râni in compiling the papers and of Gita Gopalkrishnan in editing them is gratefully acknowledged

V. Arunachalam

M. S. Swaminathan Research Foundation
December 1998

Workshop on Farmer Participatory Methods In Research and Development For The Semi-Arid Tropics

27-28 October 1998 at ICRISAT, Hyderabad

27 October 1998

0845-0900	Introduction to the meeting	S. Parthasarathy
0900-1030	Participatory Methods to Enhance the Quality of Germplasm Collections	P.J. Bramel-Cox and A. Christinck
	Evaluating Pearl Millet Cultivars with Farmers	A. Christinck and K. vom Brocke
	Farmers' Participation in Pearl Millet Breeding in Marginal Environments of Rajasthan	O.P. Yadav
	Farmer Participation in Pearl Millet Research in Namibia	F. R. Bidinger
1100-1300	Farmers' Participatory Varietal Selection for Improving Rabi Sorghum Productivity in India	B.S. Rana, S.L. Kaul, Chari Appaji, B.V.S. Reddy, J. R. Witcombe, and D.S. Virk
	Farmers' Participatory Research in the Development of an Integrated Pulse Pest Management Programme in Southern Asia	G.V. Ranga Rao and V. Rameshwar Rao
	Farmers' Participatory On-Farm Evaluation of Groundnut Foliar Disease Management Technologies in the State of Andhra Pradesh	S. Pande and H.D. Upadhyaya
1400-1530	A Participatory Plant Breeding Program at Jeypore, Wayanad and Kolli Hills	V. Arunachalam, Geetha Rani, S. D. Sharma, N. Anil Kumar, and D. Dhanapal

1500-1530	**Gender Dimensions in Farmers' Participatory Research**	**Hemal S. Kanvinde**
1600-1700	**Discussions**	

Wednesday 28 October

0900-1300	Voluntary Code of Conduct and Issues Related to Access and Benefit Sharing	**P. Balakrishna**
	Discussion Groups in Monitoring	
1400-1530	Plenary Session	
1545-1600	Closing Remarks	

Participatory Methods to Enhance the Quality of Germplasm Collections

P. J. Bramel-Cox and A. Christinck

In the past, ICRISAT's traditional collection trip consisted of a team which included an expert on the crop from ICRISAT and a local expert. The collection sites were selected based upon the knowledge of the crop specialist or priorities set by breeders of the crop. Essentially, the focus was on conserving and using "valuable diversity" in landraces and/ or wild species. Collections were made mainly for breeding programs, classification, or conservation. The increasing need for such collections by the national programs, by NGOs, and by local communities requires a rethinking on the collection procedures to be used and the types of information needed for the passport databases. The increased value of genetic resources to the country of origin requires that we consult the local users when determining the priority to be given. The process from identification of the collection sites to regeneration and evaluation of collections needs to be more participatory with a broader group of users. The targeting of priority areas should include information on environmental heterogeneity, history and distribution of the crop, cultural diversity, history of the movements of people, and possible threats of genetic erosion. There are many sources of this information and these need to be consulted for planning.

Participation of local experts will be critical to this process and in the make-up of the collection team. This team should have a thorough knowledge of the possible sources of diversity among and within landraces. This will assist in the identification of priority areas and possible sources of unique genetic material. Some understanding of the number of landraces grown in an area helps to predict the degree of diversity among landraces and insures all are adequately sampled. This information can usually be obtained from the local extension agent. Another source of this information may be in past crop surveys done by other government agencies, university scientists, reports of NGOs on food relief or community seed banks, FAO/UNDP reports, or student thesis reports. A review of previous collection trips and all germplasm held in international or national gene banks will also be useful. The status of past collections by less traditional sources also needs to be determined.

The focus of the collection can be multipurpose — *for the national gene bank*, for development programs, collections for specific breeding programs, or for scientific study. All these need to be determined ahead of time and their specific requirements addressed. They could differ in the sampling strategy used and the information needed from the farmers. Sometimes they can be the same but it is best if viewed differently. The collection for the gene bank would concentrate on maximum diversity with a minimum number of samples to represent the degree of diversity among the factors. The samples would have to account for diversity both among and within landrace and in the fields. On the other hand, the collection for breeding programs might concentrate on identifying sources of improved farmer varieties. The need could be the same for development programs but information from farmers on them would be more important and targeted.

The planning phase should include specific requests from the NARS and the team should represent the needs of the trip. The country's support should include research as well as extension agencies. Relevant NGOs should be involved in planning, especially those with experience in community seed banks, rural appraisal methodology, food aid, or any other development. This broad team for planning would then be narrowed for the actual collection but their assistance may be solicited for local collection activities. Planning should also take into account reports developed from previous surveys and databases on crop diversity. They should be the base to *predict the diversity in a locality and* possible urgency of the collection. Priority areas will however be identified on all the sources of information. This planning phase may include actual visits and preliminary surveys in the targeted localities to set final priorities.

Collections can be made by a single team or can be co-ordinated through local or regional staff. Each team should be made up of at least one woman and local guides who speak the local languages. The single team model was used in the past but requires more careful planning *to time the collection, for example*, to coincide with the seed harvest. This can present problems for documentation because of the range of maturity of the crop that was grown. The best model might be to use a team to identify specific collections to be made and then request local co-operation from the extension agents or NGO staff to make the final collection of the seed. This model might require special instructions to be given to the staff for seed drying or storage. If they obtain seed of acceptable quality from the farmer this can be accommodated. Farmers have a good understanding of methods of seed conservation for their local conditions; therefore, seed samples obtained from their stocks should generally be of acceptable quality. Needs of special sampling strategies will have to be planned ahead of time and this information communicated to the farmers and local staff, to elicit permission from the farmers for special requirements. Individual plants or heads, as required, need to be left for sampling. It is best to specify to the farmers whether individual heads or a sample of a bulk is required. Flexibility to accommodate the procedure used by farmers to maintain their seed is a good option.

Information to be gathered from the survey to better document farmers' traditional knowledge of landraces should include the following:

- *Farmer's name and description of environment* : This can include the more traditional type of information of the collection site but may be made more specific by including the farmer's own description of the field site. The farmer's name should be as correctly documented as possible.

- *Description of the characteristics of the variety, both by the farmer and the collection team* : Simplified classification to rapidly describe specific attributes will assist both documentation and data collection in the field. More elaborate statements on the specifics of the attributes can be written in narrative on the forms as well. The general categories could be morphological, agronomic, and specific stress reaction. It should concentrate on both positive and negative aspects. This is one of the most difficult pieces of information to verify but its value can be judged later. It should be attempted only to document this information clearly without questioning its integrity. The collection team should listen to learn from the farmers and not teach or challenge the validity of their observations.

Description of the end use and specific properties of the variety : This should include discussions of its cooking/processing/storing properties. The market value for specific products can be requested. The constraints to its use or storage should be learnt, including the quality of its products and specific storage practices used for ensuring a crop and its seeds (which, in fact, can be very different).

Description of normal cultural practices used with a variety or landrace : This information is best taken in the field. It can include a comparison with other landraces grown by the farmers. Information should be collected on the role each gender takes in cultivation and an effort made to discuss the specifics with the proper household member. This can be difficult without a mixed gender collection team.

Discussion of the history of the variety with the farmer : As thorough a discussion as possible of the selection history of varieties should be undertaken. If it results in the identification of another farmer who has had a long previous history, then an effort would be needed to collect the information from that farmer. The longer the history and more the effort made by the farmer to select the seed stock, the more important would be the collection. This question should also be explored in the field *so that the actual selection* procedures used by the farmer (either male or female) can be seen. The gender of the selector for each phase of selection during harvest and storage should be recorded.

The team should use a semi-formal questionnaire (**Appendix 1**) to verify *the information* by *brainstorming after* the collection is made. A summary of all the information gathered can be written for the collection trip report. Such documentation needs can be specified during the planning phase and should incorporate the requirements of all the participants.

When *the primary focus of the collection* is the needs of national programs or of local communities, a broader partnership can be built with the NARS to strengthen both genetic resources and breeding program capability. The collected germplasm could be evaluated in the relevant local environments. This grow-out could be used to regenerate and characterize the collection in the country of origin for the gene bank. A field day could be planned to solicit farmers' input into the identification of locally-adapted farmer varieties that could be a base of the NARS breeding program. Collection, documentation, and evaluation of the locally adapted farmer varieties could lead to a design of the breeding program by the national program, private sector, or NGOs whose goals are to meet the needs of the traditional farmers. This would allow the primary benefits from this collection to be shared among the country of origin and the local communities. The global importance of the collection would be secondary but its value would be enhanced with additional information.

Farmer's survey form used in collection of sorghum varieties from the Lowlands of Eritrea

Farmer's name ______________________________

Site characteristics

Topography (local name) ______________________________

Site (local name) ______________________________

Soil (local name) ______________________________

Farmer's description of landraces

Landrace name ______________________________

Type within landrace characteristics ______________________________

Farmer's

Collector's

Morphological

Maturity	early	medium	late	
Plant height	short	medium	tall	very tall
Tillering	none	1 or 2	many	very many
Head compactness and shape				
Curve	bent	erect		
Head size	very small	small	medium	large
Plant color	pigment	tan		
Grain color	white	yellow	red	brown
Glume color	tan	red	purple	
Glume coverage	0-25	25-50	50-75	complete
Race				
Stem thickness	thin	average	thick	
Leaf type	thin, short	thin, long	thick, short	thick, long

Agronomic

Grain Yield	Low	medium	high	
Fodder Yield	Low	medium	high	

Building	Low	medium	high	

Disease Problems

Problem	Susceptible	resistance

Insect Problems

Problem	Susceptible	resistance

Weed, Storage Pest, or Bird Problems

Problem	Susceptible	resistance

Stress Reactions

	Sowing	seedling	heading	maturing
Month				
Drought				
Water logging				

End Use

Local bread	Poor	good
Injera	Poor	good
Porridge	Poor	good
Local beer	Poor	good
Popping	Poor	good

Quality

Taste	Bitter	sweet
Cooking time	Poor	good
Threshing ease	Poor	good
Dehulling	Poor	good
Storeability	Poor	good

Cultural practices

Planting time ____________________________
Number of weedings ____________________________
Harvest time ____________________________
Irrigated or rainfed ____________________________
Number of times to irrigate ____________________________
Fertility requirements ____________________________
Intercropping or sole cropping ____________________________
Normal crop rotation ____________________________

Source of seed

Own crop ____________________________
Number of years
before that ____________________________
Received from relative ____________________________
When ____________________________
Purchased from others ____________________________
When ____________________________
Given as gift ____________________________
When ____________________________
Relief Agency ____________________________
When ____________________________

Seed selection and conservation practices

Timing of selection for seed
Field prior to harvest ____________________________
Field at harvest ____________________________
Prior to threshing ____________________________
Save from bulk after threshing ____________________________
Harvest or production of seed stocks
In same field as crop ____________________________
In separate area of field or
separate field ____________________________
Any special cultural practices ____________________________
Thresh separately ____________________________
Drying procedures ____________________________

Selection criteria used for seed stock

Selection criteria used for seed to plant

Evaluating Pearl Millet Cultivars with Farmers

A. Christinck and K. vom Brocke

"Enhancing quality, diversity, and productivity of farmers' pearl millet genetic resources in Rajasthan" is a collaborative project between ICRISAT, its national partners in India, GTZ, and the University of Hohenheim (Germany). Our main focus is to describe farmers' own seed stocks of pearl millet in terms of productivity and morphological as well as genetic diversity, and also farmers' strategies for improving their pearl millet cultivars and maintaining the seed quality. For this purpose, a population geneticist (Ms. Kirsten vom Brocke) and an agricultural social scientist (Ms. Anja Christinck) are working closely together on this project. Methodologies for evaluating farmers' germplasm are required for nearly every part of our research agenda, be it comparisons between purchased varieties and farmers' own material, or between material collected from different villages and in different years, or for assessing the effects of separating food and seed grain. Earlier activities in Rajasthan carried out by Dr. Eva Weltzien (ICRISAT) and Mohan Dhamotharan (University of Hohenheim) resulted in some methodological experience of how professional researchers could communicate with farmers in an efficient way. These methods, mainly based on PRA approaches, could be further improved for a variety of research topics. In this workshop, it is desired to share some of the experiences and results obtained so far in evaluating germplasm with farmers.

Main differences in the research approach of farmers and scientists

Farmers have developed technologies and evaluated innovations since many centuries, although their methods have seldom been understood or recognized. In the case of pearl millet in Rajasthan, at least 10-15 landrace cultivars adapted to a wide range of conditions from sand dunes to high quality irrigated soils can still be found now, giving testimony to the abilities and wisdom of people living in this harsh, very diverse, and often unpredictable environment.

The main differences in the research approach of farmers and scientists are :

- Farmers deal with complexity (whole farm and family, natural as well as social environment), whereas professional researchers tend to reduce complexity, and work on isolated cause-effect relations.

- Farmers can evaluate their observations immediately and easily, because they are at the same time the users of the technology. Researchers have more difficulties in evaluating their observations in a relevant way, as they do not know the complex situation of the user of the technology.
- Farmers have a unity of study, work, and life, and most often conduct life-long observations (including long-term effects) in a specific environment. Professional researchers often have a separation between their work and private life, live in cities, and have a completely different lifestyle. In the case of pearl millet, they might not even eat the food crop on which they conduct their studies, and they might be transferred to other stations several times during their career.

The result of these differences is that farmers and professional researchers might tend to give more emphasis to those observations in the particular setting of their lives and minds, and rank the results of their observations on different criteria. As farmers (particularly poor farmers) are supposed to be the "beneficiaries" of most of the research work done in pearl millet, their perception and experience, if considered, would add to the relevance of formal research.

Classification of pearl millet cultivars done by farmers

In the course of our research, we have asked farmers to classify different pearl millet cultivars on many occasions but with different objectives. The main methodological approach was visual sharing—having a range of grain samples, panicles, whole plants or even plots in front of us while discussing. It is interesting that the villagers themselves often suggest this method by showing grain samples to us, or asking us to go to the fields and see the plants there.

An interesting result of such exercises was that farmers use "botanical descriptors" for differentiating pearl millet cultivars, like, for example, size, colour, and shape of grains, size and shape of panicles, stem diameter, number and shape of leaves, number of tillers and synchrony of tillering, etc.

At first sight, there does not seem to be much difference in this approach and how scientists describe and evaluate millet cultivars. But our experience suggests that farmers use botanical traits in a different way. For them, they are intimately related to environmental conditions as well as quality aspects and potential use. The botanical characters do not seem to be "fixed", but continuously evolving under environmental conditions to which the plant is exposed. Consequently, the environment where a plant type would do well is an integral part of the classification system, as are also potential uses or constraints.

In workshops with farmers in September 1997 and in September, 1998, participants related botanical traits to environmental adaptation and quality aspects.

Traits observed and related by farmers to environmental adaptation or quality

Trait observed	Related adaptation/quality aspects
• panicle size	• yield and vigour
• panicle shape	• drought resistance
• compactness of panicle	• yield, susceptibility to bird damage, seed quality
• grain colour	• taste, market value, soil type
• grain size and density	• yield, taste, storability, nutritious value
• stem diameter	• drought resistance, fodder value, susceptibility to breakage
• number of tillers and synchrony of tillering	• yield, adaptability to environmental conditions
• number, shape, and colour of leaves	• fodder value, drought resistance, adaptation to soil fertility
• plant height	• fodder yield, adaptation to soil type

Diversity of preferences in a diverse social and natural environment

While asking farmers from different villages in Rajasthan or even different people within the same village to evaluate millet cultivars, the description itself might be similar, but the preferences may vary a lot or might even be contradictory. A social scientist would be led to find out reasons why people living in a similar natural environment have different views about millet varieties.

The life of rural people in Rajasthan is strongly influenced by social conditions such as gender and caste. The division of work between men and women shows that they have different fields of experience and expertise. Therefore, some traits might be perceived as very important by women and others by men, resulting in different ranking and preferences. Our results do indeed indicate that women give more importance to quality aspects, medical use, and fodder value than men, though it depends on other factors also.

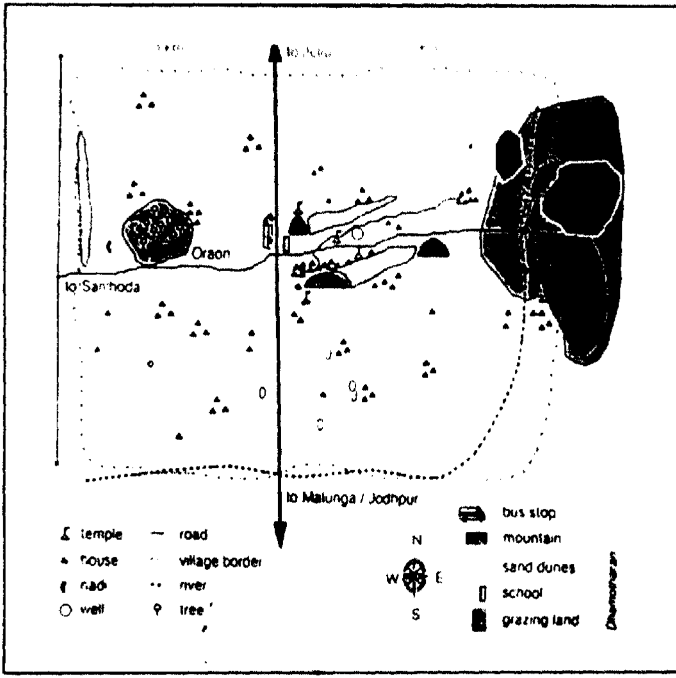
Division of agricultural work between women and men farmers and related fields of expertise

Women Farmers	Men Farmers
• store and prepare seed	• purchase seed in the market
• do weeding in different growing stages of the crop	• prepare soil for sowing
• do harvesting and seed selection	• do harvesting and seed selection (sometimes)
• prepare and eat food from bajra	• eat food from bajra
• feed and milk the cattle	• sell products in the market (grain, milk, etc.)
• observe health of family members as well as animals, and prepare medicines	• discuss with other villagers in local information networks

In many villages, the settlement pattern indicates that people of different castes reside in separate parts of the village. If different soil types are also to be found, it can be that people belonging to different castes have their fields in different soil types. This condition is not found in every village and depends very much on the history of the village. But in many cases, lower caste people seem to have land in less fertile parts of the village. Another point related to caste is the differential number and species of animals owned by different farmer families resulting in high or low availability of manure.

The map of village Digadi in western Rajasthan gives an example of the settlement pattern which is more or less organized by caste. The Rajput and Sutar people live mainly in the western part of the village, where lands are regarded as most fertile; Meghwal and other communities live on the eastern side of the main road where land quality is inferior, and sand dunes are prevalent.[1]

Map of village Digadi



---

1 From "Seed management strategies of farmers in western Rajasthan in their social and environmental contexts - Results from a workshop using new communication techniques for a dialogue between farmers and scientists", by M. Dhamotharan, E. Weltzien R., et al., Integrated Systems Project Report Series No. 9, ICRISAT Patancheru / University of Hohenheim (1997)

Besides gender and caste, there are several other socio-economic factors influencing the preferences of farmers with regard to millet cultivation.

Socio-economic factors influencing farmers' preferences regarding millet cultivars

Socio-economic conditions	Influenced preference
• large number of cattle and/or possibility to sell milk or milk products	• tall varieties of high fodder value (e.g. certain landraces)
• regular occurrence of drought years	• long-term storability of grain and fodder, drought resistant plants
• access to cash income	• saving own seed can sometimes become less important
• no access to loans/cash money at the time of sowing	• possibility to produce own seed is extremely important
• size of land holding small (mainly subsistence-oriented)	• varieties which are good for home consumption (high quality of food, fodder, good for medicinal use, etc.)
• size of land holding larger (more market- orientated)	• varieties which are good for selling in the market (high grain yield, light grain colours, etc.) very often additional to varieties which are good for home consumption

In short, millet varieties do not only have to fulfil the need to grow in a certain range of rainfall or natural environment, but any new technology has to be compatible with the overall farmers' "environment".

Methodology

Methods used have been developed from PRA approaches. They comprise mainly semi-structured interviews, classification and ranking exercises using grain samples, panicles, whole plants or plots for visualization. For example, grain samples in small plastic jars were shown to farmers, and about 100 panicles showing different traits. Jars or panicles can be numbered for easier documentation of results. For on-station evaluation, demonstration plots were grown which allowed evaluation on single plant as well as plot basis.

The methods can be used at any stage of germplasm evaluation—prior to collection to identify material which needs to collected, to identify typical or high quality material during collection, for evaluating collected material, or identification of base populations for breeding. The same methods can also be used for evaluation of breeders' material or varieties before or after release.

According to the objective, the methods can be used in a variety of situations: with individual farmers or small groups at their homes, in the fields, and even at road-sides and village tea-shops; during farmers' workshops and meetings in villages; or at research stations. Some methods, particularly those using grain samples and panicles, can be done off-season also, independent of he growing season.

Importance and outlook

In our experience, farmers' evaluation of millet cultivars is an efficient way to screen material for environmental adaptation, potential uses, and main constraints. Farmers' participation can therefore help to efficiently allocate resources, target potential needs, and avoid unpromising efforts in formal research work. However, some expertise and clear methodology are required to identify villages and individual farmers for co-operative participation with scientists and research institutions, as well as for facilitation of discussions and exercises.

Farmers often have complex traits under observation, like, for example, adaptation to a wide range of conditions, food quality, etc., whereas scientists focus most often on traits like grain yield and disease resistance that can easily be quantified. Consequently, evaluating millet cultivars with farmers can particularly help to understand better the value and importance of landraces which are most often ranked much higher by farmers than by scientists.

Information given by farmers can stimulate the work of scientists in many ways, such as developing new methods to quantify traits preferred by farmers or for a different way of taking observations. The direct feedback from farmers might also add to the motivation for innovative research.

Farmers' experiences can also help to identify new fields of action. For example, the formal system of seed multiplication and distribution seems to fail often in the case of improved millet seed in Rajasthan, so that the farmers do not capture the full benefit of new varieties. Farmers frequently stressed this point when seed management was discussed.

For establishing a culture of dialogue and co-operation between farmers and scientists, we should also think about how relationships can be founded which are satisfactory not only for the scientists but also for the farmers. Our experience is that farmers are interested in long-term relationships that may not be restricted to one single and specialized research topic. Furthermore, after identifying and analyzing problems, farmers are interested in solutions and how to bring them into action. These activities are sometimes not what scientists can organize and do, and they might not also be the most qualified persons to do so either.

Lastly, innovative project designs should be developed giving more emphasis to the process of research. Defining needs, selecting methods and evaluating results in a participatory way for each phase of the project could become a standard procedure. Of course, funds and expertise have to be allocated accordingly.

In future, possibilities exist in all these fields for extended partnerships between research institutions and NGOs.

Farmers' Participation in Pearl Millet Breeding in Marginal Environments of Rajasthan

O P Yadav

There are several good reasons for involving farmers in the breeding of pearl millet, especially in marginal areas of the State of Rajasthan. Climatic conditions are extremely diverse in various parts of this State with the amount and distribution of rainfall varying greatly. In western Rajasthan, early withdrawal of the monsoon often results in moisture stress towards the end of the growing season. In addition, intermittent spells of moisture stress during the early growth stages of the crop are also not uncommon. Genotypes adapted to such diverse conditions may not exist and may be difficult to breed too. Thus, farmers look for optimal trait combinations in adapted cultivars to ensure some yield even in poor growing seasons. Their preference of traits is influenced by the type of soil on the farm, input purchase ability, size of land holding, livestock population maintained, and also the risk affording capacity. Though several high yielding cultivars including both single cross hybrids and open pollinated varieties (composites) have been developed and recommended for general cultivation (Yadav 1996), their adoption in marginal environments has been desperately low (Bidinger and Parathasarathy Rao 1990). Poor adaptation of high yielding cultivars to severe stress environments entailing high risk of crop failure has been one of the main reasons. Moreover, quality of grain and stover of the high yielding varieties (HYVs) are not as good as those of the local cultivars. Poor adaptation of elite new modern varieties to the low nutrient conditions is an additional reason for their low adoption. All these factors make the cultivation of pearl millet an ideal situation where participatory breeding approaches can be employed, so that cultivars developed through the involvement of farmers suit local conditions and possess preferred traits for adoption. In this paper, various issues that are important for farmers' participation in pearl millet breeding are discussed.

Defining goals and setting objectives

Goals of breeding programmes determine the type of germplasm used, choice of breeding method, and also experimental sites. The setting of appropriate goals in participatory breeding programmes is crucial. Farmers of Rajasthan in differing rainfall regions have different preferences for traits (Weltzien et al 1998). Though higher grain and stover yields are the foremost requirement of the cultivars for the drier regions, farmers may even sacrifice some grain yield in good years for better performance in poor years. Stover yield assumes more importance than grain yield especially in extremely poor years. Quality of both stover and grain is also an important consideration in western Rajasthan (Kelley et al 1996). Thin stemmed stover of local landraces and grain quality including grain colour, taste and keeping-quality of chapati are preferred. In the drier regions of western Rajasthan, early maturity and high tillering which farmers associate with low water requirement are preferred, while farmers from higher rainfall areas prefer large panicles over high tillering (Weltzien et al 1998).

Creation of variability

For creating the base material, breeding lines entering evaluation at research stations can be examined by farmers for a broader range of material than that available at their fields. Such evaluations need to be done under conditions close to those at farmers' fields. Selections by farmers can be utilised in constituting a broad-based population, and can be given to them after 3-4 cycles of random matings, for mass selection in the target environment. Large plots of such populations need to be grown to maintain their identity as it may not be possible to isolate them by adjusting the sowing dates during the crop season.

Pollination behaviour of pearl millet offers a grea. opportunity of obtaining desirable and highly variable populations. Though the HYVs have not been adopted on a large scale in marginal environments, farmers do prefer specific traits of the new elite cultivars. As a strategy to minimise the risk due to new seed source, farmers plant mixtures of new improved elite cultivars with their own local varieties. In pearl millet, these mixed sowings result in natural intermating of groups of material, thus creating highly variable populations. Such populations are extremely useful given that one parent is highly adapted to local conditions while the other can contribute towards higher productivity. Farmer-generated population crosses have also the advantage of recombination within large populations that may not be possible in a breeder's nursery. Moreover, breeders often make such crosses during offseason which is non-representative of farmers' field conditions. Such naturally generated populations can be evaluated by visiting the fields of farmers who had earlier participated in the on-farm evaluation of modern varieties and also in areas where adoption of HYVs is partial.

Farmer involvement in selection

- *Mass selection*

  Genetically broad populations or farmer-generated population crosses can be grown over large areas and mass selected in the target environment. The populations can be given to several farmers with different growing conditions. The selected plants can be harvested in bulk to constitute the improved version which can further be selected by the participatory farmers.

- *Progeny-based selection*

Progeny selection is more efficient than mass selection though it requires a little more scientific effort. Chosen farmers need to be trained to evaluate the progeny trials during the crop season, and effect desired selections.

Farmers harvest the open-pollinated seed from individual plants before general harvest. Seeds from each individual selected plant produce a half-sib family and are further subjected to natural outcrossing. Farmers evaluate half-sib families in the next season in order to select families with desired trait combinations. The breeders could then get one cycle of inter-mating done in the offseason, using remnant seeds. The improved bulks may be further utilised for cyclic improvements.

Other methods of progeny testing like full-sib or S1 families are more resource- intensive and require greater input from breeders to self or hand-pollinate plants to produce the families. Visible genetic differences among the progenies would be ensured for farmers to appreciate their strength for selection at their fields.

- *Defect elimination*

The major biotic constraint in pearl millet production is downy mildew. Farmer selection for overall adaptation, productivity, and quality-associated traits can be augmented by breeder's selection for downy mildew resistance. Farmers would select for ,resistance against local pathotype. In case of mass selection, the resistant plants can be transferred to the field for inter-mating. Progeny screening for downy mildew can be done using part of individual progeny seeds. Only disease resistant selections should be evaluated in the following season.

It would be useful to give the same population to farmers having different growing conditions. Such selections can be recombined in a single population to reduce the risk associated with reliance on only one farmer and to produce material with wider adaptation, though it could reduce the genetic gains that could be achieved with selection made by a single farmer.

Open-pollinated varieties would be the product of each selection cycle. If they are regarded as finished and acceptable products, they can go to formal testing systems or they can be utilised for further selection. However, it may not always be that the cultivars bred through participatory approaches outperform other contemporary varieties in the testing system. A few landrace-based varieties were eliminated on co-ordinated trials due to their below-average performance (Yadav and Weltzien unpublished data). But such trials are heavily biased for potential yield rather than for farmer-preferred traits and adaptation to marginal environments. Therefore, it would be logical that the product identified through participatory approaches be entered into informal seed multiplication programmes involving local farmers and non-government organisations, with technical guidance and assistance from the breeder. Since the varieties are developed using locally adapted material selected in the target environment for the traits preferred by farmers, they should find a ready place in their fields. The only requirement would be strong seed production programmes (informal or formal) to ensure timely and easy availability of seed.

References

Bidinger, F.R., and P. Parthasarathy Rao. 1990. "Genetic and cultural improvement in the production of pearl millet." In S.K. Sinha et al (eds.) *Proceedings of the International Congress of Plant Physiology, New Delhi, India, Feb 15-20 1988*. Vol. 1: 194–206.

Kelley, J. G., P. Parathasarathy Rao, R. E. Weltzien, and M.L. Purohit. 1996. "Adoption of improved cultivars of pearl millet in an arid environment: straw yield and quality considerations in western Rajasthan." *Experimental Agriculture* 32:161–172.

Weltzien R. E., M. L. Whitaker, H. F. W. Rattunde, M. Dhamotharan, and M.M. Anders. 1996. "Participatory approaches in pearl millet breeding." In Witcombe, J.R. et al (eds.) *Seeds of Choice*. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd. 143–170.

Yadav, O. P. 1996. "Pearl millet breeding: achievements and challenges." *Plant Breeding Abstracts* 66: 157-163.

Farmer Participation in Pearl Millet Research in Namibia

F. R. Bidinger

Pearl millet research in Namibia is a young program, but one that has always used a strong participatory approach. The extensive involvement of farmers in the program is a consequence of several factors: (1) the strong pro-people bias both of the post-independence government and particularly of the scientists who have been mainly responsible for the development of the program, (2) the fact that the scientists involved were not experienced with the crop and recognized the need for farmer input to set priorities and breeding objectives, and (3) a strong re-enforcement of a farmer participatory approach by the regional SADC/ICRISAT Sorghum and Millets Improvement Program (SMIP). This paper reviews the development of farmer participation in the Namibian pearl millet research program, based largely on published materials, supplemented by the author's personal knowledge of the program from a sabbatical year in Namibia in 1991/92.

Pearl millet (hereafter referred to as millet) is the main staple cereal produced in Namibia, largely because the rainfall and soils of the vast majority of the country are unsuitable for either arable agriculture at all, or for more productive cereals such as maize or sorghum. Millet is still preferred by consumers, but the lack of marketing, processing, and retailing channels for the crop means that town and city dwellers depend on (largely imported) maize meal. Despite the importance of millet, there had been no research done on the crop or its production prior to 1990, as colonial governments made little investment in subsistence agriculture. The government's priorities changed with independence, but it had little or no trained staff or resources with which to begin research and extension programs on millet.

The Okashana 1 story

The first attempt to introduce and evaluate new millet varieties was made in 1987 by the Rossing Foundation through its farmer training centre at Okashana. The director of the centre invited local farmers to evaluate a set of 50 millet varieties he obtained from the SMIP Program in Zimbabwe, on the premise that the farmers would be best able to select types that would best fit the requirements of both producers and consumers (Lechner to be published). From this collection, farmers selected the original Okashana 1 - ICTP 8203, a variety bred by ICRISAT in India from a landrace from Togo, which at one time covered an estimated 1 million hectares in peninsular India (Andrews and Anand Kumar 1996).. This variety combined several traits—short duration, large panicle, and large seed size—which farmers in later surveys consistently rated among the most important for new varieties. After several years of on-farm testing, the variety was released by the Foundation in 1989; and a slightly improved version was formally released by the government in 1990 (Lechner to be published). The variety is now estimated to have been adopted by an estimated 45% of millet growers in northern Namibia, and has been the basis of a very successful farmer-based seed production program, which produced 245 tons of cleaned and graded seed in 1996/97 (Auino to be published).

It is interesting to consider that Okashana 1, which is probably as successful a millet variety as any ever released in terms of acceptance by farmers and relative coverage of cropped area, was identified by farmers and released almost entirely on the basis of farmer experience in on-farm trials and farmer demand for seed, as there was no plant breeding program or varietal release procedure in Namibia at the time. Certainly the original ICTP 8203 variety had a proven track record elsewhere (Andrews and Anand Kumar 1996), but there were undoubtedly many varieties among the original introductions which were higher yielding, had better tillering, stem strength, etc., but Okashana 1 met the farmers' desire for a short duration variety with good yield and large grain size. The Namibian germplasm collection contains all of these traits, but not in single variety. Okashana 1 thus offered the farmers a unique combination of traits which they did not have available among their own landraces.

Farmer participation in priority setting

Formal millet research began in Namibia in 1991/92, with the appointment of a millet breeder and the initiation of a formal on-farm research program by the extension service, which included collection of base-line data on millet production systems (Matanyaire 1996). The survey collected data on desired traits in millet varieties from 209 farmers in 1992/93, using a structured questionnaire; results are presented in **Table 1**, with a priority ranking based on the numbers of farmers including an individual trait in their priority list and the ranking each gave it.

Table 1 : *Ranking of desired traits in improved pearl millet varieties; results of a structured survey of 200 farmers in northern Namibia in May 1993.* (Matanyaire 1996)

Trait		Rank	% Rank
Short duration	89	1	21
Grain yield	72	2	15
Drought tolerance	59	3	10
Grain size	55	4	13
Plant height	44	5	6
Panicle size	41	6	9
Insect resistance	39	7	5
Grain colour	38	8	7
Grain storability	34	9	5
Disease resistance	27	10	3
Bird tolerance	25	11	3
Stem thickness	24	12	2
Stover yield	22	13	2
Milling quality	3	14	1

Score = no. of respondents ranking a trait, multiplied by the rank order value

The overall rankings of traits provide several important guidelines for the establishment of priorities for the breeding of new millet varieties:

- The importance of drought stress in the production environment is reflected in the high priority given to short duration (rank 1) and drought tolerance (rank 3).
- The farmer preference for large grain (rank 4) and panicle size (rank 6) which attracted the original farmers in Okashana to ICTP 8203 seems to be widely shared.

Plant height was rated as important (rank 5) but stover yield was not (rank 13), indicating a greater importance of millet straw for construction uses than for fodder.

Disease (rank 10), insect (rank 7), and bird (rank 11) resistance are of lesser concern to farmers than drought tolerance, plant type, and productivity.

Storability of the grain (rank 9) appears more important than milling quality (rank 14). (It is not clear if the survey included food product quality considerations among desired traits.)

Farmer participation in variety evaluation

More formal input of farmers on the strengths and weaknesses of varieties in the final stage of testing was collected in 1991/92 in the form of paired comparisons of selected varieties for a broad range of characteristics (Ipinge et al 1996). **Table 2** presents a comparison of various aspects of consumer quality of the local Mahanene landrace and Okashana 1, done by members of a local women's co-operative. Okashana was rated better than the local variety for grain size and ease of food (thick porridge) preparation, very inferior to the local for ease of dehulling and milling the grain (time required by hand pounding in both cases), and not markedly different in grain colour and taste. A series of such comparisons quickly established the women's preferences for individual varieties in the testing program, and was very useful in eliminating those with little chance of acceptance by the local community (Ipinge et al 1996).

Table 2 : *Percentage of farmers rating specific grain quality traits of Okashana 1 as better than, similar to, worse than those of the local farmers' landrace.* *Comparisons were done by members of the Tunetu Women Farmers' Cooperative, northern Namibia, 1993* (Ipinge et al 1996)

Trait	No. of Farmers	Better than local	Same as local	Worse than local
Grain size	10	90	10	0
Grain colour	10	20	30	50
Dehulling	25	0	0	100
Milling	25	0	0	100
Food preparation	25	100	0	0
Food taste	25	20	40	40

Farmer participation in breeding

A series of such interactions with farmers readily confirmed the earlier identified faults of Okashana 1—poor stem strength, greater susceptibility to grain storage insects, and poor dehulling and milling properties. The correction of these faults became the first goal of the breeding program; crosses made earlier between Okashana 1 and a number of local varieties were selected deliberately for a combination of the preferred traits of Okashana 1 (earliness, drought tolerance, large grain and panicle size, and good grain yield) but better straw strength and length, greater grain hardness, and better milling characteristics. At the same time, however, local farmers, who had been growing Okashana 1 mixed with their own landrace varieties, were also selecting better types from the plants which resulted from natural crosses of the two varieties. In 1992, the millet breeder at Mahanene selected several hundred plants from a farmer's field which retained the desired Okashana 1 panicle and grain type and earlier maturity, but which had better tillering, stem height, and stem strength than the original Okashana 1. These were subsequently random-mated to form a new breeding composite, named after the farmer from whose field they originated, Maria Kaharero (Ipinge and Monyo to be published).

Simultaneously, interactions with farmers at Mahanene progressed from the evaluation of new experimental varieties to a systematic process of prioritization of traits needed in the breeding program and the identification of specific sources of these traits. The trait prioritization exercises involved several methods, including pairwise scoring and ranking in which an overall priority ranking is established from a matrix of single pair comparisons This was usually done by groups of farmers, rather than individuals, to encourage discussion among farmers of the relative values of individual traits (Monyo et al 1998). Table 3 presents the results of one such exercise designed to establish priorities among large grain size, early maturity, light grain colour, drought tolerance, strong stalk, and storability. The set of individual pairwise comparisons ranked drought tolerance (5 of 5 comparisons) and early flowering (4 of 5 comparisons) as the greatest priorities.

Table 3 : *Results of pairwise scoring and ranking of priorities for new cultivar development, by farmer groups in northern Namibia* (Monyo et al 1998)

Trait	Early flower	Grain colour	Drought tolerance	Stalk strength	Storage ability
Grain size	Early	Size	Drought	Size	Size
Early flower		Early	Drought	Early	Early
Grain colour			Drought	Stalk	Storage
Drought tolerance				Drought	Drought
Stalk strength					Storage

These prioritization exercises were then linked to having farmers identify desirable sources of prioritized traits from special "diversity" nurseries, containing materials specially chosen to represent the full spectrum of genetic variability for priority traits. Farmers were asked to rank their choice of sources of priority traits and to discuss their reasons with the plant breeder (Monyo et al 1998). This process identified specific parental materials for improving the expression of priority traits in existing breeding lines. One such exercise, involving 200 farmers, identified 30 varieties with desirable traits from the diversity nursery, which the breeder subsequently introgressed into the original Maria Kaharero composite to produce a "participatory breeding composite" (still named after Maria Kaharero) representing the expression of the farmers' priority traits.

Experimental lines selected from the Maria Kaharero composite were subsequently compared to experimental lines selected from the local Mahanene landrace and another composite bred by conventional procedures. (i.e. without farmer participation).Table 4 presents the results of this comparison; the final column gives the frequency of lines from each composite which exceeded set criteria for earliness (<65 days), seed size (medium to large), and high grain yield potential (>3.3 tons/ha). The greater the frequency of such lines, the better the chance of selecting a variety from the composite that meets all the set criteria simultaneously. Thus the participatory breeding composite should provide a better chance of selecting such

Table 4 : ***Mean values and opportunities for selection for earliness, grain size, and grain yield in local farmers variety (= Farmers), a conventional breeding population (Namibian Composite 90 = NC 90), and the participatory breeding composite (Maria Kaharero Composite = MKC). Data are for lines extracted from each variety/composite*** (Monyo et al 1998)

Trait/ Composite	Mean	Opportunity for selection
Earliness (days to flowering)		
Farmers	71	20% of lines flowered in <65 days
NC 90	63	86% of lines flowered in <65 days
MKC	62	96% of lines flowered in <65 days
Grain size (g/1000 grains)		
Farmers	12.3	64% of lines had med-large grains
NC 90	13.0	72% of lines had med-large grains
MK		14.4 88% of lines had med-large grains
Grain yield (t/ha)		
Farmers	0.74	0% of lines yielded >3.3 tons
NC 90	2.03	18% of lines yielded >3.3 tons
MK	2.05	22% of lines yielded >3.3 tons

a variety than the conventional composite, as the frequency of early lines, lines with medium to large seeds, and with high yield in the participatory composite exceeds that of the conventional composite, even though the mean values of the two composites are similar (Ipinge and Monyo to be published; Monyo et al 1998).

Farmer seed production of Okashana 1

In the beginning, following the release of Okashana 1, limited quantities of seed were supplied by ICRISAT and later the Namibian research service itself produced 20 to 40 tons per year (Table 5). The demand, however, far outstripped the amounts that could be produced by the government, and there were no private sector seed producers in the country who could fill the gap. In 1993, the FAO provided funding to initiate a program of farmer production of Okashana 1 seed, and the government assigned an experienced manager to the project. The project was run on a commercial basis, with farmers obliged to purchase the foundation seed and to meet accepted standards for isolation, and seed purity and seed quality. Sale price of the seed was fixed at a sufficiently high level to cover all costs of production, transport, and processing (apart from the capital costs of the processing equipment), and to pay the seed producers approximately twice the price of millet grain for their seed (Auino to be published). The program grew from 17 successful farmers producing 21 tons of seed in 1993/94 to 94 farmers producing 245 tons in 1996/97 (Lechner to be published; Auino to be published). In 1998, the government officially recognized the Northern Namibian Farmers Seed Growers' Co-operative, and granted it a Namibian $ 500,000 revolving fund to finance each year's operation.

Table 5 : *History of seed production of pearl millet variety Okashana 1 in Namibia* (Auino to be published; Lechner to be published)

Year	Seed production by various agencies (tons)		
	Research	ICRISAT	Farmers Co-op
1988/89	5[1]	—	—
1989/90	—	10	—
1990/91	—	—	—
1991/92	8	28	—
1992/93	37	—	—
1993/94	38	—	21 (17)[2]
1994/95	46	—	74 (35)
1995/96	17	—	214 (59)
1996/97	21	—	245 (94)

[1] *Produced by the Rossing Foundation*

[2] *Number of successful farmers*

Regional program support for participatory research

One key reason that the level of farmer participation in the Namibian national millet program has continued to grow was the active support of SMIP staff for the participatory approach. SMIP organized a practical training course on participatory methods in 1995, which included both lectures on the objectives and methods of farmer participatory research (Nkhori 1998) as well as field exercises in interacting with farmers in priority setting and in consumer quality evaluation, using Mahanene Station labourers as "farmers" (Heinrich 1998). The SMIP program has in many ways used the Namibian program as a laboratory to evaluate and experiment with the participatory approach to research and development. In 1998, SMIP organized a regional review of the Namibian experience in involving farmers in both variety breeding and seed production, for southern African regional sorghum and millet. The report on the Namibian farmer-based seed production project (Auino to be published) was of particular interest, as the lack of availability of seed of new sorghum and millet varieties is a region-wide prrblem that prevents new varieties from playing the catalytic role in changing agriculture that they have so effectively played in Asia.

Conclusions from the Namibian experience

- It is important to expose farmers to as wide a range of varietal differences as possible in initial interactions with them, to stimulate their thinking and imagination on the possibilities of new varieties.
- Soliciting farmer priorities for new variety development programs in a systematic, structured fashion can simplify the plant breeder's task. In the Namibian case, the highest priorities were primarily given to simple morphological traits (early maturity, large panicle and grain size) for which progress can be much more rapidly made than for more complex traits such as insect or disease resistance.
- The use of farmers, and especially women farmers, to evaluate the processing, product preparation, and product quality as early as possible in the variety breeding program can simplify making choices among existing germplasm, and identify requirements for variety acceptability.
- The use of farmers to identify new parental materials for a breeding program deserves further evaluation. Farmers' collective experience should make it possible for them to evaluate the likely utility of new traits, plant types, etc., in their own production systems.
- Because of its cross-pollinated nature and large genetic variability, pearl millet can provide a unique opportunity to experiment with using farmer selection of superior plant types from hybrid populations in

their own fields to develop the basic materials for new varieties.

Quantifying the benefits of farmer participation

Farmer participation in plant breeding is a controversial topic, and a technique with different degrees of relevance to (for example) subsistence millet farmers in developing countries and commercial wheat farmers in developed countries. Where the method appears applicable, it is important to demonstrate and quantify its advantages in terms of both success and cost- effectiveness of plant breeding research, which is not always an easy matter. Satisfying personal interactions with farmers, meetings which are largely a preaching to the converted, and so on, are not a substitute for data from comparative studies of differing approaches. Wherever possible, such quantitative comparisons should be built into new participatory programs.

The Namibian experience offers two useful insights into this question—Okashana 1 and the Maria Kaharero Composite. Although there was no comparison of methods involved in the original choice by farmers of Okashana 1 from the nursery of introduced varieties in 1987/88, subsequent evaluations have demonstrated that Okashana 1 does combine an equivalent yield to other introduced varieties, with a greater degree of farmer acceptability (Ipinge et al 1996; Ipinge and Monyo to be published). And certainly the estimated 45% adoption rate of the variety is a plant breeding success by any criterion. On the other hand, the suggestion that the role of farmers in the selection of parental material for the Maria Kaharero Composite is responsible for the apparent superiority of the composite as a source of new varieties is not substantiated. Genetically, the Composite originates from three sources: (1) Okashana 1, which is the source of large panicle and grain size and early maturity, (2) Maria Kaharero's original landrace variety, which was the source of improved tillering and stem strength, and (3) the varieties selected from the diversity nursery, which probably contributed additional variability for many traits, including presumably grain yield potential. Similarly, the relative contributions in selecting the plants that make up the composite by the original Okashana farmers, Maria Kaharero, the Mahanene farmers who selected in the diversity nursery, and several plant breeders, have not been determined.

The above is not meant as a criticism, but to point out that in this case there is an opportunity to quantify the importance of each stage in the process by a systematic comparison of the following: (1) Okashana 1, (2) the original Maria Kaharero Composite as selected from its namesake's field, (3) the present version as modified by the introgression of additional varieties, selected by the Mahanene farmers, and (4) the specific experimental lines selected from the composite by the plant breeder. Such a comparison presents a unique opportunity to quantify the contribution of different types of participatory approaches to both the performance and the acceptability of the final product. Such quantification seems to be rare in the literature; comparisons such as the one suggested above could help to scientifically evaluate/document the contributions of a participatory approach to variety development.

References

Andrews, D. J., and K. Anand Kumar. 1996. "Use of the West African pearl millet landrace Iniadi in cultivar development." *Plant Genetic Resources Newsletter* 105: 15–22.

Auino, E. To be published. "Farmer-based pearl millet seed production systems in Namibia." In Heinrich, G. M. (ed.). *Proceedings of the Workshop on Farmer Participation in Pearl Millet Breeding and Farmer-Based Seed Production Systems in Namibia, 23-27 March 1998, Oshakati, Namibia*. Bulawayo, Zimbabwe: SADC/ICRISAT Sorghum and Millets Improvement Project (in press). 7–10.

Heinrich, G. M. 1998. "Report on field exercises held at the workshop." In Heinrich, G. M. and E. S. Monyo (eds.). *Proceedings of the Workshop on Farmer Participation in Sorghum and Pearl Millet Breeding, 25-27 April 1995, Mahanene Namibia*. Bulawayo, Zimbabwe: SADC/ICRISAT Sorghum and Millets Improvement Project. 8–12

Ipinge, S. A. and E. S. Monyo. To be published. "Participatory approaches and the use of farmers' knowledge to improve pearl millet in Namibia." In Heinrich. *Farmer Participation in Pearl Millet Breeding and Farmer-Based Seed Production Systems in Namibia*. Bulawayo, Zimbabwe: SADC/ICRISAT Sorghum and Millets Improvement Project. (in press). 12–17

Ipinge, S. A., [illegible] R. Lechner, and E. S. Monyo. 1966. "Farmer participation in on-station evaluation of plant and grain traits: the case of pearl millet in Namibia." In Leuschner, K. L. and C. S Manthe (eds.). *Drought-tolerant crops for Southern Africa: Proceedings of the SADC/ICRISAT Regional Sorghum and Millet Workshop, 25-29 July 1994, Gaborone, Botswana*. Patancheru, Andhra Pradesh, India: ICRISAT. 35–42.

Lechner, W. R. To be published. "Impact of pearl millet breeding and cultivar selection in Namibia." In Heinrich. *Farmer Participation in Pearl Millet Breeding and Farmer-Based Seed Production Systems in Namibia*. Bulawayo, Zimbabwe: SADC/ICRISAT Sorghum and Millets Improvement Project. (in press). 5–6.

Matanyaire, C. M. 1996. "Pearl millet production system(s) in communal areas of northern Namibia: priority research foci arising from a diagnostic survey." In Leuschner and Manthe. *Drought-tolerant crops for southern Africa*. Patancheru, Andhra Pradesh, India: ICRISAT. 43–58.

Monyo, E. S., S. A Ipinge, G. M. Heinrich, and E. Chinhema. 1998. *Participatory Breeding: Does it make a difference ! Lessons from Namibian pearl millet farmers*. Unpublished paper presented at the Second International Seminar/Workshop on Assessing the Impact of Participatory Research and Gender Analysis, 6-9 September 1998 at Quito, Ecuador.

Nkhori, S. 1998. "Training course on farmer participatory approaches for Namibian scientists." In Heinrich and Monyo. *Farmer Participation in Sorghum and Pearl Millet Breeding*. Bulawayo, Zimbabwe: SADC/ICRISAT Sorghum and Millets Improvement Project. 3–7.

Farmers' Participatory Varietal Selection for Improving Rabi Sorghum Productivity in India

B. S. Rana, S. L. Kaul, Chari Appaji, B.V.S. Reddy,
J. R. Witcombe and D. S. Virk

Participatory Varietal Selection (PVS) is a recent approach for the selection of suitable varieties from finished or near finished products arising from plant breeding programmes through a process of evaluation by farmers on their own fields and under their own management (Maurya et al 1988; Joshi and Witcombe 1996).

Participatory approaches in pearl millet breeding led to the active involvement of farmers in the choice of the most acceptable varieties and also threw up reasons for those not accepted. Adoption time of such varieties was considerably reduced if farmers had the option of multiplying their own seed. These studies improved scientist understanding of farmers' needs and preferences.

A farmer participatory varietal selection (PVS) was adopted to identify farmer-acceptable cultivars of rice and chickpea out of released and non-released cultivars (Joshi and Witcombe 1996). From the farmer-managed participatory trials, farmer-acceptable cultivars were found among released material, but not among the varieties recommended for that area. A higher adoption rate is expected through increased farmer participation, appropriate choice of varieties for resource-poor farmers, and a more liberal release system.

This paper deals with the application of general concepts of PVS in the enhancement of rabi sorghum productivity.

Relevance of PVS in rabi (post-rainy period) sorghum

Lagging productivity growth : India is the largest sorghum growing country in the world, with Sudan and Nigeria each with 5.8 m ha area ranking second, and USA third.

Major hybrids developed in the last three decades have made considerable impact on sorghum productivity. With negative growth rate for the area (-1.28% yr-1) having a negative impact on production, the total production of 9.67 m t from 16.3 m ha in 1975–76 could increase only to about 12.9 m t in the favourable years, 1989 and 1992. Compared to kharif (rainy season) sorghum, rabi productivity lags behind by about 200 kg/ha despite several years of research. Sorghum is grown under contrasting moisture regimes in kharif and rabi seasons, which explains the considerable difference in productivity and realisable potential in the two seasons.

Low investment in rabi sorghum research : Further, there is a gap in research investment, output, adoption rate and yield between the rainy and post-rainy season crops. The number of hybrids and varieties developed and extended in the rainy season is much more than that in the post-rainy season. Hybrids are popular in kharif, varieties are in rabi. Decline is rapid in kharif area while rabi area is consistent.

Constraints in rabi sorghum production : The major constraints restricting yield improvement in rabi sorghum are : large drought-prone, medium to shallow soils, susceptibility to shootfly, charcoal rot, and leaf spot diseases, nutrient-poor lands, lack of hybrids with desired traits and rabi adaptation, poor response to nutrients under moisture stress, inadequate support for rabi hybrid seed production, and predominant coverage by local cultivars than by hybrids.

Farmers desire the following traits incorporated in rabi cultivars : High yield and quality of both grain and fodder, bold and lustrous grains, and resistance to biotic and abiotic stresses equal to the popularly grown cultivar, M 35-1. Under these constraints, a PVS approach involving farmers for selection and genetic enhancement would be worthwhile.

Participatory research in agriculture

Government has established research stations, seed production agencies, extension departments, and credit and input related agencies to accelerate the pace of progress of agricultural development as well as to provide food, fodder, and livelihood security in the country. It is essential to involve farmers in a process that will enable them to identify and solve problems themselves, achieve their own goals, and to provide feed back to scientists to address their production problems. The current emphasis on "farmer participation" is an outcome of earlier experiences in on-farm research which were unable to effectively incorporate farmers' skills and experimental practices into the research process.

Attempts to utilise farmer skill and experience led to a number of avenues— Rapid Rural Appraisal (RRA) in late 1970s; Rapid Assessment Procedures (RAP) in the 1980s, and most recently, Participatory Rural Appraisal (PRA). In Rapid Rural Appraisal, there was major concern with farming systems and livelihood. Participatory Rural Appraisal (PRA) appears to be a more effective short-term planning process.

We have chosen an approach involving NGOs through which farmer participation can evolve. This implied partnerships with NGOs who have a better understanding of farmers' attitudes and problems. The All India Coordinated Sorghum Improvement Program (AICSIP) Centres in different States have already developed affinity with some NGO groups. They were selected on the basis of their integrity, expertise, and established experience in agricultural development projects. The selected NGO groups have already acquired the trust of farmers and have analysed farming systems and associated problems. They have the profiles of various villages, people, natural resources, and prevalent technologies in their operational areas. NGOs and farmer groups are interested in trying out new varieties/hybrids and production technologies to improve production and profitability. Likewise, participating scientists would also like to learn the Indigenous Technical Knowledge (ITK) and landrace biodiversity available in farmers' fields.

Both NGO and farmer groups will develop the capacity to implement, monitor, and systematically evaluate the new cultivars and technologies. The activity will be organised in such a way that farmers will learn to select better varieties. They would also manage seed multiplication and diffusion so that the programme becomes self-sustaining. An inter-disciplinary team from AICSIP will interact at on-farm level, to learn production problems, farmer preferences, and experiences.

A comprehensive meeting with Deccan Development Society (DDS) and other NGOs revealed that they are willing to operate this pro-farmer approach to provide sustainable improvement. They felt positively about project propositions such as testing under farmer management, solving the farmers' problems (not dictating to them), and establishing variety as a component of cropping system diversity. They share the project views on giving equal importance to grain and fodder in research, adoption of a non-pesticidal, farmer management system, promotion of farm level diversity, farmer choices, and in short, creating a self-sustaining system which can work even after the project period. They expect that this first model project would influence ICAR's research methods to make them farmer-led and farmer-influenced.

Objectives

The major objective is to improve the productivity of rabi sorghum in core production areas in Maharashtra, Karnataka, and Andhra Pradesh, through

1. Selection of suitable varieties by farmers from improved cultivars tested in farmer-managed trials
2. Demonstration of Farmer Participatory Research (FPR) methods that are effective in increasing cultivar diversity and replacement rate, and thereby production
3. Increased farmer (both men and women) participation

4. Removal of the constraints that cause farmers to continue to grow landraces for productivity

5. Promotion of superior local varietal selections, natural management practices, and low cost production technology identified in farmer-managed trials

6. Collection of local landrace bio-diversity for conservation and utilisation in breeding programmes

The research agenda

To start with, elite varieties would be evaluated to promote participation and capability of farmers. The following areas of work were identified on the assumption that technology scores over other social constraints :

- A joint work programme with researchers and NGO groups; involve farmers subsequently after they observe the co-operative work mode
- NGOs will involve farmers in the process of varietal selection, conduct of trials and data recording
- NGOs would monitor data collection on prevalent land races, agronomic management practices, farmer perception, experiences, preferences, and assessment of need
- Intra- and inter-village farmer visits
- Specialised training of NGOs and scientists in the area of participatory research
- Growing identified F2 populations on farmers' field for PVS

Identifying project locations

It is proposed to carry out research in the following target districts of the three major rabi sorghum growing States: Medak in Andhra Pradesh ; Solapur, Dhulia and Parbhani in Maharashtra; and Bijapur and Dharwad in Karnataka. All these sites have centres of AICSIP located in State Agricultural Universities.

In the target districts, the following NGOs have been identified :

1. Krishi Vigyan Kendra, Jeevan Jyoti Charitable Trust, Jintur Road, Parbhani
2. Krishi Vigyan Kendra, Yeshwant Rao Chavan Mukta Vidyapeth, Solapur
3. Krishi Vigyan Kendra, Dhulia
4. Institute for Studies on Agricultural & Rural Development, Dharwad
5. Association for Studies on Agricultural & Rural Development, KHB Colony, Bijapur
6. Deccan Development Society, Hyderabad

The project site at the National Research Centre for Sorghum (NRCS) at Rajendranagar, Hyderabad will work with local NGOs in at least three villages. ICRISAT will be indirectly involved with NRCS.

A reasonably large sample (20) farmers per village will be used for detailed surveys and monitoring the adoption of varieties. Farmer-managed participatory research trials with new varieties along with a control, as a public sector extension activity, would be the main focus.

Four released varieties, one released hybrid, sixteen elite varieties, and the popularly grown cultivar M 35-1 form the material for trials on farmers' fields. The seeds of 23 selected varieties were multiplied during rabi 1997-98. Those genotypes are presently being tested in advanced and initial varietal trails and have shown promise at one or the other of the locations. The variability for panicle shape and plant height, determining fodder yield, is represented.

Each variety is to be grown along with a local variety at three farmers' fields representing three replications. Half an acre of test variety and half an acre of locally-grown variety was considered as one experimental unit. The allotment of a variety to a farmer is at random. There will at least be three replications in a village with three farmers for every variety.

All the centres contributed entries to the experiment. The seed was distributed to NGOs in a joint meeting with scientists held at Solapur on 2 September 1998 so that planting could be taken up in time. The relevant points that emanated from these discussions are as follows :

- The cultivars to be demonstrated under the programme should be self-propagating varieties and only one released hybrid which has not reached the farmers, i.e. CSH 15R, may be included.

NGOs will take the responsibility to persuade farmers to participate in this programme and would work on a voluntary basis.

The seed treatment of both test and local variety will be done by the farmers under the guidance of NGOs.

Three meetings of NGOs and scientists would be arranged : first meeting, a month after the sowing; second, as a monitoring by all NGOs and scientists; and the third being an annual data review meeting and planning for the following year on the pattern of the annual workshop of the sorghum project.

The NGO group will also help in collection of local germplasm in this area.

Joint monitoring by NGOs and scientists will be done in the second or third week of January 1999.

A visit by the participating farmers should be arranged to the local research station so that they may get an opportunity to undertake their choice of entries for the next year.

Within each NGO group, a farmer rally including both men and women will be organised so that participating and non-participating farmers may interact as well as see the performance of these varieties interaction.

- Regarding the choice of varieties in each NGO group, it was agreed that at least 30 or more participating farmers will be chosen from three to four villages which are accessible and within the mandate area of the on-going programmes of the NGOs.
- It was agreed that there will be no free supply of any inputs except the seed.
- The Front Line Demonstrations based on released hybrids/varieties planned in the NGO group should be visited by concerned farmers.
- The general related issue regarding participation of women was explained so that women could choose the variety depending on the traits liked by them, e.g., plant height, roti making quality, duration of storage, flour recovery, etc.
- Each centre should multiply at least 50 kg of seed of each cultivar for the To be published rabi programme.
- The best variety selected in the first year's programme by farmers should be allowed for horizontal spread. Large-scale multiplication of such varieties should be taken up by respective centres so that seed can be distributed widely among farmers in September 1999 (second year of project).
- Each centre will simultaneously cultivate/demonstrate all the varieties/hybrids at their research station. CRS, Solapur and NRCS will demonstrate all cultivars being tried/tested under the programme.

Special efforts may be made by Deccan Development Society to identify farmers who may like to cultivate three M 35-1 bulks. They should be informed that the bulks are genetically variable and they should select single plant earheads based on their perception and practical experience.

The AICSIP centres also decided to attempt 5 crosses based on M 35-1 based derivatives.

The PVS programme is essentially expected to result in the following :

Farmer-preferred varieties, better in yield, quality, and tolerance to drought, insect pest, and diseases

Varieties adaptable to the different agro-ecological niches in which farmers grow rabi sorghum

Farmer Participatory Research as an effective tool to increase sorghum productivity

Enhanced farmer-to-farmer and village-to-village diffusion of varieties, ideas, and production technologies, resulting in increased availability of foodgrains

Benefits reaped by participatory farmers to influence non-participatory farmers

NGO-led inter-village co-operation to enable development of new farmer organisations to help further diffusion of participatory concepts

- Conservation of landrace bio-diversity

References

Witcombe, J.R., A. Joshi, K. D. Joshi, and B. R. Sthapit. 1996. "Farmers' Participatory Crop Improvement: Varietal selection and breeding methods and their impact on bio-diversity." *Expl. Agric.* 32: 453–460.

Joshi, A. and J. R. Witcombe. 1996. "Farmers' Participatory Crop Improvement: Participatory varietal selection, a case study in India." *Expl. Agric.* 32 : 461–477.

Joshi, A. and Witcombe, J.R. 1998. "Farmer participatory approaches for varietal improvement." In J. R. Witcombe, Daljit S. Virk, John Farrington (eds). *Seeds of Choice*. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd. 171–189.

Maurya, D.M., Bottrall, and J. Farrington. 1988. "Improved livelihood, genetic diversity and farmers' participation: strategy for rice breeding in rainfed areas of India." *Expl Agric.* 24: 311–320

Farmer Participatory Research in the Development of an Integrated Pulse Pest Management Programme in Southern Asia

G. V. Ranga Rao and V. Rameshwar Rao

Under a project on the development of an Integrated Pest Management (IPM) programme for the management of pulse pests in south Asia, funded by the International Fund for Agricultural Development (IFAD), chickpea on-farm trials were organized during the 1997/98 season in collaboration with the Indian Council of Agricultural Research (ICAR), NGOs, and agricultural universities. The Centre for World Solidarity (CWS) was chosen as the co-ordinating NGO. Surveys confirmed that farmers use insecticides indiscriminately on both chickpea and pigeonpea crops. Biopesticides such as neem, Helicoverpa Nuclear Polyhedrosis Virus (HNPV), and tobacco decoction were found effective in controlling the pod borer *Helicoverpa*. Monitoring of adult population using pheromone traps indicated significant variation among the locations. This resulted in different levels of pod damage. This was the background to the project.

Project Objective

- To characterise chickpea and pigeonpea production systems in south Asia, identify and prioritize constraints to production in farmers' fields, and identify indigenous pest management technologies in target areas
- To develop, evaluate, implement, and share IPM technology including host plant resistance, biorational insecticides, cultural practices and enhancement of natural enemies for chickpea and pigeonpea agro-ecosystems
- To establish and/or strengthen formal and informal communication networks among farmers, extension and NGO personnel, researchers, and policy makers to improve the exchange of information among the project partners

IPM components

- Effective monitoring
- Follow thresholds
- Encourage resistant /tolerant varieties

- Use of botanicals
- Use of insect pathogens
- Encourage natural enemies
- Follow effective cultural operations
- Need based use of chemicals

Methodology

1. Identification of constraints to chickpea and pigeonpea production by interacting with about 50 farmers at each location (**Annexures 1 and 2**)
2. Evaluation of pest management components
    - Select 5 farmers with 1.0 ha field in each location
    - Implement IPM in half the area
    - Weekly observations on pest population in IPM plots and farmer practice plots
    - Placing of one field assistant at site and frequent visits by scientist

Constraints

- Farmers' attachment to insecticides
- Difficulty in showing success of IPM in small plots
- Different sowing dates, and the high variability among farmers
- Social factors in some villages
- Lack of in-depth knowledge of NGO staff
- Good quality pheromones and biopesticides like NPV not readily available

Results obtained so far

1. Unusual weather (late monsoon and cyclonic rains during chickpea sowing time) during the season throughout Andhra Pradesh, Karnataka, and Maharashtra had aggravated the overall pest situation. Consequently chickpea and pigeonpea crops were heavily damaged by insect pests, particularly pod borers.
2. Farmers at most locations were using insecticides indiscriminately (**Table 1**).
3. Farmers are highly motivated to move from total dependence on chemical control to other options of pest management.
4. Selection and training of village-level scouts from villages proved very useful.
5. Collaboration and sharing among several organizations were particularly fruitful.
6. Reducing insecticide usage in chickpea has little impact on yields, but improves profits by saving on insecticide.
7. Continuous training of staff and farmers at village level at different

crop stages is of greater help than a single comprehensive training course.

8. Involvement of women farmers is of great help to mobilize women who are worried about the effects of pesticides on their health.

Table 1 : ***Number of insecticidal sprays* on pigeonpea and chickpea crops on-farm locations, 1997/98***

Location		Number of insecticidal sprays	
State	**Village**	**Pigeonpea**	**Chickpea**
Andhra Pradesh			
	Pedagottipadu	3 - 5	6 - 8
	Passumarru	4 - 6	6-10
	Mettipalem	4 - 6	6 - 7
	Moosapet	2 - 4	2 - 3
	Naskal	3 - 5	2 - 3
	Gulladurthi	4 - 6	7-10
	Tekullakodu	4 - 5	4 - 5
Maharashtra			
	Ashta	5 - 7	3 - 4
	Anjangaon	4 - 7	2 - 3
	Chincholi	3 - 5	3 - 4

* *Data collected during on-farm visits*

Annexure 1

Questionnaire to generate information on pest problems and farmer's perceptions on Insect Pest Management on pigeonpea and chickpea

ICRISAT/IFAD IPM PROJECT

Date : ________

1. Farmer's name :
2. Village, district & state :
3. Crop :
4. Variety :
5. Area (ha) :
6. Soil type :
7. Cropping systems :
8. Insect pests occurring : Insect name % damage
   1.
   2.
   3.
9. Control measures : Chemicals used No. of sprays Quantity/ha
   1.
   2.
   3.
10. Remarks :

Annexure 2

DATA SHEET FOR INSECT MONITORING IN PULSE CROPS
IFAD-ICRISAT IPM PROJECT

Farmer's name

Village

District

State

Soil type

Date

Date of sowing

Crop

Previous season crop

Intercrop/sole crop

Treatment

Sample /plant number	Number of eggs		Number of larvae			Total pods	Damaged pods	% pod damage
	Helico	Bugs	*Helico*	*Maruca*	*Cydia*			
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

Remarks :

Farmers' Participatory On-Farm Evaluation of Groundnut Foliar Disease Management Technologies in the State of Andhra Pradesh, India

S. Pande and H. D. Upadhyaya

Groundnut (*Arachic hypogaea* L.) is cultivated in more than 100 countries around the world with an annual production of 28.0 million tonnes on 22.5 million hectares. Groundnut is produced predominantly in developing countries and about 62% of world production and 54% of area is confined to India and China. United States of America is also a major groundnut producer with 1.63 million tones on 0.73 million hectares. Groundnut yields average about 0.8 t ha-1 in the developing countries compared to 2.28 t ha-1 in USA. The occurrence of diseases and pests, lack of suitable adapted varieties, and poor socio-economic conditions of the farmers are the main reasons for poor yield of groundnut in these countries. The gap between the yield obtained by scientists and the farmers is wide. It is particularly so in developing than in developed countries. It is essential to narrow, through greater involvement of farmers, the gap in developing countries where the environment is heterogeneous and the resource base of farmers is poor.

Need for farmers' participatory integrated disease management

Late leaf spot (LLS), caused by *Phaeoisariopsis personata* [(Berk and Curt) v. Arx.] and rust caused by *Puccinia arachidis* (Speg.) are the two most destructive fungal foliar diseases of groundnut. The management practices of foliar diseases vary widely. There may be *some minimal disease management*, some use of chemicals or total reliance on host plant resistance, and/or uneconomical use of fungicides. In recent years there has been an increased effort in combining a range of host-plant resistance with judicious use of chemicals to achieve economical yields. Results of on-station experiments at ICRISAT Center and elsewhere have *clearly demonstrated* that when moderate levels of resistance are combined with chemical control, expected yield and economic returns are higher than disease control by chemicals alone.

Farmers' participatory integrated disease management

Therefore, on-farm research was initiated to evaluate and validate this combination of genetic resistance and chemical application in control of foliar diseases in collaboration with Acharya N.G. Ranga Agricultural University (ANGRU), Agricultural Research Station, Anantpur; Rural Development Trust, Anantpur; Krishi Vigyan Kendra, Banganapalli, Kurnool; and Krishi Vigyan Kendra, Geddipalle, Nalgonda. The study was carried out in the 1995 and 1996 rainy seasons. Both short- and medium - duration high-yielding groundnut varieties bred at ICRISAT Center, Patancheru, India given below served as experimental material:

Short duration : ICGVs 89104, 91114, 91123, and 94361. They had a maturity duration of 85-95 days and low to moderate levels of resistance to LLS and rust.

Medium duration : ICGVs 86699 and 86590 and ICGS 76. ICGV 86699 was resistant to both LLS and rust and ICGS 76 and ICGV 86590 were moderately resistant.

Control : TMV 2, A highly popular variety susceptible to both diseases ; and a local cultivar. Seeds of test varieties and of TMV 2 were provided by ICRISAT. Farmers used their own seeds of the local cultivar. Seeds of test varieties were treated with a commercial seed dressing compound consisting of Thiram + Ridomil. Seeds of farmers' cultivars were rarely treated with fungicides. Sixteen farmers from different villages of districts of Anantpur, Kurnool, and Nalgonda raised the experiment in the 1995 rainy season and 36 farmers participated in the 1996 rainy season. The crop was raised as per the local recommendation or according to participating farmers' agronomic practices for groundnut crop. However, sowing was done only in the presence of a collaborating scientist or an ICRISAT Center staff.

On short-duration varieties, foliar disease severity remained low (3-4 on 1-9 scale), in general upto 60-65 DAS. Thereafter, LLS increased and was between 7 and 9 at maturity in both protected and unprotected plots irrespective of varieties. In the fungicide protected treatments, pod yields were significantly higher in the test varieties than in the non-protected plots. The groundnut variety ICGV 89104 produced the highest pod yield of 1.68 t ha^{-1}, 61.5% more than the local cultivar and ICGV 91114 yielded 1.64 t ha^{-1}, 57.6% more than the local cultivar across locations and farmers in the 1995 and 1996 rainy seasons (Table 1). Similar trends were observed for haulm yield. The net economic gain of one spray of fungicide was highest at 25.8% in ICGV 89104 and 19.5% in ICGV 91114 compared to 10% in farmers' cultivar (Table 2). Among the additional varieties tested in the 1996 rainy season, ICGV 91123 gave highest average yield of 2.31 t ha^{-1}, 59.3% more than local cultivar in protected plots and 1.93 t ha^{-1}, 87.3% more than local cultivar in the unprotected plots. The increase in the protected plots over unprotected was 15.5% to 19.6% in these varieties compared to 40.7% in local cultivar. ICGVs 89104, 91114, and 91123 were the most preferred varieties by farmers.

These varieties have greater resemblances to the local cultivar in plant and pod characteristics. They were 10-15 days earlier in maturity, produced high pod yields, more shelling outturn, and had moderate levels of resistance to LLS and rust. Also, all the test varieties produced 2.30-2.69 t haulms ha^{-1} under protected and 1.95-2.27 t ha^{-1} under unprotected conditions.

LLS severity on resistant ICGV 86699, moderately resistant ICGV 86590, and ICGS 76 were significantly less than on the local cultivar at all the sites in both the years. Also, as expected, disease severity on fungicide sprayed plots was less than on unsprayed plots. ICGV 86590 yielded highest pod yields in both sprayed and unsprayed plots in both years. The maximum haulm yield was obtained in ICGV 86699 in both sprayed and unsprayed plots.

Significantly higher pod and haulm yields of the test varieties as compared to the local cultivar in the unprotected situations demonstrated the importance of genetic resistance as an integral part of foliar diseases management. The situation holds good for the resource-poor farmers who do not have the means to buy fungicides.

Farmers' perception/preference

The unbiased opinion and perception of participating farmers were obtained through a simple questionnaire. All the participants expressed their appreciation for being exposed to genetic resistance and fungicide treatment in management. This participatory approach saved time between technology generation and transfer.

In both the seasons, the resource-poor farmers liked the cultivars which were phenotypically similar to their local cultivar, had a clear yield advantage and foliar disease resistance over the local in rainfed cultivation. The farmers expressed their preference for the cultivar which matures either early, along with local cultivar or along with TMV 2. In this category, ICGV 89104 and ICGV 91123 were the farmers' unanimous choice over local and TMV 2, especially in purely rainfed cultivation. On the contrary, resource-rich farmers who have irrigation facilities would like to grow medium-duration varieties such as ICGV 86699, ICGV 86590, and ICGS 76. They were also convinced about the integration of a judicious use of fungicides with moderate levels of host plant resistance to maximise yield and total biomass advantage. Among the medium-duration varieties, ICGV 86590 was liked by all the participating farmers. ICGV 86699, though ranked best both for pod and haulm yields and disease resistance, was rejected or hesitantly accepted by most farmers because of its red seed colour and poor market acceptability. The big pod and bold seeds of ICGS 76 attracted many farmers but it had problems in mechanical sowing ; being bold seeded it frequently blocked the local seed drill. In general, all the participating farmers retained the short- and medium-duration varieties for further confirmation and use. The response of farmers in the subsequent year, 1997, was encouraging and in 1998 rainy season, 60 farmers have taken up the evaluation.

Table 1 : *Mean haulm and pod yield ($t\ ha^{-1}$) of ICRISAT short-duration groundnut genotypes in on-farm trials on Integrated Disease Management (IDM) in three districts1 of Andhra Pradesh, during the rainy seasons of 1995 and 1996*

Genotypes	Disease Category[3]	Yield ($t\ ha^{-1}$)[2] Haulm No spray	Haulm one spray[4]	Pod No spray	Pod one spray[4]
ICGV 89104	MR	2.70	3.10	1.68	2.25
ICGV 91114	MR	2.43	2.75	1.64	2.10
TMV 2	S	1.74	2.17	1.06	1.30
Local cultivar	S	1.65	2.04	1.04	1.28

[1] Nalgonda, Anantapur, and Kurnool

[2] Based on 30 farmers (6 farmers in 1995 and 24 farmers in 1996)

[3] MR = Moderately resistant, S = Susceptible

[4] Chlorothalonil sprayed once at 60-70 DAP (when first symptom appeared)

Table 2 : *Total Income (Rs), net income (Rs) and gain (%) by adopting IDM components (ICRISAT, short-duration cultivars + 1 spray) for the management of foliar diseases in on-farm experiments during the rainy seasons of 1995 and 1996 in the three districts1 of Andhra Pradesh*

Genotype	Disease Category[3]	Income (Rs)[2] Total No spray	Total one spray[4]	Net[6]	Gain (%)[5]
ICGV 89104	MR	16800	22500	21140	25.8
ICGV 91114	MR	16400	21000	19640	19.5
TMV 2	S	10600	13000	11640	9.8
Local cultivar	S	10400	12800	11440	10.0

[1] Nalgonda, Anantapur, and Kurnool

[2] Based on 30 farmers (6 farmers in 1995 and 24 farmers in 1996)

[3] MR = Moderately resistant, S = susceptible

[4] Chlorothalonil sprayed once at 60-70 DAP (when first symptom appeared)

[5] Percent gain = Net income of sprayed plots - Net income of unsprayed plots + Net income of unsprayed plots x 100

[6] Net income = Total income - Cost of fungicide and manpower etc. (cost of one spray including manpower and rental value for sprayer = Rs. 1360)

A Participatory Plant Breeding Program at Jeypore, Wayanad, and Kolli Hills

V. Arunachalam, Geetha Rani, S. D. Sharma, N. Anil Kumar, and D. Dhanapal

Participatory Plant Breeding (PPB) is a specific activity of the M.S.Swaminathan Research Foundation (MSSRF). Funded by the Swedish Development Corporation (SDC) and initiated in June 1998, it empowers farmers to identify means by which their current capacity of farm production can be enhanced and to convert the available genetic diversity into products for their use and livelihood security.

As paradigms of participatory performance initiative, MSSRF has a concentrated core program around three diverse locations of strategic importance in terms of the (a) diversity of (tribals and) residents, (b) major crops which occupy a niche in farmer-conservation and under-utilised genetic diversity, and (c) remote location of farmers away from the usual range of Government-supported extension.

SDC has provided adequate operational costs for the PPB program and one research associate at each location. The manpower needs are therefore shared with other programs on conservation of biodiversity in the three locations. The site co-ordinators at the locations are the nodal pivots of the program and they monitor field activities to optimal performance.

The PPB activity matrix was set to be in tune with site ecology, participatory tribal farmers, their needs, and their prime crops. A concise description of the sites, given below, would therefore place the designed PPB activities in proper perspective.

Jeypore Tract (Orissa)

Situated about 250 km north of Vishakapatnam, this tract is rich in traditional rice varieties and supposed to be one of the centres of its origin. The climate has a good variation between locations, the temperature ranging between 35° C and 45° C. The region is served by the southwest monsoon and rainfall is around 1700 mm per annum.

Humidity is high during monsoon and post-monsoon periods. The soils have a good variation from coarse sandy loam, alluvial, red laterite, clay to black soil. The soils are usually not treated with chemical fertilisers. Rice is grown in upland, medium and low land. With the onset of rain, farmers broadcast rice, though, in some places, nursery raising and transplanting are practised. The primitive tribes of Orissa such as Kandha, Longia Saora, Paroja, Gadaba, Koya, Bonda and Didayi are still practising shifting cultivation along with settled cultivation.

Tribal farmers predominantly grow rice in addition to minor millets, pulses, and oilseeds. Site-rich genetic diversity in rice is conserved to an extent due to their own interest. The local varieties catering to their requirements of fodder and cooking quality were observed to have the potential to serve as the best initiating material for PPB. The program was therefore initiated with a chronicling of site-adapted local varieties and landraces, farmers' cultivation practices along with the underlying reasons, farmers' skill in trial selection, gender expertise in seed selection, regeneration and the like and the cost : benefit ratio under existing modes of cultivation. This data would be the base to evaluate the impact of PPB activities as the program gains momentum.

Three districts were chosen to represent agro-climatic variation within program-reach distance. In each district, two blocks—and in each block farmers growing rice, one each in upland, medium, and lowland areas—were selected (except in Malkangiri district where three blocks had to be selected). In all, thirteen villages were thus included.

Details of 18 participatory farmers for PPB in rice from the Jeypore Tract of Orissa

District	Block	Upland villages	Medium land villages	Low land villages
Koraput	Boipariguda Jeypore	Kolar (39) Samantara Sahi (6)	Bhaluguda (43) Okilaguda (8)	Bhaluguda (43) Pujariput (21)
Nabrangpur	Nabrangpur Nandahandi	Badakumuli (62) Mentry (65)	Badakumuli (62) Mentry (65)	Hatibeda (60) Mentry (65)
Malkangiri	Malkangiri Khairput Mathili	Batapalli (115) Khemaguru (60) —	Teakguda (116) — Uduliguda (63)	Batapalli (115) — Sindhabeda (67)

Figures in parentheses are the distances of villages from Jeypore in km

Several farmers were contacted by MSSRF field staff and their enthusiasm and interest in participatory research assessed. After the aims, mode of work, and targets of the PPB program were explained, 18 willing participants were selected. For the participatory program, no monetary incentives were ever offered and the work participation thus is exclusively voluntary and based on the goodwill established already between the tribal farmers and MSSRF site office in Orissa. Case histories are available to reveal that monetary incentives spur short-term significant changes, but as soon as payments stop, progress dwindles, as reported, for example, in the conservation reserve program of United States (Ervin 1998).

Farmers were asked to set apart 10 plots of 6 cents (approx. 240 sq. m) each. They were given seeds of 6 locals, 3 improved cultivars, and one variety released from the all-India network. There were, however, variations in the farmers' allotment of plots and the number of varieties planted. Being the initiating year, the choice of land, planting schedules, and optimal cultivation practices could not be monitored, and the farmers were allowed to plant the experiment as per their own practices. However, this would provide a right opportunity for collection of base information and also relevant yield data by the scientist investigators.

The target farmers chosen being mostly tribals, the program did envisage problems in top maintenance by the farmers. Thus, of the 18 farmers, 4 could not plant the initial experiment as per plan.

Regardless, the base data collected were analysed and the following salient conclusions were drawn :

- There was a variation of about a month in the dates of planting (direct seeding) and transplanting, among the farmers' experiments.
- Vast differences existed in crop management including cultural practices. Most of the farmers were either unaware of or did not practise optimal crop protocols.
- In the employment of labour in rice cultivation, female: male ratio was about 2:1, suggesting farm activities were done to a greater extent by women.
- While rice is the primary crop, the farmers do also work on finger millet, horsegram, and other pulses in that order.
- Of the harvested produce, 38% was retained for self-consumption, 8% as seed, and 39% sold in the open market.
- Cost-benefit ratio estimated from the primary data from the 14 participatory farmers showed a high variation of benefit : cost ratio from 0.46 to 8.26. There is no relationship between the total area cultivated and this ratio (correlation coefficient = 0.04 NS). Farmers' practices of raising the crop widely vary. This

would imply scope for improvement even with their own varieties and cultivation practices.

Farmers possess special skills in identifying traits of importance and also selecting for them. A frequency distribution of these important skills revealed that productivity, cooking properties, stand of the crop, and plant height were the key traits farmers use as diagnostics. They are highly efficient in selecting for number of tillers (used as an indicator of productivity) followed by comparative tillering potential (usually contrasted between local and improved varieties).

Wayanad (Kerala)

Located in the northeastern part of Kerala at a distance of 76 km from Calicut, Wayanad is rich in biological diversity, particularly medicinal plants and spices. 54% of the total area of 2131 sq. km is agricultural land (~21135ha). The literacy rate is high (88% of male, 78% of female, and 51% of the most common scheduled tribes). The climate is generally cool, with temperature ranging from 18° C to 30° C. Though rainfall is relatively high, the area does not have adequate water harvesting technology in place. The Kuruchias are the common hill tribe; they preserve their habitats and conserve many traditional crop varieties, in addition to a variety of sacred groves covering wide biological diversity. On the other hand, Paniyas are the dominant tribals in the State. They are poor and do not have cultivable land.

In addition to rice, with rich variability including medicinal rice (*njavara*), coffee, pepper, and a number of spices are grown in this region. Wayanad is the second largest producer of pepper in the State, this crop being cultivated both as a pure and an inter-crop. Rice is cultivated as a wetland crop; the first crop is raised during June-July (*virippu*) and is purely rainfed, the second from January to May (*puncha*) is partly rainfed. The tribals do not use chemical fertilisers during *virippu* but the second season demands fertilisers including organic manures.

Work has just been planned and initiated. One pepper farmer was identified as a participant and his site-specific problem, the *phytophthora* disease, is planned to be solved with IDM (integrated disease management) strategy. Six farmers have been identified for medicinal rice, the major target being pyramiding medicinal quality traits with productivity. Details are being worked out.

Kolli Hills (Tamil Nadu)

As an important eco-region of the Western Ghats, Kolli Hills is a repository of rich diversity, particularly in minor millets—finger millet, ragi (*Eleusine coracana*); little millet, samai (*Panicum miliare*); Italian millet, thinai (*Setaria italica*); common millet, panivaragu (*Paricum miliaceum*) ; barnyard millet, kudiraivalli (*Echinocloa colona*).

Of the total population, 95% are tribals (~32,130). Of the total area of 28,293 ha, 51% is cultivated (~14,609 ha). Only about 1946 ha (~13.3%) have irrigation facilities.

The climate is temperate in nature, the temperature ranging from 10°C to 30° C. The annual mean rainfall is around 1445 mm. The soils vary in structure: in the upland top slopes, the soils are sandy loam, in the mid-slopes they are loamy, and in the valley alluvial to clay loam. Other then minor millets, sorghum, rice, turmeric, tapioca, red gram and several fruit crops are grown in this area. In all the three growing conditions, crop rotations are usual with coriander, sorghum, tapioca as the companion crops.

Due to various causes, the tribals of Kolli Hills were initially uninterested in participation; about four years' consistent work by the biodiversity group of MSSRF has succeeded in enlisting and ensuring farmer participation in various areas of biodiversity including PPB. Tribals who were cultivating minor millets particularly finger millet and little millet are switching over to cash crops like tapioca and coffee, mainly due to the unsustainability of production and profit. Initial survey and spadework to prepare the farmers for PPB have been completed. It is planned to apply participatory strategy to even identify farmers' preference of the crop for PPB in addition to selecting participatory farmers for the activity. This is expected to be completed before the end ofthe year and the program would start thereafter.

Program approach in identified sites

After initial chronicling of farmer environment in detail, the following major strategies of PPB are planned to be put on the anvil:

Disruptive ecological selection: Local varieties adapted to various climatic regimes in the tract would be evaluated and exchanged between sites. This would enable a potential local, not grown in a site so far, to prove its worth, and could be a short-term avenue of enhancement of production.

Participatory, genetic enhancement: Genetic divergence between locals across the site is expected to be large. This would be estimated and evaluated. The Indian Council of Agricultural Research has a wide research network through which high yielding varieties (HYVs) under assured inputs are released for all the growing tracts of the country. Two types of initiating crosses to derive high yielding varieties are envisaged— Local X Local, Local X HYV.

Participatory seed generation: The F1 seeds would be obtained on a participatory mode. Farmers, both men and women, would be trained in emensculation-pollination techniques. They would generate F1 seeds under scientific supervision. Only this would enable the generation of a large quantity of F1 seeds. The F2 generation would be grown in the participatory farmers' plots and the farmers would select desirable segregants. This would provide a basic understanding to scientists of farmers' methods of selection. The process can be extended to further generations till a desired adapted variety is derived.

Participatory selection and seed production: Farmers have their own methods of selection for seed ; they also select for other desired traits, not only for grain and fodder productivity but also for cooking quality and consumer preference. Their skill would be utilised in landrace and germplasm evaluation and selection. They would also participate in sharing their knowledge and learning scientific yardsticks of seed production, maintenance, and commercialisation. This would also be a sustainable and profitable avenue to improve livelihood security.

Periodic internal and external reviews, workshops, participatory dialogues, and training programmes have been built into the program operation matrix so as to effect mid-course corrections and efficiently steer the program to targeted goals.

Reference :

Ervin, D. E. 1998. "Shaping a smarter environmental policy for farming." *Issues in Science and Technology, Summer 1998.* 73–79.

Gender Dimensions in Farmers' Participatory Research

H. S. Kanvinde

India is known to be one of the twelve mega-diversity countries of the world. Of more importance is the fact that India has 166 species of crops and 320 species of wild relatives of crops. This broad diversity is the country's insurance against famine. It is well known that the first inhabitants were hunters and gatherers; these people are still found in pockets of the country. The tribals today continue to cultivate folk varieties and landraces. This kind of on-farm conservation helps in maintaining a genetic stock for further selection.

In traditional agriculture systems, there are well-defined gender roles, particularly in areas of seed selection, crop storage, and cropping pattern. Women's pivotal role in domesticating plants and their profound knowledge of plants and animals help in conserving crops, forests, and natural resources.

In a nation-wide study on gender dimensions in biodiversity conservation, it was observed that there were no exclusively demarcated domains for men and women (Swaminathan 1998). Caste, community, and locally specific social and cultural factors that change over time define economic roles. Some interesting facts that came out of the study: In the Kolli Hills region of Tamil Nadu, hunting and honey gathering are done by both sexes. Women in Mizoram possess knowledge of animal ecology though they no longer hunt. Women are more conversant about resources near their homes and men know more about the oceans and the reefs in Lakshadweep. In Bhitarkanika, women's economic roles are determined by their caste rather than by their sex alone.

The study also looked into gendered roles in agriculture, which are generally dependent on the community, terrain, and agriculture pattern.

Women have knowledge about the needs of crops regarding climate and nutrition. Their vast experience in agriculture has made them proficient in making crucial decisions on plant breeding and selection as well as seed selection. This has helped in maintaining genetic stocks that are able to withstand local adverse conditions and has also ensured the survival of traditional crops. Since the crops that are grown are for domestic use, women's contribution to crop preservation is not recognised. Programmes that promote agriculture are targeted at men, development policies have tended to increase cash crops and promote commercial agriculture which are controlled by men. Training in agriculture and allied subjects are aimed at men, the training officers and extension workers are men, few women are in those professions. Women are thus pushed into marginal lands and their work is undervalued, with the result that their needs are not targeted in development programmes in agriculture.

Agricultural roles in various regions of India

Area	Pre-planting	Care	Harvest	Post-harvest	Storage
Wayanad	Men	Women	Women and men	Men and women	Men
Kolli Hills	Men and women	Women	Men and women	Women	Women
Lakshadweep	Men	Women	Men	Women	Women
Bhitarkanika	Men	Men	Men	Men	Men and women
Jeypore	Men	Men and women	Men and women	Men and women	Men and women
Mizoram	Men	Women	Men and women	Women	Women
Arunachal Pradesh	Men	Women	Women	Women	Women

Source: Swaminathan 1998.

Studies carried out in Sri Lanka and the Maldives show the same trend—loss of decision making and control over resources by women when agriculture becomes commercial. Women in Sri Lanka were involved in seed selection and germination, weeding, watching out for plant diseases, threshing and winnowing, and drying and cleaning of produce. But, with home gardens and chena fields being converted to tea gardens and rice fields in the river valleys giving place to banana plantations, women's role has changed from active participation in agriculture to arranging and supervising labour and family care.

In the tropical coral islands of the

Maldives, the soil is poor with low organic content and no water retention. The main field crops are millets, maize, and sugarcane and the cash crops are chillies, onions, and ginger. There are coconut and arecanut plantations. Vegetables like pumpkin, gourds, taros, tapioca, eggplant, and cucumber and fruits such as papaya, banana, lemon, pomegranate, bilimbi, and breadfruit are also grown. Women who managed home gardens do not find a role in commercial agriculture now. Trained as teachers and nurses, women often do not pursue their vocations because of the constraints of island life. They should be utilised by the agriculture department as trainers in pest and seed management.

In participatory research, specially in agriculture, it is necessary to understand the agriculture patterns, social structure, and power flows in the community. Interventions to improve their way of life may not work out if such prior knowledge is not obtained. In implementing a participatory research project, it is thus necessary to orient the project staff on the issues that will come up when they interact with the community. A workshop with the help of an active local NGO will help to break the ice. Including a community organiser in the team will increase the project's impact. Frequent meetings with the local leaders and participating farmers will keep up the morale of the people and help a lot when the research project ends and the farmers have to be independent. Similarly, the impact of the intervention on the life of women and men should be studied as this will help in drafting future programmes. An attempt should be made to study, in particular, the preferences of women farmers.

The methodology to orient the community to gender issues could include a discussion of the roles of men and women, with emphasis on socially defined discrimination. The concept of practical and strategic gender needs should be introduced. Case studies, preferably from the organization's experience in previous programmes, could be analysed. The current project and its impact on the management of natural resources used by the community should be fully studied. Preliminary work with the community will highlight areas of discrimination that need attention for the participatory research to become a success. Thus, a few meetings on gender orientation will help in getting co-operation from the women farmers also. The project staff should ensure that in all meetings men and women should participate, changing the time and dates, if needed, to accommodate them. Rigid timings do not work in community based research projects.

A gender-sensitive research team and a well-informed community will ensure continued participation of the farmers and success to the project.

Reference

Swaminathan, M. S. (ed.). 1998. *Gender Dimensions In Biodiversity Management*. New Delhi: Konark Publishers Pvt Ltd.

Voluntary Code of Conduct and Issues Related to Access and Benefit Sharing

P. Balakrishna

The Convention on Biological Diversity (CBD) is based on three main objectives: conservation of biodiversity, its sustainable utilisation, and equitable sharing of benefits from such use.

All the objectives are to be implemented by the Parties (Signatories to the Convention) by either adopting a suitable mechanism already available or by developing a *sui generis* system to address the implementation. A clear understanding is required to develop such a process and appropriate method to realise all the provisions of the Convention.

Many of the Articles of the CBD are relevant to the access of genetic resources, sustainable use, benefit sharing, and traditional knowledge, including: Articles 1 (*Objectives*); 8(j) (*Sharing of Benefits with Indigenous Communities*); 10 (*Sustainable Use of Biodiversity*); 11 (*Incentive Measures*); 12 (*Research and Training*); 14 (*Impact Assessment*); 15 (*Access to Genetic Resources*); 16 (*Technology Transfer*); 17 (*Exchange of Information*); 18 (*Technical and Scientific Cooperation*); 19 (*Biotechnology*); 20 (*Financial Resources*); and 21 (*Financial Mechanism*).

Article 15 requires each contracting Party to endeavour to facilitate access to genetic resources for environmentally sound uses by other contracting Parties. The principle of sovereignty over natural resources is the pivot of Article 15. National governments have authority to determine access to genetic resources. Access to genetic resources is to be subject to the prior informed consent (PIC) of the contracting Party providing the resources, unless it decides otherwise. Further, where access is granted, it must be on mutually agreed terms. This Article also requires Parties to take measures to share the benefits of commercialisation and utilisation of genetic resources with provider countries.

Decision IV/8 (3) adopted at the 4th Conference of Parties to the CBD (CoP-4) held in Bratislava in May 1998 urges the establishment of a panel of experts to develop a study on guidelines and codes of best practice for access and benefit sharing arrangements, in addition to issues on mutually agreed terms (MATs).

Besides, in February 1998, a South and Southeast Asia Regional Workshop on Access to Genetic Resources and Traditional Knowledge was held at the M. S. Swaminathan Research Foundation in collaboration with the IUCN. One of the significant recommendations of this meeting was :

> Pending the enactment of suitable legislation to give effect to the provisions of the CBD, we urge countries in this region to introduce immediately steps such as codes of conduct for both academic researchers and commercial entrepreneurs and companies, and information and material transfer agreements for the purpose of implementing the PIC and benefit sharing provisions of the CBD. Know-how licenses of the kind introduced in Peru will also be valuable to regulate the flow of information and resources. Knowledge and the resources to which the knowledge relates often go together.

The importance, relevance and need to develop a Voluntary Code of Conduct (VCC) for research and academic purposes was strongly felt. This Code of Conduct must consider the following points for its effective implementation:

- Access to material and access to knowledge—issues of PIC and MATs
- Community biodiversity registers—compilation, maintenance, and access
- Issues of patenting vs publishing
- Biopartnerships : How and when

Some of the recommendations that arose out of the discussion on the methodology and the need to develop a VCC are:

1. After considering the decisions of the SSEA workshop on Access to Genetic Resources and Traditional Knowledge and based on Decision IV/8(3) of the CoP-4, there is an urgent need to develop voluntary and non-legal codes of conduct for both academic and non-academic researches, especially on the issues of Prior Informed Consent and Mutually Agreed Terms.

2. Considering the continuing role played by rural communities in conserving, enhancing and protecting our biological diversity at all levels—*ex situ, in situ*, on-farm—there is a great responsibility in sharing the benefits of the use of resources and encouraging sustainable conservation methods.

3. Such a process of using the resources must begin with a mutually agreed, transparent, and participatory approach.

4. Subsequent to the coming into force of the CBD, the World Trade Agreement and its provisions for Trade Related Intellectual Property Rights (TRIPS) have also come into place. The decision of the World Intellectual Property Organisation (WIPO) to establish a separate division on the Global Intellectual Property Information Division (GIPID) is welcome, especially since it is beginning to consider

mainstreaming traditional knowledge into the TRIPs process.

5. Pending enactment of a suitable legislation to give effect to the provisions of CBD in addressing the issues of PIC and MATs (Article 15), it is important that voluntary codes of conduct for research and use be developed both on the lines already in use like the Tropical Botanical Garden and Research Institute (TBGRI) model in India, the Kew Botanic Gardens model, Andean Pact countries' model, and by new processes including chronicling the traditional knowledge, wisdom, and resources of the local communities in a Community Biodiversity Register (CBR).

6. The development of CBR must be based on the following :
   - Who own the genetic resources ?
   - How to get PIC?
   - What are the MATs ?
   - Who is authorised to give PIC & MATs ?
   - Who will manage the CBR ?
   - Who will have access to CBR and how ?
   - Will CBR be a official document in case of dispute settlements ?
   - What will be the attention given to the role and contribution of women in preparing and maintaining the CBR ?

7. Chronicling of traditional practices and local biodiversity wealth will help to generate greater awareness of the importance of conserving biodiversity and using it sustainably and equitably. At the same time, such Peoples' Biodiversity Registers will help to safeguard the IPR rights of local communities. Multimedia database development on the innovations, selections, and genetic resources conserved by tribal and rural families will help to ensure that they receive benefits as and when national and global biodiversity funds are established. Such Registers and databases will also help to chronicle dying wisdom in matters relating to the conservation and use of biodiversity. It will be appropriate to accord legal recognition to such local level Biodiversity Registers.

8. With regard to seeking PIC, the Biodiversity Management Group (BMG) must be given full particulars about the nature of work to be carried out, what it is for and who is going to use the information resources and knowledge.

9. MATs must be discussed with the BMG. This group can then authorise meeting relevant local people who can help give necessary information.

10. Pending suitable enactment of a legislation, the CBR or any such information will be the property of the community whose written permission will be required for publishing or carrying out research on the material.

11. For access by public institutions, any transfer of material and knowledge must be for non-commercial use. If

there is any interest in commercialisation, there can be an "across the board" fee to part with resources and/or knowledge.

12. Development of suitable institutional structures based on the non-legal measures may act as models for effective implementation process of CBD.

13. Suitable examples of VCC from national and international models can be studied and suitably adopted—based on case-by-case approach to using VCC and its modifications.

Conclusions

CBD marks a transition from an exploitative and inequitable relationship between the providers of biodiversity and its users to one of partnership between them based on principles of equity and ethics. There is, therefore, an urgent need to implement provisions enshrined in CBD, by letter and spirit. The complexity associated with matters related to benefit sharing should not become an excuse for inaction. A learning process needs to be involved before perfection is achieved. Non-legal methods coupled with legal processes to implementation of CBD principles are the needs of the hour. This is based on the experience of implementing the Philippines Executive Order No. 247 and the Andean Pact countries' legislations. Voluntary codes of conduct aimed at streamlining ethical principles into equitable partnership development are important for both non-academic and academic purposes. It is essential to address issues of empowering communities with adequate knowledge and information of matters discussed here since they are the ultimate custodians of knowledge, information, and resources.

The recommendations outlined above are very generic in nature and form the basis on which activities at the M S Swaminathan Research Foundation will be based. There may be a need to modify certain considerations based on requirements of specific cases.

Major Areas of Concern

Papers presented at the workshop were followed by fruitful discussions, and many issues that needed attention and accpetable solutions were identified. They are briefly highlighted below:

A. Impact assessment

- Impact assessment of Participatory Research (PR) and PPB is a major issue. It was felt essential to develop measurable indicators to study the thrust of both research and development.
- It was recognised that involvement could be at various levels—for example, active or passive participation—and the impact on the farming community, natural resources, and research institutions needs to be measured.
- When and how to measure impact are also debatable. It can be short- or long-term, and the right time to measure may also vary, depending on the depth of the project.
- Measuring the impact of several participatory approaches is an interesting problem. A comparative evaluation would help to select efficient approaches.
- One avenue is to start assessing one or a group of participatory activities of the project. The quantum of improvement (in measurable indicators like yield, quality, cost : benefit ratio, marketable surplus, and the like) over the initial status before the start of the project can be a good impact measure. Such measures can later be modified and extended.

B. Minimum information needs (MIN)

- Minimum information requirements could vary depending on the interest of the investigator; for instance, information needs of a plant breeder, social scientist, or the participating community itself would differ. How then to arrive at MIN ? Though difficult to demarcate, it would be useful to gather base information on various areas such as:
- Overall structure: Community; Resources; Biodiversity; Seasonal calendar
- Preference of people: Consumer preference and consumption pattern; Specific trait requirements in a crop
- Participatory Project Planning: Either allocate funds to this phase or co-operate with others (e.g. NGOs) who might have collected base information
- Future Needs: For example,

multiplication, certification, and sale of seeds of successful crop varieties resulting from participatory breeding

C. Sustaining voluntary participation

- Basically, awareness, empowerment, and training are the fundamental requirements for voluntary participation.
- It is necessary to involve the whole community in the activities, *en* block or in stages, as feasible.
- It is essential to build confidence in the participating community, which needs a variety of approaches, spread at times over a long period.
- The objectives, targets, outputs and benefit sharing should all be clearly discussed (using local language) with the participating and target groups, and modified to set them on a feasible mode.
- Successes of initiated projects, accrued benefits, and fair deals with the participatory farmers including benefit sharing are components of sustainable participation.

D. Constraints to be conscious about in PR

- There could be inadequate control over experimental design. Participatory experiments on farmers' plots have necessarily to be governed by site-driven specifics and may not always be framed to a regular design. There is a need in this context to develop/modify designs to suit the site demands. Naturally, evaluation of results and repeatability of inferences would be functions of the design and analysis.
- There is the inherent danger of losing landraces, As and when PPB develops varieties incorporating the needs of the farmers, the expansion of the area under the varieties would be at the cost of regeneration and maintenance of landraces. It is therefore essential that PPB recognises this eventuality and provides for maintenance of the landraces and genetic diversity in the project itself. *In situ* conservation of such material can be sustained/ promoted through monetary compensation (e.g., community biodiversity fund) or social recognition/rewards and the like. Successful new PPB generated varieties can be maintained by *ex situ* conservation.
- Provisions of IPR and the voluntary code of conduct are ideal beginnings of information sharing. However, necessary precautions to time such sharing are essential. Too early information empowerment may alert and alarm the participants to retract from full voluntary participation. One suggestion would be to initiate PR and allow this mode to lead to gainful outputs to the farmer before IPR awareness activity. In this context, the experience of the Tropical Botanical Garden and Research

Institute (TBGRI) is valid. Before the advent of community biodiversity entitlements, TBGRI identified a herb, *Arogya Pacha*, maintained by the Kani tribes in Kerala, and developed a drug, *Jeevani*. Fifteen percent of the proceeds of the sale of this drug is given as the benefit share to the tribals. Difficulties in continuous supply of this herb have started to surface as there is no organised cultivation and the forest authorities restrict its access from forests. Such difficulties need to be visualised, far in advance, to sustain the benefits of PR.

- In view of the divergent mandates of institutions, it is essential that the institutional structure and priorities are kept consonant with participatory research.

E. Sustainability of PR programmes

- It was highlighted that, along with PR strategies to improve current livelihood status, it is essential to recognise issues in the overall development of the region as well as various dimensions in building the capacity of the target community.
- At the earliest opportune time, the PR project has to become independent of the financial support from funding agencies and the project itself needs to be handed over to the participating community.
- The project should have built into it policies and strategies of seed production, certification, marketing, and associated storage and post-harvest problems. This is crucial for the project to be owned by the participants and sustained on a continuing basis.
- The impact of the project would remain sustained and multiply many-fold with encouragement by the State, and political and bureaucratic commitment supported by strategies continuously evolving to accommodate the dynamic needs of the farming community. The recent example of a participatory path leading to green wealth in the Jhabua district of Madhya Pradesh would stand in testimony.

Possible Areas of Cooperation

Detailed discussions on areas of general concern led to possible areas of collaboration between ICRISAT and MSSRF. The following were some suggestions that need follow-up:

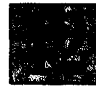
- ICRISAT-MSSRF dialogue on PR, like the current one, has proved to be a forum for frank exchange of ideas, work plan, methodology, and program output. Therefore, it is necessary to continue this activity.
- ICRISAT's PPB is on cultivated mandate crops and the target farmers are from the areas growing them. MSSRF continues to care for the uncared, particularly tribals, and

strives to show them avenues of sustainable livelihood. At some point of time, one or more scientists from each institution can be invited as observers of the program in operation at target sites.

- Exchange of information on germplasm, *in situ* conservation strategies, methodology development in PR was identified as a mutually beneficial activity.
- The experience of MSSRF in integrating research and developmental activities was recognised and recommended to be used as a consulting base for project planning, monitoring, and impact assessment.
- It was felt that minor millets can be an area of mutual interest and co-operation.

These suggestions need to be given a sharper focus in the light of accruable collaborative benefits to both the institutions.

Participatory Plant Breeding Paradigms - An Overview



Exchange of views, experiences, comments, and criticisms during the workshop suggest a green path to benefit and profit sharing through PPB activities.

- Participation is the key principle in PPB and is recognised as the main component in sustaining the benefits of PPB.

- The extent and success of participation are direct functions of the structure, social status, and environment infrastructure of the target farmers. Any PPB activity has to chronicle and evaluate these aspects of ground information to plan a feasible work schedule.

- PPB activities and success cases published so far have targeted, in general, farmers who practise relatively subsistence agriculture. But their social fabric, educational background, and general level of comprehension of scientific improvements are, on an average, sound. In contrast, the target farmers of the PPB programme of MSSRF, for example, are tribals, resource-poor, and highly tradition-driven with a strong cultural and social background and inadequate literacy. In this backdrop, concerted efforts over time are warranted, most often, for voluntary acceptance of, and co-operation with PPB efforts. Such sharp differences need to be taken into adequate account before setting an activity plan.

- Farmers' knowledge about the crops in their areas has a high potential to power PPB programmes (**Table 1** for a few reports). It would serve well to empower scientists' knowledge for designing site-, crop - and farmer-specific PPB activity.

- Most of the known PPB success cases (**Table 2**) have mainly been based on the two methods—Participatory Farmer Evaluation and Participatory Farmer Selection. Varieties and/or target material were usually generated by scientists and evaluated and/or selected by farmers in their sites.

- In order to sustain the enthusiastic participation of farmers in PPB programmes, it is crucial that initial PPB activities lead to visible yield enhancement and profitability. Therefore, when there is scope for improved agronomic/cultural practices (as is, often found in farmer-sites), such interventions must be tried on priority.

- Once the advantages of PPB have become evident, farmers need to be trained on participatory mode on the methods of selection of desired parents, making F1 crosses, raising F2 populations, and identifying recombinants and further selection in advanced generations. Their preference for various quantitative and qualitative traits must be recognised and utilized in selection. Such participatory breeding capacities must be extended to production, selection, grading, and maintenance of quality seeds by farmers. Eventually, these activities should lead to seed co-operatives and seed villages that would serve as strong sustainable strategies for secure livelihood.

These suggestions are indicative; site and target farmer-driven modifications are imperative for assured success of the programmes.

A PPB programme for target farmers is of the farmers, for the farmers, and by the farmers, with the active help of scientists, for achieving the twin goals of secure livelihood for the farming community and genetic diversity for sustainable agriculture.

Table 1 : *Potential of farmers' knowledge for PPB*

Irian Jaya (Indonesia)	Sweet potato	FS ; CC
Bolivia	Potato	FS
Malawi	Tea	OA

CC : Community conservation ; FS : Farmer Selection ; OA : Organoleptic assessment

Table 2 : *PPB success cases*

Country	Crop	Variety	Method	Remarks
Nepal	Rice	MP3	PFS	Selection in F5
Niger	Pearl millet	ICMV IS 92222	PFE	Preference to released population
Rwanda	Beans (*Phaseolus vulgaris*)		Landraces	PFS Arresting genetic erosion
Brazil	Beans		PFS	Sel. in Seg.Population
Syria	Barley		PFS	Sel. in Seg.Population
India	Rice	Rel. vars	PFE	Enhanced productivity through green manuring with *Sesbania*
	Pearl millet	Population	PFE	Sel. in Pre-release
	Maize		PFS	and released lines
	Chickpea		PFS	
	Blackgram		PFS	

PFE : Participatory Farmer Evaluation ; PFS : Participatory Farmer Selection
Sel : Selection; Seg: Segregating; Rel.vars: Released varieties

List of Participants

ICRISAT

Genetic Resources and Enhancement Program
Patancheru
Andhra Pradesh 502 324
E-mail : ICRISAT @CGNET.COM
Fax No : +91 (40) 241239

A. Christinck
(Institute for Social Sciences of the Agricultural Sector
Department of Agricultural Communication and Extension
University of Hohenheim (430a)
D-70593 Stuttgart
Germany)
Now Spl. Project Scientist
C/o Dr. O.P. Yadav
CAZRI
Jodhpur, Rajasthan

F.R. Bidinger
Principal Scientist (Crop Physiologist)

C. T. Hash
Principal Scientist (Plant Breeding)

Paula J Bramel-Cox
Acting Program Director

S. B. Sharma
Senior Scientist (Nematology)

H. D. Upadhyaya
Scientist (Plant Breeding)

O. P. Yadav
Pearl Millet Breeder
CAZRI

C. L. L. Gowda
Principal Scientist
ICRISAT

B. V. S. Reddy
Senior Scientist (Plant Breeding)
ICRISAT

G. V. Ranga Rao
Spl. Project Scientist
ICRISAT

S. Pande
Senior Scientist (Pathology)
ICRISAT

V. Rameshwar Rao
ICRISAT

MSSRF

M.S. Swaminathan Research Foundation
3rd Cross Road, Taramani Institutional Area
Chennai 600113
E-mail : MDSAAA51@giasmd01.vsnl.net.in
Fax : +91-044-2351319

N. Anil Kumar
Head & Co-ordinator
Community Agro-Biodiversity Centre
MSSRF, Chandra Bhavanam
Puthoorvayal P.O, Kalpetta
Wayanad
Kerala 673 121

V. Arunachalam
Distinguished Fellow

P. Balakrishna
Senior Scientist

M. Geetha Rani
Gene Bank Manager

H. S. Kanvinde
Consultant

R. D. Iyer
Consultant
CP VIII/152, Indira Nagar
Chengala, Kasargod 671 541
Kerala

B. P. Mohanty
Site Co-ordinator (Jeypore)
Site Office : Lingaraj Nagar
Dist Koraput, Jeypore 764 004
Orissa

S. D. Sharma
Distinguished Fellow
M.S.Swaminathan Research Foundation
Base Centre, Plot No. 658
Mahanadi Vihar, Cuttack - 753 004
Orissa

OTHERS

B. S. Rana
S. L. Kaul
Chari Appaji
National Research Centre on Sorghum
Rajendranagar
Hyderabad 500 030

K.vom Brocke
Institute of Plant Breeding, Seed
Science and Population Genetics
University of Hohenheim(350)
D-70593 Stuttgart
Germany

J. R. Witcombe
D. S. Virk
Centre for Arid Zone Studies
University of Wales
Bangor, U.K.