Participatory approach in varietal improvement: A case study in finger millet in India

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Crop improvement research has made a significant contribution in the last 5 decades through the development and release of a large number of varieties in all important crops for general cultivation. It is generally felt that the modern plant breeding has catered more to the needs of rich farmers who could afford high management under irrigated situations. In contrast, subsistence farmers growing millets and other minor crops in unfavourable environments use low levels of inputs and have not been benefitted by high yielding variety (HYV) technology. In the present case study, the usefulness of the participatory approach for identifying cultivars for harsh environments and acceptable to resource-poor farmers has been demonstrated. The study carried out in Chitradurga district using six finger millet varieties with 150 farmers pointed out the effectiveness of such an approach in identifying cultivars for meeting the requirement of the resource-poor farmers under real farm situations. Another important outcome of the farmer participatory varietal trial has been the identification of a most suitable variety for growing in a specific niche as a second crop which otherwise would have been difficult under the variety evaluation system confining to research stations.

CROP improvement research has been in progress since the beginning of this century. However, progress in plant breeding has been phenomenal in the last 5 decades in India. The coordinated crop improvement programme was first conceived in maize during 1956 and later on expanded to all the other important crops either individually or in groups under the National Agricultural Research System (NARS). The conceptualization of land grant system of agricultural research, education and extension and the establishment of agricultural universities further helped in developing broad-based agricultural research activities to address the agricultural research needs of different states. As a result, a large number of varieties were bred and released for general cultivation in all important crops in the country. The successful adoption of these varieties along with improved cultivation practices helped in a 4-fold increase in food grain production, from 50 million tonnes to more than 200 million tonnes. However, much

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of this increase has come from two major cereals – rice and wheat – (155 million tonnes out of 200 million tonnes); the contribution of other crops is still less. It is now generally accepted that the high yielding variety (HYV) technology has made more impact in high external input areas which are mostly irrigated. In low external input areas which are dryland areas, the impact of HYVs on crop productivity has been limited. The group of millets, which include sorghum, pearl millet, finger millet and small millets falls in the latter category. Subsistence farmers growing millets in unfavourable environments use low levels of inputs and are reluctant to adopt HYVs. Given the uncertainty of the circumstances, the farmers' concern is not so much to increase productivity but to avert complete failure. Many of the modern varieties of these crops have not been able to provide a satisfactory replacement to traditional varieties. The continued popularity of M 35-1 *rabi* sorghum, A 1 bengal gram, A 1 safflower and PR 202 finger millet which are the purified versions of the farmers' selection, substantiate the versatility of these cultivars in providing both general and specific adaptation to a wide range of farming environmental situations in the southern peninsula including Karnataka. Modern plant breeding mostly caters to favourable environments, since the entire varietal improvement work is carried out in research stations. On the contrary, millets are grown in harsh environments and the performance of the variety is linked to its ability to adjust to fluctuating edaphic and climatic situations. Obviously, local adoption will have to be the main consideration in cultivar development which could be successfully achieved through the participatory approach.

The usefulness of the participatory approach for identifying cultivars for harsh environments, which are difficult to replicate in research stations, has been recognized by the crop breeders[1–4]. However, not many well-planned studies have been reported on the participatory approach of varietal selection and crop improvement. This paper discusses the results of a case study on farmer participatory varietal selection in finger millet in India to substantiate the importance of such an approach in the identification of cultivars for harsh environments, acceptable to farmers with poor resources.

The present study was carried out in Chitradurga, Holalkere and Hosadurga taluks of Chitradurga district, Karnataka. Participatory rural appraisal (PRA) was part of the study, to understand the needs and preferences of farmers on varietal choice in finger millet. An elaborate proforma was developed for PRA survey which included 150 finger millet-growing farmers representing all the socio-economic classes from 7 villages, viz. Katihalli, Jalikatte, Erajjanahatti, Maddheru, Kumminagatta, S. Roppa and Bansihalli in the three taluks. PRA helped in assessing the cropping system, economic status, input–output management as well as the preferences of varieties with reference to plant characters that the farmers look for in the new variety.

Farmers had their own perception of choice of varietal characters. For 89% of the farmers grain and fodder yield were the main considerations. The other characters considered as important were compact ear (68%), medium height of around 100 cm (65%) and early maturity (38%). In other words the farmers were looking for a variety maturing in about 105 days, with a height of 100 cm, having medium-sized compact ears with moderate tillering ability besides good productivity. A suitable variety was also needed for delayed sowing particularly for planting in the middle of August and also for growing as a second crop in the kharif season after sesame or cowpea.

Based on the farmers' preference, from the varieties available at the national and state level, six of them, viz. GPU 28, GPU 26, VL 149, VL 305, GPU 46 and 9002 were short-listed for use in the fields. They were evaluated in a farmer managed varietal trial (FAMPAR) conducted on the field.

One hundred and fifty farmers were involved in the FAMPAR trials during *kharif* 1999. Each farmer was given 1 kg of seeds of one of the six varieties to be grown over an area of one-eighth of an acre (approximately 500 sq m) along with the local cultivar. These were unreplicated trials. Two farmers were given all the six varieties for growing side-by-side or contiguously for a more critical comparison. These trials were conducted in the same villages where PRA was carried out. In the FAMPAR trials, the traditional crop management practices in vogue in that area were adopted. They were not stereotyped trials as in case of conventional variety evaluation trials.

The analysis of variance helped in discerning location differences and subsequent analysis of varieties helped in the comparison of their superiority.

The performance of the varieties in the FAMPAR trials was judged both visually and quantitatively by a group of 25 farmers specially formed for this purpose. The group visited all the 150 trials twice. Scientists, extension officers and other officials also accompanied the group. However, the farmers themselves made the final judgement and ranking of varieties. The input provided by the group was used for formulating a pre-harvest matrix ranking of varieties along with local check, by taking six important characters, namely crop duration, ear type and size, disease resistance, drought tolerance, grain density, and estimated yield potential. In addition, quantitative data on important plant characters including yield were collected from all trial plots for a more critical comparison.

The farmers selected GPU 28 for normal planting in the second fortnight of July, GPU 26 for delayed sowings till middle of August and VL 305 (maturing in 85 days) for planting as the second season crop. From the point of view of yield also, GPU 28 was superior, followed by GPU 26. VL 149, GPU 46 and 9002 were not preferred by the farmers. We now discuss the advantages and disadvantages of these trials in comparison with the

Table 1. Salient features of conventional and participatory approaches in varietal improvement

	Variable									
Breeding approach	Test environment	Size of material evaluated	Experimental precision	Statistical validation	Participation of farmers and scientists	OFT inbuilt/ additional	Adaptability horizon	Farmer acceptability	No. of years taken for variety release/identification	Requirement of man-power/infra-structure
Conventional	More uniform (–)	Large (+)	Good (+)	Good (+)	Fair (–)	Additional (–) Minikits/FLDs/ farm trials	General (+)	Moderate to high (–)	10 (–)	High (–)
Participatory	Highly variable (–)	Moderate (–)	Fair (–)	Fair (–)	Good (+)	Inbuilt (+)	Specific (+)	High to very high (+)	6 (+)	Low (+)

(+) or (–) indicate strength and weakness of the programme, respectively; OFT, on farm testing; FLD, frontline demonstrations.

national variety evaluation system prevalent now in the country.

Under NARS, in the coordinated crop improvement programme, a well-knit National Plant Variety Evaluation System (NPVES) is in vogue for the last four decades. The coordinated varietal trials are conducted on research farms located in different states and in different agro-climatic zones. A variety will have to undergo a three-year testing before consideration for release/identification at the state or national level. No doubt this system has served well and a large number of varieties have been identified and released. The varieties thus released have found acceptance in areas where crop production is assured. On the other hand, the adoption of newly bred varieties in harsh environments particularly in drylands has not been satisfactory as the yield difference between local and improved varieties was very marginal. This was due to the fact that the conditions provided on research farms during variety evaluation were quite different from the real farm situations. The new varieties lack local adaptation and/or are inferior in other attributes which the farmers look for. Hence the varieties identified under the national variety evaluation system often fail to spread in dryland/tribal/hill and harsh agriculture areas. In the present case-study on farmer participatory varietal selection in finger millet, one of the varieties VL 149, released at the national level has found least acceptance in Chitradurga district, as this variety lacked most of the characters preferred by farmers. On the other hand, the varieties GPU 26 and GPU 28 released at the state level were accepted although they still lacked a few characters preferred by farmers. This shows that there is scope for genetic improvement to meet the requirement of the farmers under real farm situations. Another important outcome of this trial has been the identification of VL 305 as the second crop in spite of its low productivity. This variety would have been eliminated in normal routine testing under NPVES.

The conventional and participatory approaches of varietal improvement are unique in their own way with several salient features (Table 1).

The conventional approach is superior to the participatory approach in 4 out of the 10 listed variables, while the participatory approach scores in 6 out of the 10 listed variables. The conventional approach, no doubt, is very effective in breeding varieties for favourable environments and high external input agriculture (HEIA) situations. On the other hand, the participatory approach may be more effective in identifying varieties for harsh environments and sporadic/specific niches which cannot be duplicated in the research station. According to a specific situation, a judicial mix of both the approaches may be needed, particularly in those crops where low input, marginal management, biotic and abiotic stresses are largely prevalent. Another important advantage of the participatory approach has been the high rate of adoption of varieties identified following this approach and also a significant reduction in the number of years that are required in the varietal identification and adoption. In crops like coarse cereals, especially rabi sorghum, pearl millet, ragi, minor millets, arid legumes and oil seeds like niger and safflower where infrastructure for research is lacking, elaborate participatory approach would be more rewarding. Under the National Agriculture Technology Project (NATP) of the Indian Council of Agricultural Research (ICAR) the participatory approach is given due attention for fine tuning of the technologies identified under the national system.

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