Generating Appropriate Agricultural Technologies through Participatory Research: Potentials and Constraints in Tanzania Smallholder Coconut Production Systems

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Abstract

The result of many rural development projects aiming to improve the living standard of the rural population in Tanzania as well as other developing countries have often, been disappointingly poor. This was largely because small resource-poor farmers did not adopt agricultural technologies propagated to increase agricultural productivity as it was expected. Currently its more generally accepted that the reason for this is not farmers ignorance, but the inappropriateness of the supposed technologies. This paper outlines briefly the conventional approaches' to agricultural research, which is behind most of these innovations, pinpointing its strengths and weaknesses. The paper also makes a critical comparison with the so-called Participatory research approach' in developing agricultural technologies particularly for smallholder farmers. The characteristics and resource endowment of the smallholder farmers in Tanzanian context is portrayed together with classic examples of innovations generated through use of participatory approaches.

Reduced costs, flexibility, high participation of the target group, timely delivery of the innovations, relatively higher returns to investment and clear focus on the problems are some of the benefits and advantages of the participatory research over the conventional approach. The paper concludes by recognising the complimentary usefulness of both approaches at different stages of the research and also on various expected outputs of the research efforts. However with declining resources for implementing research activities, a move towards participatory research seems to be the next best option available.

Key Words: *Conventional research approach, participatory research approach, smallholder farmers, appropriate innovations, resource endowment.*

1 Introduction

Over the past few years participatory research has gained a widespread support among donors and international research institutes. The thrust of the participatory research is to carry out farm level research through a farmer/researcher partnership in problem identification and farm level testing of improved technologies. The proponents of the participatory research contend that the farmer/researcher partnership is needed because much of the top down research in experiment stations has not given sufficient attention to the relevance of the technology in terms of the goals and resources of smallscale farmers.

The approach of developing new technologies first in central research stations and releasing them to practical agriculture has generated powerful technologies to resource-rich-farmers. Yet as soon the integration of resource-poor-small scale farmers into the

development process began to gain priority, the normal approach appeared less suitable because it did not contain an institutional mechanism to ensure that the recommended mechanism focuses on the resource endowments, goals and habits of the target group. First attempts of on-farm-research grew out of some apparent problems in applying the results out of the conventional research methods beyond areas and farm types where the green revolution had its initial success (Chambers, 1983).

In view of these shortcomings, better adapted technologies were expected from farming systems research through its *on-farm research* methods developed in the early 1980s. Smallholder production conditions and systems are systematically analysed and production constraints defined by researchers as far as possible from the farmers' point of view. Potential solutions are subsequently tested in farmers' fields. Economic considerations became as important in the trial evaluation as the agronomic analysis.

The results achieved were, nevertheless, still unsatisfactory as researchers had difficulty in considering the production goals and decision criteria of smallholder farmers in the development of agricultural innovations. The complex goals and decision criteria of smallholder farmers are often beyond the understanding of agricultural researchers. Failure to understand farmers' goals and decision criteria increases the likelihood of addressing the wrong problem or valuing an innovation incorrectly. On the other hand, over the past four decades failure of farmers to adopt new technologies has had several evolutionary explanations as summarized in Table 1.

Table 1 Researchers interpretation of farmers' failure to adopt technologies

Stage	Period when dominant	Explanation of non-adoption	Prescription
1.	1950s - 1960s	Ignorance of farmers	Agricultural extension to teach farmers the right technology
2.	1970s - 1980s	Farm level constraints	Easy constraints to enable farmers to adopt e.g. Credit for inputs or implements
3.	Early 1980s	Technology does not fit RPF conditions	Researchers to understand & generate technologies which fit RPF condition
4.	Late 1980s-1990s	Technology does not match RPF goals	Farmers participate in planning and evaluation of Research Programmes

Source: Adopted from Werner, 1993

The current trend is therefore towards increasing the involvement of farmers not only in the physical implementation of trials but also in the definition of research needs and the design and evaluation of programmes in order to utilise their knowledge.

2. Conventional approaches to research by National Agricultural Research Systems in Tanzania (NARS)

Tanzanian agricultural research system has passed through transformation stages, which are closely linked with the political history of the country. Probably the most important determinant factor in the functioning of the research systems is the pre-independence and post-independence government agricultural policies.

2.1 Pre - independence agricultural research aolicies

During pre-independence era the economy of the Tanzania (then known as Tanganyika) was based on the development of plantation crops such as sisal, cotton, coffee, cashewnuts and tea. During this period, agriculture research policies and activities took the same orientation. Most of research programmes were aimed at addressing issues related to or facing the plantation or estate farmers. Few commodity research station were thus established such as Lyamungu specialising in coffee, Ukiriguru on cotton and sisal at Mlingano. Co-ordination of research activities were centred and solely controlled by the Ministry of Agriculture.

2.2 Post-independence agricultural research activities

Agricultural development and research activities took a different turn during the post-independence period. More emphasis was placed on diversified crop production and the integration of cash crops with food crops. This strategy was aimed essentially at achieving self-sufficiency in food production and simultaneously producing surplus for export. With the new perspective, research activities are now geared to transform the peasant methods of production and raise their farm income. By 1979 there were 12 research institutions namely Ukiriguru, Ilonga, Katrin, Marikitanda, Naliendele, Tengeru, Mlingano, Lyamungu, Tumbi, Uyole, Kibaha and TPRI. The Sokoine University of Agriculture is also substantially involved in research activities on her various faculties (MOA, 1993).

2.3 Problems facing NARS in Tanzania

The major drawbacks that have limited full and effective implementation of the research programmes have been determined to be, among others the following

- Fragmentation of the system.
- Lack of co-ordination of the services.
- Inadequate programme planning, in particular failure to identify research priorities to match available resources.
- Poor research - extension linkages.
- Lack of research data bank.
- Lack of incentive to researchers to attract, motivate and retain competent staff and
- Lack of adequate, up-to-date research facilities

2.4 Restructuring NARS Tanzania

In 1989 the government of Tanzania consolidated agricultural research in DRT by dissolving twin parastatal institutions TARO and TALILO which was responsible for crop and livestock research respectively. All research activities, personnel and assets were placed under the DRT. An integral element of these organisational reforms was the establishment of seven agricultural research zones. At the helm of the research hierarchy the DRT is headed by a commissioner (CRT) and is supported by five assistant commissioners (ACs) responsible for crop research, livestock research, farming systems research, special programmes and Training (Appendix 1). A high level National Agricultural Research Council (NARC), chaired by the Deputy Minister for Agriculture has been appointed to support DRT to ensure that national agricultural research priorities conform to the national development goal.

3 Participatory research with smallholder farmers

Participatory research approach has adopted a number of features from ethnographic research technique, such as an emphasis on understanding peoples own point of view. Participatory research is characterised by an applied, holistic and flexible approach of progressive learning, conducted by multi-disciplinary team of researchers, emphasising community participation. Having developed alongside farming systems research, participatory research methods have been widely applied, mostly in agricultural development.

3.1 Rationale for farming systems participatory research

A number of factors explain the move towards participatory research in the form of farming systems research and local technology development;

- Previous strategies within conventional research approach aimed to improve livelihood of smallscale farmers have repeatedly failed.
- Disappointingly poor adoption of technologies which seemed to be appropriate to farmers by conventional researchers.
- Many agricultural development programs have led to unequal distribution of benefits. Green revolution for instance, despite its successes, has created numerous equity problems in the process of increasing agricultural production. Many smallcale farmers and landless found it difficult to gain access to land and the technological packages (Poleman and Freebairn, 1973).
- The increased realisation, supported by empirical evidence, that many traditional practices used by smallscale farmers for generations are sound and should be preserved (Navarro, 1977)

These and other factors have contributed to the emergence of a bottom-up or farming systems approach to the development of smallscale farming technologies. In contrast with the conventional research approach, participatory research gives the smallscale farmers a voice in tailoring research priorities, both in technology development and evaluation, to their needs. The farmers become the central figure in the research process, particularly at the descriptive and testing stages when dialogue is of particular importance. In the current set-up of the NARS in Tanzania there has been little communication between smallscale farmers and the researchers. Ideally communication should be possible via the extension worker, but this has not been possible due to a

number of reasons including poor research - extension linkages.

3.2 Resource endowment of typical small scale Tanzanian farmer

Tanzanias agriculture is predominantly of small holding kind of production. Most of the farming systems are based on smallscale household oriented production with cross sectional resemblance on several characteristic features. A baseline survey conducted in coconut based farming systems in Tanzania revealed the following characteristic features of smallscale farmers (NCDP 1987);

- Small size of the holdings 1 - 3 ha
- Limited capacity of labour force often 2 -3 active family members per household or an average of 4.5 potential man equivalents per household
- Women bearing the heavier workload including the heavy work of soil preparation
- Low level of mechanisation on cultivation often with use of rather rudimentary implements leading to small arable acreage per household
- Extremely low use of fertiliser and other physical farm inputs in agricultural production
- High percentage of subsistence production with maize, roots and tuber crops being the most important food crops

4 Empirical results from farming systems participatory research

Farming systems research has already contributed to the development of improved technological packages for small farmers. The following examples drawn from Coconut based farming systems research in coastal belt of Tanzania will help to underscore the potential outcome of the participatory research in agricultural technology development.

4.1 Sole cropping versus inter-cropping

Earlier effort during establishment of NCDP was directed on promoting plantation type of coconut production in sole cropping systems. Research stations, trial sites and earlier demonstration plots used spacing that was mainly tested for sole cropping production systems. Experience gained by extension services within the project indicated a rather slow adoption particularly on spacing of coconut palms.

Farming systems research unit was established in 1977 in order to gain more understanding of farmers physical and socio-economic environments. Farm management studies conducted by the FSR unit helped to account for this rather poor adoption rates (NCDP, 1992). The study revealed that most farmers are constrained with resources, particularly labour and in some locations land was a limiting factors. Farmers favoured inter-cropping systems because it helped to economise use of scarce labour and land resources available per household. Another advantage of inter-cropping systems with small-scale farmers, is the spreading of risks in case of crop failure by diversifying on more varieties of crops in the same land. Wider spacing of coconut palms to allow permanent inter-cropping is one of the technology which is well adopted by farmers because it is compatible with their farming systems and was developed by involving farmers in outlining their production goals.

4.2 Traditional versus improved maize seeds

Maize is one of the main food inter-crops in the coconut based farming systems in the coastal belt of Tanzania. It is often inter-cropped underneath coconut palms. Studies conducted on-station and on-farm trials indicated that use of improved maize varieties coupled with employment of improved management practices improves biological yield of the inter-cropping system by 64% (Table 2).

Despite this impressive increment in productivity, still few farmers have adopted these improved packages. The main reason for low adoption have been found among others to be, farm level constraints, particularly lack of capital to purchase necessary farm inputs required in the improved technologies and lack of adequate labour force to cope with the added labour requirements in most of the improved cropping systems.

Table 2 Estimated productivity of CBFS according to management levels

Crop	Farming System		
	Small scale (Use of local farm inputs)	Medium scale (Partial use of improved package)	Large scale (Fully use of improve packages)
Coconut (Nuts/palm/year)	18	28	55
Maize (Kgs/Ha)	750	1170	2960

Source: Adopted from Ngowi and Stocking, (1989)

Another problem which contributes to farmers reluctance to use improved maize varieties stems from post - harvest problems facing farmers. Farmers have found that storability of the improved maize varieties TMV1 and Staha is very poor in the context of the current storage techniques by smallscale farmers. Storability is a very important criteria in farmers choice of crop varieties, because most of them are subsistence producers who need to keep their harvests for household food requirements for relatively long periods.

With the use of improved varieties production per unit area is higher compared to when local varieties are used, but farmers are compelled to dispose-off their harvests immediately in order to avoid post-harvest losses. At that particular time the market is flooded hence prices are at lowest stage. So inspite of attaining higher yields farmers ends up getting low income and possible food insecurity.

From participatory research point of view farmers again were able to contribute in defining their research needs, which will subsequently have to be adopted by researchers. In this case breeder's challenge will encompass aspect of storability rather than higher yields and early maturity only.

4.3 Introduction of hybrid coconut varieties versus local East African Tall (EAT)

Exotic hybrid coconut varieties CAMWA and MAWA were introduced in Tanzania in the early 80's. This move was part of the government strategies to reverse the declining trend in coconut production in Tanzania observed in the seventies. Factors, which contributed to the decline by then, were identified to be among others:

- Lack of policy priority in the development of the crop.
- Lack of established nurseries to provide selected seedlings from high yielding varieties.
- Ageing palms with low replanting rates.
- Pest and disease threats.
- Poor husbandry practices.

The coconut hybrid varieties perform exceptionally well under high input management practices and relatively better environment. Low tolerance to stresses such as moisture, disease and pest attacks are some of the weaknesses of the improved hybrids. Under the prevailing farming environment of small holder farmers in Tanzania, hybrids performed very badly compared with EAT which is more adapted to lower input management practices.

Environmental factors played a big role in masking the potential of the hybrids in Tanzania, but also socio-economic aspects had their share of masking the biological potential of the hybrids. In such a situation, involvement of the farmer from the very beginning will help to detect obvious constraints likely to hinder full exploitation of the technology. Such earlier recognition of the bottleneck facing a technology will have an impact of stretching the research objectives to incorporate those aspects, which were overlooked in preliminary attempts to get solutions.

5 Conclusion and recommendations

Participatory research has a vast potential of generating useful and appropriate agricultural technologies for small scale farmers, because it is consistent with the current notion of equity, participation, and employment generation in rural economic development. Participatory research approach has a potential strength of pinpointing relevant problems facing farmers hence improving accuracy in the planning and implementation of the research strategies. On the other hand, the current set-up of the NARS has an important relevance particularly in carrying out basic research, which is necessary in addressing problems and constraints defined by farmers in collaboration with the researchers.

In determining trade-offs between conventional research approach and the emerging participatory research, some of the possible institutional drawbacks have to be taken into consideration. The systems approach in research for instance puts consideration of crop production, livestock production and off-farm business. Currently crop and livestock research is carried out in separate institutions making it difficulty to achieve integration. The issue of time lag from recognition of the problem to actual discovery of the solution has to be recognised by funding agencies who has shown a tendency of demanding quick break through research findings.

It is of paramount importance that these two research approaches obtain, an institutional support that will ensure a complementarity at various stages of research activities, in order to generate comprehensive and relevant agricultural technologies for Tanzanian small holder farmers.

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