Uganda Journal of Agricultural Sciences, 2003, 8 : 17- 28 ISSN 1026-0919
Printed in Uganda

Client orientation of agricultural research in Uganda: the Namulonge experience

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Abstract

In the 1960's and1970's research in Uganda and other developing countries was top down approach where the technology was developed on research stations by researchers and then turned over to extension for demonstration and diffusion to farmers. Farmers were not consulted on what type of technologies were suited to their systems. Hence there was a catch-phrase in agricultural development i.e "yield gap". Farmers could not attain yield comparable to those at experiment stations. Therefore due to those problems an important trend in the last decade has been increasing attention paid to the client i.e client orientation. The gap now is between the research-clients.

There is therefore need to close this gap i.e researcher-client gap. It has been shown that to be successful agricultural research has to respond to demand for assistance in solving agricultural problems. This paper presents how Namulonge Agricultural and Animal Production Research Institute (NAARI) through its different research programmes has addressed the gap between researchers and the clients. It is the experiences through this work that is presented in form of case studies.

Background

The primary goal of agricultural research in developing countries has been to increase agricultural production through increased productivity. During the 1970's an important catch-phrase in agricultural development was the "yield gap". Why were farmers not capable of obtaining yields on their own farms comparable to the high yields on the scientists experiment stations. The main reason given then was that "research workers preferred to do research about a problem rather than research to solve a problem. Thus, biological scientists kept busy, and happy, breeding new varieties, developing disease control systems, or new store designs while the socio-economists undertook their surveys and described systems but left the actual solving of farmers (clients) problems to someone else and hence we had poor extension services and poor farmers" (Robert Rhodes 1993). The system was a top down approach where the research developed the technology, which they then turned over to extension for demonstration and diffusion to farmers. However, the lack of effective links between the separate research and extension institutions impended the development and transfer of technology which is appropriate for small scale, resource poor farmers.

The scientist was then very distant from the farmer who is supposed to benefit from the research. Farming systems research, and especially on farm research was then later developed and promoted as a means of developing appropriate technology and adapting it to specific agroecological and socio-economic conditions of small-scale farmers. Interdiscipline programs of this kind were developed with two major objectives:

- To diagnose needs and constraints at the farm level
- To adapt technologies to the agroclimatic and socio-economic conditions of target producers (Andrew and McDermatt, 1995).

Farming systems research has also had its limitations. However it has been realized that while research institutions may be the right place to carry out some basic and strategic, it has limitations for real life, applied research. The next "gap" that needed to be closed is the farmer-scientist gap; Research – extension gap; and Research - other clients gap. Namulonge Research Institute through its different research programs has tried to address the reduction of this and it's the experience through this work that is being presented in this paper in form of case studies.

Clients

Clients are beneficiaries of the technologies developed by research. For NAARI our clients were grouped into seven categories:

i. Farmers
ii. Consumers
iii. Processors
iv. Extensionists (Public and Private)
v. Industrialists
vi. Market agents (Traders, exporters, retailers, middle men)
vii. Policy makers

What is Client Oriented Agricultural Research (COAR)

An important trend in the last decade has been the increasing attention paid to client orientation. Applied agricultural research is increasingly being regarded as an agricultural service acting upon demand and seeking to develop close links with clients. It has been shown through experience that research becomes more effective when it takes local knowledge into account and actively seeks to cooperate with farmers. To be successful agricultural research has to respond to demand for assistance in solving agricultural problems. It is the farmers who finally decide whether a change proposed to them actually becomes a useful innovation or not.

Applying the service concept to research means intervening at different levels.

a) strengthening farmer demand for service
b) improving linkage to farmers and other clients
c) using participatory approaches to conduct research activities and
d) improving research management

Therefore client oriented research is designed to help research meet the needs of specific clients most commonly resource poor farmers. But as mentioned above there are other clients apart from farmers. It complements and is dependent upon experiment station research. It is also important to point out here that farmer participation in research planning and execution per se is a necessary but not sufficient for client orientation. In order to realize this there should be a deeper understanding of the targeted clients, their needs/constraints within their livelihood systems and their ability to articulate demands.

The functions of client oriented research as listed by Merril-Sands (1988).

1. To support within research a problem solving approach, which is fundamentally oriented toward farmers as the primary clients of research.
2. To contribute to the application of an interdisciplinary systems perspective within research.
3. To characterize major farming systems and client groups using agroecological and socio-economic criteria, in order to diagnose primary production problems as well as identify opportunities for research with the objective of improving the productivity and/or stability of those systems.
4. To adapt existing technologies and/or to contribute to the development of alternative technologies for targeted groups of farmers and other clients sharing common production problems by conducting experiments under farmer's conditions.
5. To promote farmer participation in research as collaborators, experimenters, testers and evaluators of alternative technologies.
6. To provide feedback to the research priority-setting, planning and programming process so that on-station and on-farm research are integrated into a coherent, program focused on farmers needs.
7. To promote collaboration with extension and development agencies in order to improve the efficiency of the process of technology generation and diffusion.

It is to be emphasized here that for effective implementation of client oriented research there must be understanding and interactions of many types and at many stages. This includes social relations, exchanges of ideas and information, linkages between people, and institutional dimensions (Paul Richards, 1993). Interactions to be considered are those between researchers and farmers; between extension workers and farmers; between women and men; and between outside science and technology and local capacities.

They are four types of farmer participation identified;

a) **Contractual**: Scientists contract with farmers to provide land or services.
b) **Consultative**: Scientists consult farmers about their problems and then develop solutions.
c) **Collaborative**: Scientists and farmers collaborate as partners in the research process
d) **Collegial**: Scientists work to strengthen and development systems in rural areas.

These modes are distinguished by differences in objectives and the organizational and managerial arrangements they require for implementation. Table 1 lays out the distinguishing features for each mode of farmer participation.

Case studies from NAARI

Namulonge Research Institute is one of the nine Research Institutes of NARO. It is located within the bimodal rainfall region. It is 0^0 32"N of Equator and 32^0 37"E. It is 27 km North of Kampala at an elevation of 1150 metres above sea level.

The main task at NAARI is to contribute to the improvement of the welfare of the people of Uganda by generating, adapting and transferring appropriate technologies (of our mandate commodities) with the clients while conserving the natural resources for posterity. The main focus is increased productivity of food crops, livestock management systems and pastures in humid and sub-hmid areas. Major efforts are directed towards beans, cassava, maize, potatoes (i.e solanum and sweet potato) and animal production pest management through Biological control and Agrometeorology research and service are *also undertaken*. Limited research is carried out on rice, soybean and yams.

Given our purpose it was deemed necessary that technology development at NAARI should be for the clients and with the clients. Cases being given are from different programs. They are at different stages of development.

Cassava Research: The case of Vvumba farmers

Until 1998, the national cassava programme conducted its research activities with limited farmer participation, often happening at the final stages of technology generation. This made the process of technology generation lengthy. Also, the many technologies generated using limited farmer participation fell short of farmers' expectations. Realizing these limitations, cassava programme with financial aid from IDRC initiated farmer participatory research (FPR) in 1998. In carrying forward the idea, it was felt necessary to understand the issues that if addressed would enhance the participation and effectiveness of farmers in FPR.

A case study adopted a descriptive survey research design which was conducted in order to formulate, expand and evaluate the possible frontiers for farmer participation in cassava research activities. A questionnaire was designed and administered to important cassava stakeholders to capture socio-economic, biophysical and institutional factors that affect farmer participation in cassava research. The results from the study indicated that farmers regarded cassava as a very important crop that contributes to their diets and income. The farmers felt research was a professional job, which required a lot of skills and funds. It was evident that the farmers were poorly mobilized and sensitized on issues involving research. Against the above background, the cassava programme undertook a strategic and deliberate approach to involve farmers in the identification and prioritization of their needs, generation, evaluation and utilization of technologies to meet their needs.

The concept of FPR was introduced to a group of farmers in Vvumba community in Luwero district. The Vvumba farmers had originally taken their own initiative to approach NAARI to be assisted with solving the problem of cassava mosaic in their area. They were initially assisted to acquire some resistant cassava varieties which they started testing in their fields. Therefore when this concept was introduced to them, they found it as worthwhile. "Expert" farmers were nominated by the farmers themselves using a criterior that was jointly developed by both researchers and farmers. The expert farmers were to participate on behalf of the rest of the farmers in the subsequent cassava research activities on-station. The research team (comprised of researchers and selected farmers) conducted field walks to ascertain the expertise of the nominated farmers. Through the field walks information was gathered on farmers field practices and general appearance of the homestead. A structured questionnaire to capture information on crop enterprises, cropping systems, production constraints and farmer needs (Table 2). The findings were presented to the farmers in a feedback workshop. Since the priority constraint was cassava mosaic disease and priority farmer needs was resistant cassava variety it was found necessary that a variety selection guidelines be developed jointly with farmers during the same workshop.

The Vvumba farmers presently participate with researchers at NAARI to address the priority constraints and needs as identified during the survey and workshop. They participate in the planning, constraint identification, priority setting, and implementation of these constraints. Their participation is what is what I would refer to as "collaborative" i.e scientists and farmers collaborate as equal partners in the research process. Areas where they have participated include Participatory breeding and variety evaluation, Integrated disease management focusing CMD, integrated crop management focussing on intercropping cassava and beans, their spacing and planting time.

Just to emphasize the participatory breeding farmer experts come and participate in selection with the breeders right from the early generations. These experts select on behalf of the other farmers in the group. Farmers have their own selection with the breeders right from the early generations. Farmers have their own criterior. They then take what they have selected and grow them on their farms. The scientist together with farmers monitor the crop. At maturity they select from those they have grown what they advance.

The farmers evaluate the varieties at pre-harvest and post-harvest stages. Negative and positive attributes are recorded. Tables 3 and 4 shows the criterior that farmers used for selecting or rejecting eleven cassava varieties. The clones MH 95/0161, MH 95/0080, MH 95/0420 and MH 95/0349 were ranked high by the farmers at harvest (Table 4). However, these varieties had critical negative pre-harvest attributes and did not feature in the final selection list. The clone MH 95/0420 also had high cynogenic potential an attribute that is not visible and therefore researchers had to intervene. Though variety MH 95/0414 was ranked poor for tuber

Table 1: Participation of farmers in research: distinguishing features of four modes

	Contract	**Consultative**	**Collaborative**	**Collegial**
Type of relationship	Farmers, land and services are hired or borrowed, e.g the researcher contracts with farmers to provide specific types of land	There is a doctor-patient relationship, researchers consult farmers, diagnose their problems, and try to find solutions	Researchers and farmers are partners in the research process and continuously collaborate in activities	Researchers actively encourage the informa IR&D system in rural areas
Research emphasis	Testing and verification of technology	Surveying and diagnosis, testing adaptive research	Learning from farmers to guide applied and and adaptive research	Understanding and strengthening informal R&D
Interaction over time with famers	Variable	determined by stages of activities i.e diagnosis, design, development, verification, diffusion, monitoring	continous specific emphasis of activities each year, depending on joint researcher/ farmer diagnosis of local	Variable
types of famers	Those who can guarantee the conditions of contract	- Represetnative of client group (which is defined by scientists)	- represetnative of client groups which are jointly defined by scientists and farmers - research farmers	Research farmers from the informal R&d systems
Who speaks for resources-poor farmers research farmers	Views and opinions of farmers are not emphasized	-Field-level staff - Social scientists - Local representative s	- themselves - research famers - local representatives	Them selves
Emphasis on extension/	Variable	Research aimed at extension target	Variable	Strenthening the integration of informal research and extension capabilties
Priorities in oon-farm research programme	Trials and writte reports	- informal surveys - trials - formal survey - reports of reseacher analysis - field days for extension purposes	- village research legitimacy meetings - meeting for diagonosis, planning and intepretation - trials - formal surveys	- supporting research farmers and resarch-minded loal representatives and politicians - information networks for resource-poor farmer

Table 3: Frequency and criteria used by farmers in selection/rejection of cassava clones in the UYT stage by gender at pre-harvest at 9 months after planting

Clone	Group 1 (Female) Reps 1 2 3 4	Group 2 (Male) Reps 1 2 3 4	Group 3 (Mixed) Reps 1 2 3 4	Reasons for selection/rejection Selection+/rejection-(frequency)
MH 95/014	Y Y Y Y	Y Y Y Y	Y Y Y Y	Highly resistant to CMD+(12), looks sweet by its petiole colour+(1), looks attractive+(6), vigorous+(3), close nodes indicating high yield+(4), thick canopy for weed smoothering+(4), soil moisture conservation+(4), very close buds indicating very small tubers-(1), offers easy field operation+(1), small leaves similar to local favourite variety+(1).
MH 95/0025	N N N N	Y Y Y Y	Y Y Y Y	Susceptible to CMD-(5), low branching=(4), hope for recovery from CMD+(1), fairly resistant to CMD+(7), easy to weed+(1), white stem colour associated with sweet types+(2), impressive canopy+(2), good internode length+(1), looks early maturing+(2).
MH 95/0311	N N N N	Y Y Y Y	N Y N N	Susceptible to CMD-(5), early flowering indicating early maturity+(6), vigorous+(4), smoothers weeds+(1), low branching-(1), does not look sweet as indicated by the hard leaves-(1).
MH 95/0192	N N N N	N N Y N	N N N N	Very susceptible to CMD-(11), looks good+(1), good growth habits=(2), not appealing to the eye-(1), poor establishment-(1), does not seem to do well on poor soils-(1), looks late maturing-(1), good branching habits+(1), good for intercropping+(1), looks high yielding+(1), looks sweet+(1).
MH 95/0080	N N N N	N Y Y Y	N N N Y	Susceptible to CMD-(7), fragile branches-(2), poor establishement-(1), looks high yielding-(2), looks early maturing+(2), not appealing-(1), recovers from CMD+(1), vigorous+(1), looks long storing inground+(1).
MH 95/349	N N N N	N N N N	Y Y N N	Susceptible to CMD-(10), good growth habit+(3), looks a recovering type+(2), high branching+(1), looks late maturing-(2), does not look high yielding-(1).
Nase 2 (check)	N N N N	Y Y Y Y	Y Y Y Y	High CMD indicence-(7), early flowering an indication of high yield+(2), looks high yielding+(4), looks tolerant+(3), recovers from CMD+(3), looks like Nase 2 variety they know it is good+92), looks sweet+(1), good leaf retention+(1), good establishment+(1).
MH 95/0204	N N N N	Y Y Y Y	Y Y Y Y	High CMD incidence-(5), looks good+(3), looks good+(3), resistant to CMD+(7), looks late maturing-(1), vigorous+(1), smoothers weeds+(2), looks resistant to drought+(1), looks high yielding+(1), smoothers weeds+(2), looks resistant to drought+(1), looks high yielding+(5), could do well in all soils+(1).
MH 95/0134	N N N N	Y Y Y N	N Y Y N	High mosaic incidence-(8), looks early maturing+(3), looks high yielding+(3), fairly tolerant to CMD+(3), good branching+(2), good growth habit+(2).
MH 95/0161	N N N N	Y Y N N	N Y N N	Susceptible to CMD-(7), high branching+(2), good growth habit+(1), robust+(1), poor establishment-(1), looks high yielding+(2)
MH 95/0420	N N N N	Y Y Y Y	Y Y Y Y	Resistant to CMD+(5), looks good for processing+(3), looks high yielding+(4), looks like stores in ground for long+(1), good plant type+(7), dard colour of leaves seems to indicate betterness-(4), vigorous+(1), looks to produe high dry matter content+(1)

size and outer skin colour, farmers almost failed to identify negative attribute of the clone at pre-harvest stage. After cooking (data not shown) the clone had very good table attributes and very mealy. Finally it was released as Nase 12 and has eventually become very popular among the farmers in Vvumba and elsewhere. Their participation has helped NAARI develop cassava varieties quicker and whatever is released now is acceptable by the clients especially farmers since their needs are the ones addressed.

Because of their close collaboration with the cassava programme, CMV is no longer a problem to the Vvumba farmers. Right now they have an overproduction of cassava. Many of them have built houses from "cassava" sales; they have educated their children, they dress better and their families are more stable. Poverty has not been completely eradicated yet it is reducing. Hopefully in the next 10 years poverty will be completely eliminated from this community.

The group number has gone up to 300 from the 30 whom NAARI started with. This is because the others have seen the benefits accruing from participating in this collaborative research. Other enterprises according to farmers' priorities are being introduced in research such as beans, maize, postharvest and pasture improvement.

Bean Resea rch: The case of Matugga Farmers

Since 1991 the Beans programme recognized and emphasized the importance of farmer involvement in research formulation, implementation and evaluation of research results. The Beans programme started active farmer participatory research in three villages. Matugga (Mpigi District), Ikulwe (now Mayuge District) and Kabale. The Matugga case is presented here.

At the time the main objectives were:

i. To understand the predominant farming systems in the area
ii. To identify farmers problems (particularly soil-related) as to relay a foundation for research towards improving the then soil management practices.
iii. To identify relationships between the farmers perceptions, knowledge and practices relating to soil fertility; and
iv. To develop a research plan for future research in the area.

The programme used various approaches to solicit information from farmers regarding soil fertility management in bean-based production systems and information on factors affecting farming in the area with more emphasis on bean production.

Several approaches and methods were used by the researchers in Matugga village to solicit information from farmers to help in formulation of a research plan.

(a) Interviews using semi-structured – The interview initially centered on soils and their management, but collected information on adaptation of various crops to different soil types and crop management was collected.
(b) Transect walk and participant observation
(c) Participatory diagramming exercises and group discussions- Diagramming exercises involved labour and rainfall distribution, labour distribution according to sexes, labour and capital distribution to different crops, a typical soil catena, and changes in importance and reasons for change of crops. These were all carried out by farmers in small groups.
(d) Problem identification and prioritication by open voting and pair wise comparison methods were used both individual interviews and brainstorming methods to come up with important problems. A total of 80 farmers were involved. The group identified 23 main problems related to agricultural production. The 23 problems were then divided into 4 main categories namely soil related problems (5 problems), disease related problems (7 problems), insect pest related problems (5) problems, and crop production management related problems (6 problems). The farmers used the pair wise comparison method to rank the problems by comparing similar problems to one another in each category. Farmers then discussed the causes of the problems and solutions to the problems. **Table 5 and 6** show the bean production constraints as identified by farmers and their rank. Each group was asked to diagram the causes of 2 important problems and identify possible solutions. The whole group then discussed these solutions and 12 researchable solutions were identified for implementation.
(e) Experimental design and trial implementation – Farmers were asked to narrate their own experiences and experimentation addressing treatment compari*sons*; plot size, site selection, replication and randomization. Steps in designing trials were highlighted including title, objectives, treatments, and replication, plot size, site selection and trial implementation, trial management and observations to be taken. Farmers worked in groups and designed 7 trials. The trials included those involving beans but others involved banana weevil control, agroforestry using leguminous trees e.g leucaena and calliandra to improve soils, manure using farmyard manure and house hold refuse and cassava mosaic resistant trials. Farmers then volunteered to carry out the experiments.

The whole process of technology development, evaluation and dissemination was participatory and farmers were considered partners in the research process rather than recipients of developed technologies by researchers. From 1992, at the end of every season the

Table 4: Farmers' assessment of cassava varieties at harvest, February 1999

Variety attributes	Variety										
	MH 95/ 01311	MH 95/ 9104	MH 95/ 0080	MH 95/ 0349	Nase 2	MH 95/ 0204	MH 95/ 0414	MH 95/ 0134	MH 95/ 0024	MH 95/ 0420	MH 95/ 0161
Yield	2	2	2	2	2	3	2	2	1	3	3
Tuber size for market	2	3	3	3	2	3	1	3	2	3	3
Tuber size for home consumption	1	1	3	3	2	3	2	2	2	3	3
Dry matter content	1	1	3	3	3	3	3	3	3	2	3
Out skin color 3	1	3	3	3	3	1	2	2	3	3	
Flesh color	3	2	3	3	3	3	3	3	3	3	3
Raw taste	3	2	3	2	3	1	3	2	1	3	3

Table 5: Bean Production constraints as mentioned by farmers

	Rank 1 X5	Rank 2 X4	Rank 3 X3	Rank 4 X2	Rank 5 X1	Composite score	Overall rank
Rodents/vermin	10	6				74	3
Adverse weather (drought, too much rain, hailstorm)	2	10	5	3	1	72	4
Lack of seed	1	2	1			16	9
High production costs/lack of Money	2					10	10
Lack of agric. inputs		1					
Pests	11	10	4	2		4	12
Transport			2			111	1
Pests and diseases	11	7	8			6	11
Poor soil fertility	5	4	2	1		107	2
Poor varieties/ quality seed	6		1	1		49	5
Poor market (low demand/ price fluctuations)	3	4		1		35 33	
Poor yields	4		2			26	8
Lack of knowledge on proper farming methods	1		1	4	12		

Table 6: Pest and disease in bean production

	Rank 1 X5	Rank 2 X4	Rank 3 X3	Rank 4 X2	Rank 5 X1	Composite score	Overall rank
	Count	Count	count	Count	Count		
Aphids	23	7	5			158	1
Monkeys/baboons		1				4	10
Bean fly	16	6	2	1		112	2
BMVD	4	7	4	1	1	62	4
Scales	1					6	9
Bean rust		1	1			7	8
Bean wilt		2		1		10	6
Ashy stalks					1	1	14
Fusarium wilt			1			2	2
Angular leaf spot	1		1			8	7
Bacterial blight	2	11	6			72	3
Bruchids	1	1	1	1	1	28	5
Pod borers						1	14
Leaf cutters						2	11
Cut worms						2	11

scientists met with the farmers to discuss the previous season's activities and plan for the next season. The trials to be implemented were designed jointly and farmers volunteered on which ones to implement.

The approach was dynamic and flexible as a mean of integrating farmer's knowledge and experiences in technology development, which had allowed faster adoption of the improved bean technologies in Matugga Village. Up to 80% of the participating farmers adopted improved production technologies after a short period of time. The approach also allowed for integration of various commodities to work together in this village with the sole interest of improving the social well being of the farmers with resultant improvement in food security. Farmers don't deal with their problems in isolation and FPR has proved important in taking improved technologies as a package.

Due to farmers participation in evaluation of bean technologies, bean variety characteristics farmers consider important in adoption of new varieties are now known to researchers which has greatly helped in the breeding process. Apart from yield, factors like seed size, seed colour, taste, cooking time, post cooking keeping quality, marketability, disease and pest tolerance and soil reaction do impact a lot on acceptable of our improved varieties which has become apparent because of involving farmers in the research process through FPR approach.

The case of beans was collaborative where scientists and farmers collaborated as equal partners in the research process.

Sweet Potato Research: The case of Soroti and Kumi

Uganda is the third most important producer of sweet potato in the world, after China and Indonesia, and is the most important producer in Africa (CIP 1999). Research on sweetpotato in Uganda started during the colonial era but was given low priority. In 1989 the sweetpotato program based at NAARI was formed with emphasis of carrying out cliente-oriented research. Multidisciplinary diagnostic surveys were conducted to document the role of sweetpotatoes and major constraints limiting production and utilization in the major sweeetpotato producing regions, analyze the patterns of marketing and consumption in rural and urban areas and catalyze cliente-oriented interdiscplinary research to include farmers and other potential users in the process of developing improved technology (Bashaasha et al 1995); Fowler and Stabrawa, 1993.

One of the most important constraint identified was the seeet potato weevil. The case study presented here focuses on the IPM of sweet potato weevil in Soroti and Kumi districts.

This project focused on two districts in North east, i.e Soroti and Kumi, where weevils are the most damaging of the several production constraints. Population of the insects build up rapidly in the warm weather. The adults find their way down to storage roots through cracks in the soil, where they lay their eggs. The larvae tunnel into and feed in the roots, which causes the damage. Previous investigations to quantify yield losses reveal that in November an average of 14% of the total weight of tubers is damaged by weevils. This rises to 29% in December and 45% in Janaury

(Kabi et al 2001). This means that the system of in-ground piecemeal harvest that is common further to the South is not applicable in the case of north-eastern region. The Iteso and other farmers in the area have developed traditional methods of drying sliced or crushed sweet potato roots and storing them in granaries for future use instead of piecemeal harvesting.

In 1996 the Uganda National Research Organization (NARO)'s Potato and Post harvest programmes at Namulonge and Kawanda respectively in collaboration with the International Potato Center (CIP) and Natural Resource Institute (NRI), embarked on farmer participatory research to test the effectiveness of IPM practices on the control of sweet potato weevil. On-farm research was started in a pilot area in Gweri sub-county, Soroti District, and later expanded into Kumi. A total of twenty-seven farms were involved in the trials.

The activities involved included:

i. Socio-economic surveys to understand constraints faced by sweet potato farmers in both districts and make recommendations to guide on-farm research.
ii. Documentation of farmer's response to integrated management (ICM) component technologies.
iii. Regular monitoring of farmers practices to document farmers cultural and pest management practices, labour use and costs of production through the season.
2. Regular monitoring of farmer's practices to document farmers' cultural and pest management practices, labour use and costs of production through the seasons.
3. Participatory on-farm and on-station trials
i. evaluate the effect of the conditions under which planting materials are grown on sweet potato weevil infestation; and yields in the subsequent season.
ii. evaluate the effect of adjacent planting on weevil infestation
iii. varietal screening
iv. evaluate the effect of a second whiling on weevil infestation and yield, using selected varieties
v. test farmers hypothesis of controlling weevils e.g applying farm yard manure to potato, spray with hot pepper; treating the basal partions of vines in direct sun before planting, planting whole vines completely buried under soil, intercropping sweet potato with beans.
4. Dissemination of findings and technologies and monitoring uptake e.g:
i. fresh storage technique demonstration
ii. sweet potato slices
iii. rapid multiplication techniques demonstration
iv. new vine distribution

The farmers participated in all these activities but were guided by the researchers. The testing of farmer's hypothesis (i.e farmer's own innovation) was to assess the understanding and capacity of the trial farmers to conduct their own on-farm experiments. Farmers were encouraged and facilitated to choose and implement their own innovative practices on weevil population and infestation. Each "farmers innovation" was a treatment that a farmer hypothesized might have a positive impact with regard to weevil damage. The innovative treatment was then compared with the same farmer's usual method. This experiment therefore varied among farmer groups.

Table 7 summarized the major outputs from this project. The farmers in both Soroti and Kumi ranked sweet potato as the most important crop. Farmers from both districts had traditional methods (ITK) that targeted weevil control but were not known to researchers whereas the weevil was the most important constraint in Soroti, it was not a priority constraint in Kumi because of the nature of harvesting in Kumi where the weevil was avoided. In Kumi labour was the most important constraint.

Because of participation of farmers in the evaluation of sweet potato varieties resulted in increased uptake of the introduced varieties especially NASPOT 5 (316) and NASPOT 1(52).

The potato example is a "collaborative" type of collaboration, but most of experiments were designed by scientists but managed by farmers. This is skewed to the researcher as the person providing the solutions that are being tested.

The farming households participated in setting priority topics of research, identification of trial participants, and the planning management, periodic monitoring, harvesting and evaluation of the trials.

The project was designed to test a series of component technologies under farmer's conditions but as it can be realized, the technologies had already been developed on station. It was hoped that this participatory approach would lead to the diffusion of improved production technologies for both production and post harvest. One of the main conclusions from the project is that a focussed programme of technology transfer needs to be carried out with groups of farmers on broader sets of crop management aspects including IPM, agronomy, post-harvest processing and marketing. An emphasis on farmer discovery and experimental learning was found to be important; so that they understand why the methods are better than existing practices, and so that they can adapt technologies to their own specific conditions.

Maize Research

Presently maize is the most important cereal crop widely grown and consumed in Uganda. Previous research on this crop was conducted at Research stations or multilocational testing centres. There was, therefore, no participation of farmers in formulation and testing of technologies. Farmers only came to know about a variety after its release.

This, however, changed in 1988 when Manpower for Agricultural Development (MFAD) project funded by USAID came to support maize research. A researcher-farmer partnership approach to maize research was employed. To ensure that the maize production was demand driven the following scheme was adopted and has since then been observed by the maize research programme.

1. Conducting diagnostic surveys
2. Generating new production technologies on-station
3. Conducting verification trials on farmers fields
4. Demonstrating production technologies on farmers fields
5. Carrying out surveys to determine whether the technologies demonstrated are being adopted by the farming community

The following production constraints were identified:

a) lack of improved variety
b) declining soil fertility
c) lack of farm inputs
d) lack of labour and mechanized power during land preparation
e) drought
f) pests ad diseases (stem borers), maize streak virus and northern leaf blight and rust)
g) poor spacing and low plant population
h) lack of market for the produce
i) poor storage facilities; and
j) lack of contact with extension staff

After the surveys which involved farmers, researchers and extensionist it was concluded that a new variety was required. The commercial variety then (KWCA) was of late maturity and succumbed to maize streak virus. This led to the development of Long 1 initially later five more varieties Longe 2H, Longe 3H, Longe 4 and 5 have been developed and released. In addition PAN 67 and SC 627 (from South African and Zimbabwe respectively) were tested and released. Together with packages on spacing and fertilizer requirement e.g adopting a spacing of 75 x 25xm (53000 plants/ha) and applying nitrogen and phosphorus at the rates of 90N and 60P_2O_5 kg/ha respectively, the farmer would raise his yield on average by 2000 kg/ha. The partnership between the maize researchers and farmers is more consultative. It is increasingly becoming collaborative with the seed production projects that have been initiated and the main stem borer striga habitat projects.

The collaboration has resulted in a large number of farmers neighbouring participatory farmers adopting the new varieties. This has resulted in increased yields.

Animal Production: The case of smallholder dairy farmers in Masaka

The Livestock Systems Research Project (LSRP) conducted diagnostic surveys to identify constraints and needs of Livestock production in the target districts, Masaka was one of these districts. Small holder dairy farmers in Masaka identified feed shortage especially in the dry season as the most critical factor limiting milk production in the district (LSRP) report 1999. The farmers and scientists have adopted four strategies to contain the nutritional problem. These include adoption of feed conservation and fodder bank technologies and strategic utilization of crop residues. Reconnaissance surveys have noted the feed problems to be related to land tenure, ignorance of feed conservation methods and appropriate forage production and management practices. In some cases negative perception of recommended fodder bank technologies and feeding practices required verification.

A project in adaptive research and technology transfer was therefore developed to improve the feed resource base under smallholder dairy system in Masaka and provide models for similar systems elsewhere.

The central objective was to improve establishment and utilization of feed resources for increased productivity on small holder dairy farms.

Specific objectives include:

1. Study of the seasonal changes in energy and protein availability on small holder dairy farms
2. Introduce and test compatible mixtures of elephant grass and forage legumes for improved availability of protein and energy
3. Improve availability of protein during the dry season through supplementation with calliandra leaf meal
4. Promote the adoption of feed conservation technologies for dry season feed security under zero grazing systems
5. Strategically utilize crop residues to reduce dry season feed shortages
6. Study the socio-economic impact of the above introduced technologies

The expected outputs of this project include:-

1. Knowledge of current seasonal variations in energy and protein availability on smallholder dairy farms
2. Compatible mixtures of elephant grass and legumes introduced and tested
3. Utilization of calliandra leaf meal for increased protein availability during the dry season introduced and adopted
4. Feed conservation technologies promoted and adopted for dry season feed security
5. Improved utilization of crop residues for reduction of dry season feed shortages

Table 7: Summary of project outputs

Activities	Major Outputs
Socio-economic surveys:	
Soroti district —, mixed commercial-subsistence Kumi district – commercial production	Sweetpotato ranked as the most important cash crop and second most important food crop inSoroti district and Kumi district In Soroti, weevils were the most important pest and the third most important overall constraint for sweetpotato production, the first and second being access to animal draft power or labour for opening land, and la opportunities for processing and marketing. In Kumi, the most important production constraints were labour shortage, lack of planting material and pests.
Regular monitoring of farmers' practices technical knowledge – ITK.	Farmers in both districts had traditional methods that argeted weevil control but were unknown to the researchers (indigenous Sweetpotato is a major crop in a complex cropping system characterised by cereals, tuberous and leguminous crops. Farm size were variable and ranged from 0.5 – 5 hectares Farmers practice both piecemeal harvesting, primarily for home consumption, and single harvesting, primary for the market.
Experiments • Sources of planting material yields	Data did not show statistically significant differences in the of fields planted with vines obtained from different sources, although vines obtained from swamps had the lowest weevil counts.
• Adjacent planting	Weevil populations were higher in crops planted adjacent to old ones, but again no significant yield differences were found among the treatments.
• Hilling-up/variety trial	An additional hilling – up resulted in improved crop yields and reduced weevil infestations, although the observed differences were small. Among the improved varieties, NASPOT 1 performed best.
• Dissemination, and M & E	Farmer uptake of introduced varieties: Increasing use of uptake of NASPOT 5 (316) and NASPOT 1 (52) Demonstration of fresh storage: a negligible number of farmers adopted this technology. The main reason given was that making and filliing the pits requires too much labour in the bush harvest season. Demonstration of slicers: Farmers showed interest but uptake was low, because the cost of the machine was high and most farmers did not have enough tubers to justify the expense. Further work on hiring schemes and credit are required. Demonstration of rapid multiplication technique: This technology was widely taken up, particularly by farmers who multiply vines in swamps.

6. Knowledge of socio-economic implications of introduced technologies

To accomplish these outputs all the work is being done jointly between researchers, extensionists and farmers. The farmers are the ones implementing the activities on the ground. The work is on-farm. The farmers were however, trained before the work started. Enumerators were also selected and trained.

Scope and limitation of the presented case studies

1. All cases focussed on one client i.e the farmer. The consumer was assumed, the other clients were not addressed. However it is becoming increasingly important that other clients especially traders, industries need to be addressed. For example cassava is now increasingly becoming important in industry e.g starch production and as a component of several other products.
2. Apart from Beans and Cassava, the other cases developed technologies on station and just took them to farmers fields to adapt them. All cases had diagnostic surveys to identify needs and constraints. It is clear that to be client oriented we need to do more than farmer participatory research.
3. There was weak linkage with extension with most of the cases. The strongest linkage was with livestock and sweet potato.

Lessons learnt

1. Agricultural research tend to limit the clients. There is need to focus on broader client community and involve all the clients in technology development.

2. That client orientation does not mean farmer participatory research per sec. It involves more than just FPR.

3. For research to be client oriented, it requires more inputs e.g personnel, financial and time. It is more than the traditional research entails.

4. In client orientation it is difficult to focus on one commodity. Depending on the priorities as identified, you may have to address a system where there are several commodities within that system.

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