Participatory On-Farm Trials – A Useful Tool

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INTRODUCTION

Farmer participatory research has been defined in various ways by different individuals (Harwood 1979; Tan 1985; Ashby *et al.* 1987; Haverkort *et al.* 1988; Okali *et al.* 1994). All the attempted definitions address the same theme, but differ in detail and emphasis on the role of the farmer(s) in the process. Participatory research is conducted on farms bringing researchers and farmers together to collaborate in a meaningful way to seek solutions to problems faced by farmers on the basis of empirical data generated from the trials.

FARMER PARTICIPATORY RESEARCH

Farmer Participatory Research (FPR) as the name implies, engages farmers as active participants with multidisciplinary teams in the research process on their farms. They are co-researchers. It is an approach based on the principle that the beneficiary community should also be an active participant of the research process. In participatory research, researchers and farmers combine their relevant knowledge, traditions, skills and experiences to solve problems faced by farmers. Experience in participatory research indicates that its impact is not limited to the farmers. The potential impacts of Farmer Participatory Research or as it is also called Participatory On-Farm Research are as follows:

- Farmers gain improved income
- Farmers' research skills are enhanced
- Farmers are enabled to solve their own farm problems
- Contributes to community knowledge, progress and networking
- Influences policies at different levels
- Influences the agenda for formal research
- Improves ecosystems
- Facilitates new technology adoption.

Participatory on-farm trials are practised in many parts of the world to seek solutions for a wide range of problems faced by smallholder farmers. This is a promising approach and indeed around the world, there have been good examples of the method being used to assist small farmers to understand their problems and help them find practical solutions in a range of areas. For instance, Lightfoot (1987) has reported on on-farm participatory varietal trials on rice and sweet potato, whereas a large-scale on-farm trial to improve cultivation of soybean in Indonesia is reported by Vanden Berg *et al.* (2001). Witcombe *et al.* (2003) reported on participatory maize breeding experiences from India. Participatory on-farm trails have also become important tools in cocoa breeding and improvement efforts for instance in countries like Cameroon (Efombagn *et al.* 2011), Brazil (Monteiro *et al.* 2011), and Ecuador (Amores *et al.* 2011) and other cocoa growing countries. On-farm soil fertility trials have been reported by Onduru *et al:* (1999) in Kenya, Maribu *et al.* (2004) in Uganda and Mavedzenge *et al.* (1999) in Zambia. Joubert and Hart (2oo2) reported on methodological issues related to weed management on-farm trials. An interesting participatory on-farm trial for control of stored seed loss due to pests, conducted by women farmers in Nepal, is reported by Gurung (2003). An on-farm trial on perennial forage varieties undertaken in Wisconsin is reported by Casler *et al.* (1998). Right here in the Caribbean, trials on weed management have also been the subject of on-farm participatory research. Isaac *et al.* (2007) reported on an on-farm trial undertaken to test the efficacy of cover crops for weed and nematode control and soil fertility enhancement in banana cultivation in St. Vincent and the Grenadines.

The participatory approach appears to possess a real potential to benefit the farmers and society at large in a tangible way:

> It provides a mechanism for re-focusing agricultural research to solving problems faced by farmers through direct involvement at the level of farms, thereby further enhancing the net gains from public expenditure on research.

> Cultural practices can be optimized to local conditions, thereby potentially ushering in an era of customized technology for the community of farmers, resulting in farm output optimization and proper management of natural resources for sustainable exploitation.

As the challenge of meeting the demand for food of a fast growing global population deepens, building capacities of smallholder farmers, wherever they are found, is one of the most effective actions for achieving the goal of producing safe and nutritious food to meet this growing demand. Participatory on-farm research provides the means to empower a multitude of small farmers particularly in the developing world to engage in research on their farms so that higher levels of productivity can be achieved.

The material presented in this chapter is a compilation of useful concepts and tools for undertaking successful participatory on-farm trials at every stage. The success depends on the level of preparation of all the participants, planning, design, execution of the trials and analysis and interpretation of the data and sharing of the results with other communities and all relevant stakeholders.

CARIBBEAN READINESS FOR FPR

FPR is particularly useful for the region because the profile of agriculture in the region is similar to other places where the approach has been, and is still being used successfully to help empower farmers to solve their own problems. This empowerment is a major function of the 'new extension' that should be practised by organizations and institutions that work with the farming community.

SMALL FARM SIZES

In most of the Caribbean region, probably with the exception of Guyana and Belize, food crop farmers operate on small farms usually of not more than a hectare in size, with the majority producing food crops mostly for domestic consumption and some for export. Most of these farmers are resource-challenged and operate in high risk environments. Some are engaged in specialized cultivation (like growing condiments), others grow diverse crops and some practise mixed farming (animal husbandry and cultivation). These farmers face a range of challenges in natural resources management, production, post-production and marketing, in addition to periodically facing varying levels of risks of natural disasters. FPR is particularly useful for small farmers operating in complex, diverse and risk-prone environments.

SUPPORT INFRASTRUCTURE

The range and strength of support to farmers in the Caribbean is not uniform throughout the region. Countries do have extension systems that, over the years, have weakened due to a number of factors. Some countries do have research institutes and commodity organizations. There are also hemispheric, regional and sub-regional research institutes and universities with agricultural and natural resources units expected to support agriculture at different levels. Thus, support infrastructure for Caribbean agriculture appears to be there, but is less effective due to institutional constraints and resource limitations. Existence of efficient, adequately resourced, suitably organized institutions servicing agriculture at different levels can only be effective through well articulated collaborations not only among the institutions themselves, but with relevant external organizations and institutions. In the era of changing priorities, dwindling resources and uncertain levels of support and the risk of environmental constraints posed by shifting climatic pattern, transformation of agricultural support institutions to achieve their mandates successfully is paramount. Again FPR should be actively considered as another research and development tool by the major traditional research organizations both in ministries of Agriculture and at the regional level.

THE CARIBBEAN EXPERIENCES WITH PARTICIPATORY ON-FARM RESEARCH

We are familiar with the following in the Caribbean:

- Researcher- designed and executed on-farm trials
- Collaborative, fully participatory on-farm research

From our own experiences it has become apparent that researcher-designed, executed and controlled on-farm trials in the smallholder environment are fraught with challenges. In the smallholder scenario, farmers consent to the use of their fields on the condition that they retain the right to the produce from the trials. Farmers quite correctly are hesitant to enter into arrangements, which will result in reduced farm income without adequate compensation. Even if the farmers are compensated for the use of the land, the possibility of obtaining reliable measurements of biophysical output from every farm participating in the trial is limited. While in some cases, researcher-designed and executed on-farm trials are desirable, in a smallholding scenario, there is a need to consider taking farmers' interests on board.

One successful participatory on-farm trial carried out to assess the effectiveness of selected cover crops for weed control in bananas involving farmers from St. Vincent has been reported by Isaac *et al.* (2007). This research was initiated by researchers, but was planned and executed with full collaboration between farmers and researchers. The trial initially involved 36 banana farmers out of which 23 persevered to the end and participated in a study designed to investigate the effectiveness of four cover crops for weed control in bananas. Feedback on participating farmers' attitudes towards the participatory research process was also assessed. The study determined that among those who fully participated in the trial, there was a consensus that the level of experience gained was useful. The farmers expressed a generally positive attitude to participatory on-farm trials, which included their eagerness to participate in future trials, emphasizing that a fully participatory approach in research is an excellent strategy for solving problems encountered by farmers (Ganpat *et a1.2009).*

• KEY ISSUES FOR SUCCESSFUL PARTICIPATORY ON-FARM TRIALS

The process is well within the capabilities of trained extension professionals to manage. The outcome of the effort however, depends on the degree of preparation, planning and execution of the trials. In the context of participatory on-farm trials, where researchers trained in scientific methods and farmers dependent on traditional approaches collaborate to seek answers through research to problems faced by farmers. Success depends on the creative application of scientific methods 'augmented by farmers' robust traditional approaches where necessary.

DECIDE ON THE PROBLEM

- Do a needs' assessment using a reliable and valid method
- The problem must be one that is faced by a large number of farmers
  It must have some significant impact on production and incomes

DECIDE ON THE TERMS OF FARMERS' PARTICIPATION IN ADVANCE.

In the Caribbean, the average farm size is no more than a hectare. Farmers' willingness to participate in many cases depends on whether their involvement results in a loss of income due to cultivation of a reduced acreage (including greenhouse space). To deal with the challenge this poses, the following should be considered:

- Compensation: Compensating farmers for use of part of their field for participatory on-farm trials. The advantage of this approach is that it allows for reliable data collection as farmers relinquish their rights to experimental produce. It also means destructive sampling of produce, where needed, can be undertaken for instance for laboratory analysis. The disadvantage is that it would increase project costs.
- Preserving farmers' rights to the produce: Allowing farmers to use the produce from the trials once the needed data are collected results in reduced cost since it cuts the cost of compensation. However, generation of reliable data becomes challenging as the farmers' schedule to sell the produce is affected by prevailing conditions and does not always coincide with the trial's data collection schedule. This approach could also hinder the use of produce for destructive sampling since it conflicts with farmers' income generation objectives.

Keep it Simple

In FPR, avoid complex experiments at farm level. In particular, the following should be considered:

- From inception involve participating farmers at every step of the process i.e. from planning to interpretation and reporting of results.
- Taking on board farmers' views on formal tools for comparison and a range of farmers' traditional practices they are likely to apply. This is useful for farm level analysis and discussion.
- Choose treatments to be tested carefully. Include appropriate control(s). Avoid complex experiments to limit unsatisfactory outcomes and consequently leaving farmers in a doubtful position not only of the trial outcome, but potentially of the participatory approach itself. One such case has been reported from Zambia by Mavedzenge *et al.* (1999).
- Testing few treatments (varieties, growth media, plant population densities, *etc.) at each* farm simultaneously at the same time ensuring that the design allows for formal analysis of the complete experimental data. For instance Isaac *et al.* (2007) tested one treatment against the farmer's control on each farm in such a way that every combination of treatments is replicated on multiple farms. This ensured that the design allowed for the comparison of all treatments in the experiment.

Pursue sound research approach

While concepts like randomization, replication, experimental design etc. are not normally part of the everyday vocabulary of farmers, some of the key concepts relevant to the success of the collaborative venture should be communicated to farmers in simple terms to assist them to understand concepts and also appreciate their importance in research. Some key points to keep in mind are:

- Replicate: A single observation for each treatment is not enough to compare the treatments and arrive at a decision that has a sound scientific basis. Replicating treatments enables determination of a measure of the inherent variation associated with the response of interest, and forms the basis for a sound comparison of treatments. Farmers should be made aware why replication is needed in a manner they can easily grasp.
- Randomize-give every treatment a fair chance: Allocation of treatment to plots/ experimental units should be done in a manner that ensures that treatments under investigation are all treated fairly. Researchers use randomization to achieve this objective. There is a deeper statistical basis for randomization, but it is unnecessary to highlight this, since it is easy for farmers to grasp the role of randomization as a basis for ensuring fairness in comparing treatments. In this context it is similar to lot-drawing, a concept not strange to them. How to allocate treatments randomly to experimental units depends on the experimental design selected for the particular case.
- Select appropriate experimental design: Randomization, the process of allocating treatments to plots (or experimental units) randomly provides a basis for a fair comparison of the effects of the treatments under study for every correct experimental design used. In planning research, it is not always possible to use plots which are homogeneous with respect to all factors which are likely to affect the outcome of study. Nor is it possible to apply uniform management practices to all plots. So in order to obtain valid results from the trials, appropriate plans for layout of plots/experimental units should be employed. Field layouts for research are based on experimental design principles. Experimental design in this context is /narrowly treated deliberately to point out that this aspect can easily be transmitted to farmers and to emphasize the importance of design of experiments for on-farm trials.

EXPERIMENTAL DESIGN

Statistical texts on this topic list a number of common designs, their main features and standard methods for analysis of data obtained from each design type. The various experimental designs described in books should not be seen as menu items, which can be chosen at will. They can however be used as guides. Experimentation is a creative process where every situation requires fresh scrutiny and there is no room for a menu type design choice. The number and nature of treatments, profile of experimental field or experimental animals, and the adopted management practices would form the basis for the design of an appropriate arrangement of the experimental units. This results in estimation of correct treatment effects and computation of a reliable estimate of the inherent variation. Thus when considering experimental designs for participatory on-farm trial, attention should be given to all relevant issues likely to impact on the decision to be made concerning the design for the study. Without the adoption of an appropriate experimental design, particularly at each farm, participatory on-farm trials are unlikely to yield reliable results. Many of the published materials on participatory on-farm trials are silent on the actual experimental designs used at farm level despite the fact that design is mentioned in the reports (see for example Onduru *et a1.1999).*

DATA COLLECTION

Collect a minimum set of primary performance indicators: The decision on observations to be made and measurements to be taken should be done at the planning phase. Farmers must be able to record the data. Collection of a minimum set of primary performance indicators and other variables would contribute towards keeping the study simple and manageable and at the same time enhance the chances of successful outcome. However, participants must also be prepared to gather data of an ancillary nature throughout the experimental period when it becomes necessary. Attention must be paid to the following:

- Ensure regularity of data collection. This must be agreed on and maintained at all times.
- All measuring devices must be standardized if possible and properly calibrated to minimize measurement related biases.
- When rating is to be used for quantifying a response, it has to be done on the basis of clearly defined criteria established well in advance and should apply across all farms.

- Standardized procedures across participating farms must be employed for the collection of each of the variables of interest.
  A minimum set of primary variables of interest to researchers and/or farmers must be collected.
  Relevant data on unexpected incidents observed during the trial, which are likely to affect the outcomes, should be collected throughout the trial cycle. For example, praedial larceny poses some measure of risk to trials in some Caribbean islands and when such incidents are observed, the relevant data must be collected for proper adjustments of performance variables during the analysis phase.
  Data should be collected on standardized forms specifically designed for the purpose. Such forms should be simple to use and suitably arranged for data transfer to computers for processing.

DATA ANALYSIS AND SHARING STUDY OUTCOMES

The outcome of participatory on-farm trials is of interest to:

- Participating researchers and farmers
- Extension officers and other farmer support groups
- Wider research community
- Relevant government departments and development agencies

Statistical issues relating to the analysis of data from participatory on-farm trials have been the subject of a number of publications (Coe, R., Stern, R. and Allen, E. **2001,** Coe, **2002a, 2002b,** 2007, Van Den Berg, H., Ooi, P.A.C., Hakim, A.L., Ariawan, H., Cahyana, W. 2004)). Since the outcome of such trials is of interest to two different groups; farmers and researchers with different levels of appreciation of technical matters, analysis of data should take this fact into account. In this regard, the following should be noted:

- Graphs and charts should be used to display comparative performances of treatments under study and examine unusual observations in the data. Graphical display of data is a powerful tool to communicate trial outcomes at any level, particularly when it is undertaken in conjunction with appropriate statistical inference.
- Subject the data to appropriate inferential statistical analysis to establish the importance of differences between treatments in statistical terms. Such analysis should be done on combined datasets, and when relevant and feasible on subsets.

The results from such analysis can be used for publication of technical reports for dissemination to researchers and other technically competent groups.

- Simple, but sufficiently detailed analysis should be made primarily geared towards participating farmers. This can be graphical and/or analytical, but should be founded on findings as a result of subjecting data to inferential statistics. Farmer- oriented analysis is kept as simple as possible to allow not only full participation of the farmers in the process, but also to avoid unnecessary distraction to farmers that the adoption of sophisticated statistical analytical tools and associated jargon introduce. Some examples of simple data analytical
tools used for farmers' focused assessment of on-farm trials outcomes are found in Van Den Berg et al. (2004).

CONCLUSION

The success of any participatory on-farm trial depends on planning, maintaining a relationship based on trust, transparency and mutual respect among participants at all times, clear articulation of the role of each participant and the successful undertaking of this role and availability of adequate resources. Without accepting farmers as equal partners
and treating them as such, and ensuring that they perceive that they are, the outcome of trials cannot be certain and could cast doubts on future participatory on-farm trials.

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