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Participatory evaluation of improved technologies with farmers: the case of bean technologies

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Abstract

The National Beans Program has carried out on-farm bean variety evaluation trials since 1986 to-date using the conventional approach in addition to using farmer participatory approach from 1992 with more farmer involvement as partners in the research process. In either approach, it was noted that farmer involvement was a key to successful technology evaluation. It was also noted that yield was not the only factor farmers consider in adopting new bean varieties. Yield had to be accompanied by other variety attributes like preference for seed colour and size, good taste, tolerance to insect pests and diseases and other adverse conditions, marketability, shorter cooking time and maturity period. Both approaches have their successes and limitations. Making both approaches very efficient requires more farmer involvement in technology development and testing. There is need for training of farmers and extension agents in on-farm management and technology testing. Dedication and devotion of all parties involved in technology development and testing is important. There is need for increased funding for technology testing with more farmer involvement. The way forward is to make both approaches more participatory with more involvement of the farmers and all other stakeholders.

Key Words: Adoption, beans, bean characteristics, conventional on-farm research, farmer participatory research, yield

Introduction

Bean (*Phaseolus vulgaris* L.) is an important legume crop in Uganda providing up to 45% of the protein uptake and 25% of the total calories in the human diet. Beans are also a valuable source of vitamin - B complex, iron, zinc folic acid, complex carbohydrates and other essential minerals. About 600,000 hectares of beans is grown annually and production ranges from 300,000 to 500,000 metric tones with consumption at the same range. The crop is important both in the domestic and export markets.

Beans are mainly grown by smallholder farmers, the majority of whom are women with a larger proportion of the harvest for home consumption and excess for sale. This makes beans play an important role in sustaining smallholder farmers and their households, providing the dietary needs and cash to meet other needs. Because of the major economic, nutritional and food security importance of beans in Uganda, significant research efforts have been placed towards improving its production.

A participatory approach to technology development, evaluation and dissemination was initiated in 1992 in Matugga village (Mpigi District), Ikulwe village (formerly Iganga but now Mayuge district) and Kicumbi parish (Kabale district). The sites are where perennial and annual crops are produced in mixed farming systems. Farmer participation in planning and implementation of research has been widely recognized as a valuable tool for successful on-farm experimentation (Lightfoot et al., 1987; Ashby, 1990; Chambers et al., 1993). Nevertheless, farmer participation in a research process has mainly been restricted to information gathering for problem identification and management of on-farm trials (Ashby, 1986) while design of research interventions tended to be the domain of the researchers. Vast majority of research work have preferred to do research about problems rather than research to solve problems (Rhoades, 1993). Ignoring farmers' knowledge in the design of research often resulted in failure of on-farm trials (Lightfoot, 1988). Farmers are capable experimenters who carry out research on subjects relevant to them (Rhoades and Bebbington, 1991). Farmers may be limited in their experimentation especially if the problems are not well understood where researchers can then supplement with their biological and technical skills to make experimentation more efficient (Fernandez, 1991). A joint effort of farmers and researchers in setting the research agenda takes advantage of both the local and researcher technical knowledge which collectively provide a better basis for generation, development, evaluation, adoption and dissemination of research technologies, rather than either alone (Raintree and Hoskin, 1988).

Generation and evaluation of technologies with farmers is an essential process, which gives researchers the needed information about the acceptability of the technologies under the farmers' environmental and socioeconomic circumstances for technology adoption. There are a number of factors farmers consider in choosing a particular technology to adopt. In evaluating bean varieties, a number of bean characteristics determined the acceptability and adoption of the varieties by farmers in addition to other socio economic aspects related to production and marketing of the crop. Bean variety characteristics such as yield, seed colour, seed size, growth habit, taste, resistance/tolerance to pests and diseases and tolerance to poor soils, maturity period, soup colour and thickness and storability are considered important in accepting a new bean variety by farmers (Kisakye and Ugen 1990). Such information can possibly be obtained through participatory evaluation of bean technologies with farmers, and therefore the need for farmers' involvement

Physical characteristics, farmer's managerial ability, average farm size and widespread poverty were other factors identified as having influenced acceptance, adoption and dissemination of new bean cultivars in Rwanda (Sperling and Loevinsohn, 1991). Differences existing in farmers' level of education, family size, land and asset ownership are likely to influence choices farmers make while cultivating their crops and crop cultivars (Mugisa-Mutetikka, 1997a). All these become apparent through participation of farmers in evaluation of technologies so that technologies are targeted at meeting farmers' needs and circumstances (socially and economically).

Since 1986, a number of improved bean production technologies have been evaluated together with farmers which have ranged from testing new varieties to management practices using both conventional and participatory research approaches. This paper discusses farmer involvement in evaluation of improved bean production technologies with emphasis on bean variety evaluation using two main approaches; namely conventional and farmer participatory research approaches, the important bean characteristics farmers consider in acceptance, adoption of new bean varieties; successes; limitations of the two approaches and the way forward for better and more efficient evaluation of bean technologies.

Materials and methods

Conventional evaluation of improved bean technologies (on-farm bean variety evaluation trials)
To increase bean productivity and maintain food security in Uganda, the National Bean Program regularly carries out on-farm variety trials in several regions of the country. The trials are researcher-designed, farmer-managed and closely supervised by the extension agents. The extension agents select the farmers involved in the trials with a few cases where researchers guide the extension agents in the selection of the farmers where involvement of women farmers is particularly encouraged. The trials had two replicates per farm in a randomized complete block design. Each plot was 3m x 4m. Each season, farmers were provided with kits containing 250 - 300 seeds of 5 to 6 test varieties. Farmers were instructed to follow their normal management practices and to plant a check variety of their choice for comparison. Farmers, with the help of the extension agents planted the trials and requested to observe variety performance till harvest. At the end of each season, researchers, extension agents and the farmers on individual and group basis conducted post harvest evaluation of the trials. Individual farmers were asked to name the good and bad characteristics of each variety without suggesting any trait for farmers' consideration. Variety characteristics were then discussed with a group of participating and non-participating farmers after yields were measured and farmers are at liberty to eat or re-sow the seeds of test varieties. Every season, the researchers provide new seeds for evaluation. Over the years, over 50 lines of promising bean cultivars were tested on-farm resulting in the release of 12 improved bean varieties namely K 131, K 132, NABE 1, NABE 2, NABE 3, NABE 4, NABE 5, NABE 6, NABE 7C, NABE 8C, NABE 9C and NABE 10C.

Researchers visit the trial sites at planting to deliver the seeds, at mid season for mid-season trial evaluation with farmers and at the end of the season to carry out post harvest evaluation with farmers. At mid-season evaluation, the researchers take disease records and other agronomic data. While extension agents take yield records. Each extension agent is given a data sheet with instructions on how to take the various records. At the end of each season, meetings are held with participating and non-participating farmers in each place to carry out evaluation of the improved technologies and discuss modalities for next season's planting. Usually each extension agent is allowed to manage between 5 and 15 on-farm trials per season. Conventional on-farm bean variety evaluation trials have been carried out in central (Mpigi, Luwero and Rakai districts), northern (Apac, Lira and Nebbi districts), eastern (Tororo and Iganga districts) and western (Kabale, Bushenyi and Mbarara districts) in Uganda since 1986 to-date. By 1992, a total of 456 responses were recorded across the region (193, 118, 31 and 114 responses from central, eastern, northern and western Uganda, respectively).

In the FPR approach, farmers are involved in the whole research process right from problem identification, possible causes, possible solutions, research planning, implementation and evaluation of research interventions. Scientists of the Beans Program have been working with farmers in several districts of Uganda over a long period of time and have been able to identify, prioritize, identify possible causes and possible solutions, and implemented trials together with farmers (Ugen, 1999; Ugen et al., 1992). A number of procedures, tools and methods have been used in FPR approach in Matugga and Ikulwe villages (Ugen et al., 1992, Ugen et al., 1993) including diagnosis through formal and informal surveys, interviews, transect walk and participatory observation with farmers and group discussions. Research planning, designing of experiments, implementation and evaluation of research results were carried out together with farmers.

In the case of Matugga village, in 1992 a total of 50 farmers were initially involved in the process with the number of farmers increasing over the years. Priority problems mentioned by farmers included poor soil fertility, soil erosion, weeds, poor seed quality, wilts in vegetables, groundnut rosette, banana weevils and cassava mosaic (Ugen et al., 1992) to mention but a few.

Together with farmers in small groups, seven trials were planned namely; bean variety evaluation, crop rotation involving beans, maize and groundnuts, mulching/weed residue management for vegetables, use of household refuse and farmyard manure, cassava variety evaluation for resistance to mosaic, agro forestry and banana weevil control. Of the 50 farmers, 23 volunteered to conduct a total of 38 trials, with the number of trials per farmer varying from one to three. Results of the FPR approach to variety evaluation with more involvement of farmers being reported emphasized more in work carried out in Matugga village between the period 1992 to-date.

In 1997, we interviewed farmers who were involved in on-farm bean variety testing from 1986 to 1996 from Luwero, Mpigi and Kabale districts to find out what factors they consider in accepting the bean varieties they were growing.

Factors affecting acceptance and adoption of improved bean varieties were noted to see if these factors had changed over time with introduction of FPR. A total of 324 participating and non-participating farmers in on-farm trials were interviewed. Non-participating farmers where those farmers who were not directly involved in testing the varieties with the researchers but who in way managed to get seeds from the participating farmers for their own planting over the years. Considering the two approaches since 1986 to-date looked critically at the merits and demerits of each approach which is reported in this paper

Results and discussion

Since 1986, over 50 improved bean lines have been tested on-farm in the county. Despite the high yields of some of the varieties and others yielded slightly lower than expected in some regions, they were accepted and adopted by farmers resulting in their official release. The 3 varieties of G13671, Carioca, and white haricot, which in central and eastern Uganda were higher yielding than the local check but were not accepted by farmers (Table 1). Farmers noted that although G13671 and Carioca yielded well, they had problems of unacceptable seed colour, low market potential, the soup made out of the two is slimy and not compatible with banana hence a preference for red colour in central Uganda. The growth habits of the two varieties could not allow them be easily inter-cropped and harvested while white haricot had high yield, short cooking time, good taste, good market in urban areas and acceptable colour. The problem with white haricot was its poor post cooking keeping quality, susceptibility to a necrotic strain of bean common mosaic virus (BCMV) attack, low storability and semi-climbing growth habit, tastes better when fried in oil where cooking oil is a limitation in rural areas resulted in farmers taking little interest in white haricot despite the good yield and other attributes. However, farmers in central and eastern still preferred it for urban market as it fetched high price.

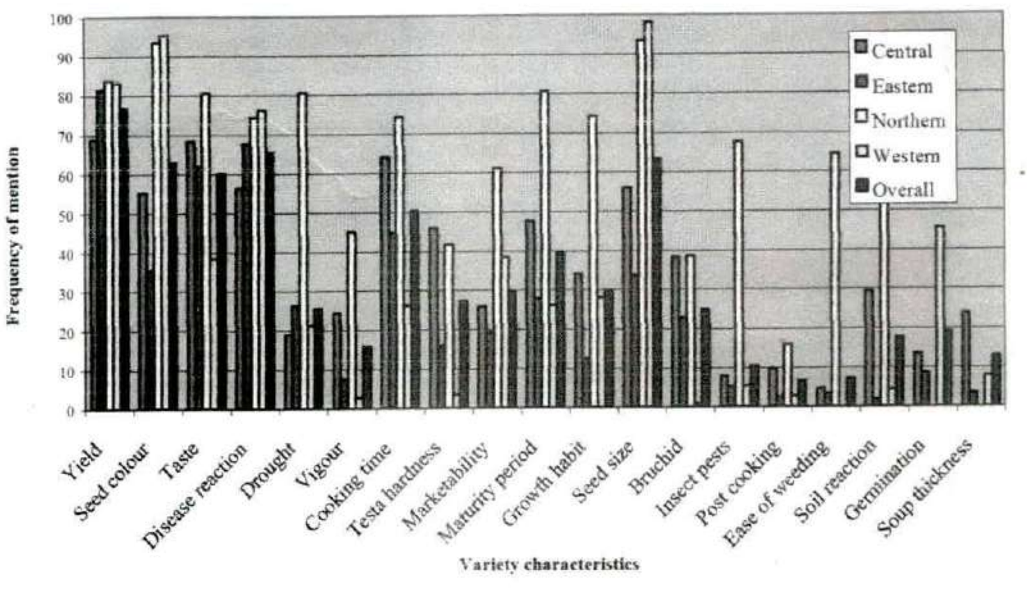
Similarly, the release of K 131, K 132, NABE 1, NABE 2, NABE 3, NABE 4, NABE 5, and NABE 6 and the climbing beans had similar inclinations to some preferred characteristics by farmers. Variety RWR 136 and white haricot performed well in central Uganda but were not accepted by farmers (Table 2) under FPR approach. However, farmers in eastern and western Uganda appreciated NABE 1 because of the colour, seed size and its high market potential. All released varieties had characteristics appreciated by farmers in one region or another. K132 was greatly appreciated for its seed

Table: 2 Average bean yield (kg/ha) under FPR approach to bean variety evaluation trial in Uganda (in brackets are percentages above or below farmers' seed yield).

Varieties	Central	Eastern	Northern	Western
CAL 96 (K 132)	1172.1 (46.2%)	867.0 (0.0%)	-	796.0 (0.0%)
MCM 5001 (K 131)	1305.4 (62.9%)	1156.6 (33.5%)	2396.0 (45.7%)	1246.0 (56.4%)
MCM 2001 (NABE 3)	1115.4 (39.2%)	877.3 (1.3%)	2223.0 (35.2%)	683.0 (-14.2%)
MCM 1015 (NABE 2)	1117.0 (39.4%)	643.3 (-25.7%)	2280.5 (38.7%)	-
OBA 1 (NABE 1)	359.2 (-55.2%)	1260.5 (45.5%)	-	1096.0 (37.6%)
White haricot	1209.2 (50.9%)	699.3 (-28.5%)	-	1025.8 (28.8%)
RWR 136	1274.5 (59.1%)	-	-	-
SUG 50	1096.5 (36.8%)	875.3 (1.1%)	-	-
PVA 698	1363.0 (70.1%)	901.0 (4.0%)	-	751.0 (-5.5%)
UG 6088	1244.3 (55.3%)	816.5 (-5.7%)	2080.0 (20.9%)	521.0 (-34.6%)
Farmer's seed	801.3	866.1	1644.5	796.5

size, colour, taste, growth habit, ease of weeding and harvesting, high marketability and good taste. K131 was resistant to bruchid attack, disease and drought tolerance, doing well under poor soil conditions but was not appreciated for its colour and size and farmers felt that the variety had low market potential. Due to the other good attributes of K 131 especially its good performance under adverse conditions, farmers are willing to grow the variety as a food security crop. Varieties PVA 698 and UG 6088 performed very well in central and northern Uganda but due to unappreciated colour and taste, they were not accepted by the farmers emphasizing that yield alone may not be the ultimate criteria for acceptance of a variety. The poor performance of beans technology trials under the conventional on-farm as compared with FPR approach was mostly attributed to poor management as farmers considered the trials as belonging to researchers rather than theirs, poor supervision by extension agents such that most operations were not timely and weather especially in eastern Uganda was also a factor. Better performance under FPR approach was due to the changed attitudes of farmers towards the trials and their being part of the whole research process early in the process of technology development, evaluation and dissemination.

Figure 1. Frequency of mention of bean varietal characteristics by farmers participating in conventional on farm trials in 1992.

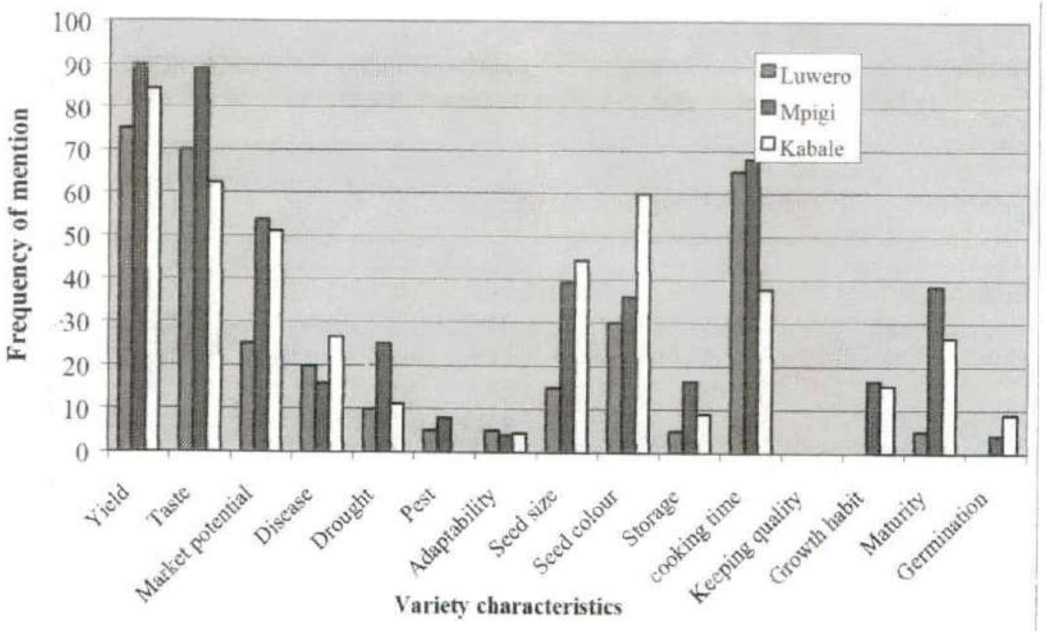


Bean characteristics preference for acceptance of new bean varieties by farmers

By 1992, farmers across the region most frequently mentioned yield, taste, seed colour, and susceptibility/ tolerance to insect pests and diseases as either good or bad bean characteristics that affected their acceptance and adoption (Figure 1). Seed size was frequently mentioned in central and northern Uganda. While central preferred large seeded varieties, northern for the case of Apac preferred small seeded variety of the black types, insect pest tolerance, maturity period, cooking time, soil reaction, ease of weeding and marketability as some of the important characteristics they consider for acceptance and adoption of a new bean variety (Figure 1). Marketability was particularly stressed as important in the north. With the wide spread cultivation of NABE 2, market has become very important in the north while lack of firewood in central and eastern Uganda makes farmers demand for varieties that are easy to cook. In the north, early maturing varieties that are tolerant to insect pests, diseases and poor soil conditions are preferred. In western Uganda, yield, seed size, seed colour, disease tolerance, taste and cooking time were important (Figure 1). Similar findings were reported in Rwanda and many other countries (Sperling and Loevinsohn, 1993; Grisley et al., 1993). In all regions, yield was the most frequently mentioned characteristic by farmers but had to be supported by many other good characteristics for acceptance and adoption as shown by varieties like G13671, Carioca and White haricot, which are high yielding but are rejected by farmers due to many other negative attributes.

In 1997, results from a survey of farmers from central (Luwero and Mpigi districts) and western (Kabale district) Uganda who participated in on-farm trials previously and continued growing the improved varieties noted similar characteristics as was noted by farmers in 1992 as important in acceptance and adoption of new bean varieties. Bean yield and taste were the most frequently mentioned bean characteristics considered by more than 60% of the farmers in accepting new bean cultivars in all the three districts (Figure 2). Farmers in Mpigi and Kabale districts were more concerned about market potential of new bean cultivars than their counterparts in Luwero district. Seed colour was more important to Kabale farmers than those in Luwero and Mpigi districts. In Kabale district 60% of the farmers who were growing improved bean varieties considered colour as important criteria is accepting a new variety. Cooking time characteristic was more important in central than western Uganda. Other important characteristics included seed size, maturity periods, and drought and disease tolerance. Compared to 1992 results, farmers were more concerned in 1997 with market potential of the varieties indicating a shift from food security to income generation. But in general, characteristics affecting acceptance and adoption of new

Figure 2. Frequency of mention of bean variety characteristics by participating farmers in FPR approach in 1997.



bean varieties had remained similar over the years with more emphasis on marketability.

Lessons learned from conventional on-farm evaluation trial approach

Over the years, the successes associated with conventional on farm approach include;

(i) Improved linkage between researchers, extension field staff and farmers

(ii) Reduction of communication problems due to language differences as researchers work with extension agents who in most cases are locals of the area.

(iii) Early involvement of extension agents in technology evaluation rather than demonstrating released technologies as in the past.

(iv) Improved interaction between participating farmers resulting in better evaluation of the trials as a group

(v) Easy access of the agents by farmers for timely implementation of the trials,

(vi) Reduced cost of visiting the trials by researchers as researchers visit the trials twice or three times in a season.

This allows for many trials to be conducted in many districts in a season resulting in collection of large data in a relatively short period of time. Where good collaboration with NGOs exists better supervision of the trials is always realized because of good motivation. Limitations associated with this conventional on-farm technology evaluation include:

(i) Low motivation of the extension agents resulting in poor supervision and monitoring of the trials, inadequate training for extension agents, NGOs or CBOs to improve on their ability, and efficiency in on-farm trial management.

(ii) Trials tend to be widely dispersed making supervision very difficult for extension agents. Having the trials in more manageable radius for extension agents could ease monitoring and supervision and makes the operation more efficient. Group evaluation of the trials becomes very difficult due to the distance involved.

(iii) Trials tend to be mostly with prosperous farmers who have relatively more resources (both physical and financial) and occasionally use hired labour to look after the trials. These farmers are usually not representative of the lager farming community in the area and they put less emphasis on trial evaluation.

(iv) Use of the same farmers season after season results in misunderstanding in the community as well as getting information from non-participating farmers becomes a problem. This can be resolved by use of different farmers each season and those who are influential in the community.

A more participatory approach is needed where researchers work together with farmers and extension agents over a longer period of time as partners in technology development and evaluation rather than merely providing sites for technology testing.

Lessons learned from FPR approach

Lessons learned from FPR approach to bean technology evaluation were that; through working closely with farmers, the following successes have been recorded; improvement in the rate of adoption of bean technologies and participating farmers adopt other technologies introduced by other researchers and evaluated by the same farmers (Mugisa-Mutetikka, 1997a). On average, 80% of the participating farmers in Mpigi, Luwero and Kabale districts adopted new technologies tested through FPR approach compared to low adoption of new varieties by 1992 (Mugisa-Mutetikka, 1997a and 1997b). Over 50% of the farmers that participated disseminated such technologies to other farmers. Apart from new bean varieties, farmers also adopted other improved crop varieties namely cassava, sweet potato and maize. Similarly, the number of bean varieties grown per season and the proportion of bean sellers increased due to increased production. There was also increase in land allocated to beans as well as yield per unit area (Mugisa-Mutetikka, 1997b).

Participating farmers have contributed a lot to technology transfer of improved bean production techniques (Mugisa-mutetikka, 1997b).

FPR has proved useful in strengthening planning and research capabilities as involvement of farmers allows for targeting technologies for specific problems identified. This makes research more efficient and economical. Farmers through their independent experimentation have provided researchers with information, which has been used to develop technologies for more efficient use by the farmers. Case in point is the use of cow urine to control insect pests and diseases in vegetables including beans (Opio and Ugen, 1998).

With the involvement of farmers in research priority setting and testing of technologies, better understanding of farmers' problems for meaningful research have been achieved. The integration of indigenous technical knowledge (ITK) in research has enhanced the research process and adoption of technologies. FPR has strengthened linkages between researchers, extension agents and farmers and a better social interaction between the three groups has been realized. FPR allows for multidisciplinary teamwork in technology generation and development both within and without the project. Social impact for farmers with diverse interest was realized as they afforded to work together in villages where FPR approach was being applied. FPR has strengthened community organizations in villages, further eased the work of extension agents as well as researchers like the formation of farmer research groups in 1998 in Matugga has eased the work of extension agents and predisposes them early to new technologies as compared to conventional approach.

FPR also allows for many commodity crops to work as a system rather than working in isolation reducing the time farmers have to attend to research trials compared to if all commodity crops move singly. This results in sharing of resources and therefore reduced costs of operation. FPR has proved useful in increasing the popularity of researchers in the rural areas creating confidence in farmers in decision making to tackle their own agricultural problems and the problem solving abilities of farmers have been improved through access to information, additional research skills and problem solving relationship with neighboring farmers.

FPR apart from the great successes has a number of limitations associated with the approach such as; farmers' expectations for free inputs and need for short-term benefits undermining the importance of FPR. Farmers are usually interested in quick results, which may be a problem with some of the technologies. Initially FPR is time consuming and expensive – much of researchers' and extension agents' time is devoted to being with farmers. With time, farmers are in position to demand for agricultural services as need arises. Communication barrier between researchers and/or extension agents and farmers poses a challenge to FPR especially where researchers may be foreign in the area. Limited institutional development like poor infrastructures have limited the extend to which FPR expand resulting in road-side concentration of activities. Low funding provision to FPR and lack of training of personnel in FPR approaches. Lack of clearly defined roles of extension agents in FPR approach and how well they can integrate the approach in their own extension system is a challenge. Level of commitment of researchers, extension agents and NGOs in working together with farmers on a long-term basis limits FPR approach application. Researchers do not make regular follow-up visits to the FPR sites as would be expected. Timely delivery of materials and feedback to farmers are important if farmers are to have trust in the system. Impact assessment studies need to be conducted in areas where FPR was initiated to determine if there is any impact of the process beyond area of operation.

Conclusion

Both conventional and FPR approaches have worked well under some circumstances with both displaying some critical limitations. Both approaches have also indicated the need to involve farmers actively in technology development, evaluation and dissemination. Farmers need to be considered as partners in the research process. FPR approach has, therefore, proved more cost effective in technology development, evaluation and dissemination. It has also shown that farmers' involvement in technology evaluation helps make research process more efficient and effective. As was originally believed, yield may not be the only important criterion for acceptance of improved bean varieties. Because farmers were involved in the evaluation process, it was noted that there were many other characteristics that farmers consider in adopting new bean varieties that may vary from region to region.

In order to make both approaches more efficient and economical, there is need to involve farmers in the whole research process. There is also need for farmer and extension trainings so that on-farm research trials are better managed. We also need to look at the negative and positive aspects of both approaches and try to make them more efficient. Lastly, there is need to increase funding of on-farm trials with more involvement of farmers in a more participatory manner. Hence, FPR is an effective tool/method for enhancing the development and transfer of technologies relevant to the needs of farmers.

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