Bridging the Gap between Farmers and Researchers through Collaborative Experimentation. Cost and Labour Reduction in Soybean Production in South-Nyanza, Kenya

Vandeplas I. [1 2], Vanlauwe B. [1], Merckx R. [2] and Deckers J. [2]

[1] Tropical Soil Biology and Fertility Institute of the International Centre for Tropical Agriculture (TSBF-CIAT), Nairobi, Kenya
[2] Katholieke Universiteit Leuven , Department of Earth and Environmental Sciences, Leuven, Belgium

Abstract— **The Tropical Soil Biology and Fertility Institute of the International Centre of Tropical Agriculture (TSBF-CIAT) introduced dual purpose soybean varieties in south-west Kenya both to improve soil fertility by nitrogen fixation and to provide a source of better food and income. Since the start of the project in 2005, the Uriri Farmer Cooperative Society was successful in spreading the seeds over the district. Nevertheless, farmers still had problems with soybean agronomy. We therefore started a Collaborative Experiment (CE) Approach in March 2006 to make soybean production more accessible to farmers. The approach consisted of four stages: 1) information sessions; 2) participatory rural appraisal; 3) collaboration in the whole process of experimentation, from problem identification, to the design and analysis; 4) handing over to farmers. In this case study, farmers identified two main constraints to the recommended soybean production methods: 1) high labour requirement 2) lack of income to purchase the inputs. The results and discussions with farmers during the field days allowed demonstrating that the CE approach had been successful on two main aspects. First, CE was successful in defining problems and yield enhancing treatments which are accessible to deprived people. During field days, all farmers felt there was at least one of the treatments accessible to them. The second main success of the CE process was the increased awareness and interest about soybean. After less than a year of collaboration, farmers saw that soybean can bring a better life, cash for school fees and better health. The number of farmers registered in the soybean cooperative also increased from a few hundreds to 4500 that year. Several farmers started their own experiments to further adapt the recommendations to their own needs. The CE approach was thus successful in bridging the power-relations and knowledge gap between researchers and farmers and in designing appropriate technologies.**

Keywords— **Collaborative research – soybean - participation**

I. INTRODUCTION

The Tropical Soil Biology and Fertility institute of CIAT introduced soybean in Migori and Rongo District of Kenya in early 2005 [1]. That year the Uriri Farmer Cooperative Society was successful in spreading the seeds over the district, but farmers still had problems with soybean agronomy.

Agriculture in this region is conditioned by cash scarcity, labour shortages, poor transport facilities, and poverty, but on the other hand decent land availability and rather high education level [2]. Labour shortage in the district is due to a life expectancy as low as 38 years for men and 43 years for women, partly due to a HIV prevalence of 14.4 % [3]. Such a situation leads to a lack of population in the productive age group (15-49 years), a very high dependency ratio of 90% (2001) and a high demand of expenditures in medical care and funerals [2].

A Collaborative Experimentation (CE) Approach was started in March 2006 to make soybean production more accessible to farmers in those conditions.

II. MATERIALS AND METHODS

A. The Collaborative Experiment Approach

The Collaborative Experiment (CE) approach is based on the concepts of putting the “last first” and the “first last” [4,5]. By bringing farmers and researchers at equal level, effective communication can take place, which is a precondition for effective collaboration.

During the four stages of the CE approach the level of farmer involvement gradually increased and the level of researcher involvement decreased.

Stage 1: Information. This stage consists of pure information transfer.

Stage 2: Participation. This stage starts building on the trust relationship between farmers and researchers. Participatory exercises included listing and ranking of food and cash crops, estimation of land and assets use, and seasonal calendars.

Stage 3: Collaboration. This is the main stage of the process. All steps of the experimentation process (from problem and treatment identification, to setup, monitoring, and analysis) are done in collaboration between farmers and researchers.

Stage 4: Handing over. The last stage is to hand over tools and full responsibilities to local leaders and farmers, and stimulate them to pursue their own experiments.

B. Case study: CE to reduce Cost and Labour of Soybean Production in Migori and Rongo districts

The Collaborative Experiments (CE) were started during the short rainy season of 2006, in collaboration with the Uriri Farmer Cooperative Society. The research lasted four seasons, or two cycles of soybean-maize rotation. The research area is located between 13°60'E - 0°46'S and 34°32'E - 1°02'S, 1323-1562m above sea level. The area has two rainy seasons, the reliable long rains from end February to late July (700-900mm) and more erratic short rains from mid August to the beginning of February (400-600mm).

The *information stage (Stage 1) and participation stage (Stage 2)* of the CE approach were held during two meetings in each of the 4 zones, in April-May 2006, a total of 712 farmers were informed about the potential benefits of soybean.

The *collaboration stage (stage 3)* of the CE process was started during one meeting in each of the four zones in June 2006, with farmer attendance varying from 30-400 people. During a brainstorming session, farmers listed the problems they experienced while growing soybean and identified which problems could be solved through experimentation. Farmers identified labour and cost of inputs as the main problems on which to experiment. Similarly, they brainstormed about possible solutions to those problems, which became the treatments. To reduce input cost, manure, ½ DAP ½ manure, ½ ashes ½ manure, full ashes, ½ DAP and ½ Tithonia, and no inputs were tested as alternatives to DAP (di-ammonium phosphate) in all zones. All inputs were applied at a rate of 20kg P ha^{-1}, or 10kg P ha^{-1} of each ½ input. The reference for the labour treatments was point-placing of seeds in planting holes and weeding twice. Treatments identified to reduce labour were: point-placing in trenches instead of planting holes, with 2 weedings or with one weeding, and broadcasting and digging the seeds with a rake with one weeding. Farmers volunteered to give land and provide labour, while researchers proposed to bring inputs and seeds. A total of 17 fields were identified by farmers over the 4 zones, each composed of about 24 plots of 8*8m to 10*10m, depending on the size of the land. A technical start-up meeting was organised in July 2006 in which the experimentation process was presented to farmers. All field activities, including pegging and planting were done together with farmers and researchers. The Namsoy variety of soybean was planted at planting distances of 5cm by 45cm. A field technician was chosen among the young educated farmers who would be in charge of monitoring and recording data. Data collection included initial soil chemical parameters at plot level, daily rainfall, which was measured by the farmers using artisanal rain gauges, dates of flowering and podding, field observations (pests, damage by animals, etc.), and the cost and time of labour required for each activity in each plot. At harvest, dry matter of grain and haulms were measured. Data were analysed statistically using the MIXED procedure of SAS.

Three field days were organised in each zone. The first field day was organised about one month after planting, when soybean was still too small to see any treatment effect in the fields, the farmers' judgments and ranking were merely based on their preconception about the treatments. In 3 groups of young men, elder men and women, farmers predicted the relative harvest for each treatment. They were given "prediction cards" to distribute over the different voting boxes, labelled with the input or labour treatments. Cards with labels of different quantities of yield (bags) were used to predict which input/labour treatment would get highest or lowest yields. The voting cards for "labour requirement" of the treatments were labelled with 1 up to 4 farmers. The access to inputs was estimated with cards ranging from "very easy to get" to "very difficult to get". A weighted mean was calculated for each input or labour treatment, by giving a weight ("3 bags" = 100% … "0,5 bag" = 20%) to each voting card and multiplying it with the percentage of votes it received.

The second field day was at the time of maximal biomass. At this moment, differences in crop growth between the treatments became visible. Farmers estimated which treatments would yield best. During this field day farmers were also asked to divide a number of coins over the different input treatments to estimate the cost of each. The average of the fraction deposited by each farmer was compared to the real calculated input cost during the experiments.

The last field day was done after data analysis. The results of the harvest were shared with farmers to identify their final preferences and comments. Farmers voted for the combination of labour and input treatment they would like to apply in their own fields.

III. RESULTS

To assess the effectiveness of the CE process in designing experiments, the actual measurements of labour, cost and yields from the experiments were compared to the farmer predictions during field days.

Farmers' estimation of the relative costs of collecting and transporting the different inputs to the field and of the labour to perform the different planting and weeding systems coincided quite well with the actual calculated cost and labour (Figure 1, Figure 2). DAP was indicated by farmers as the most difficult treatment to access, and having the highest cost. Treatments with half the quantity of DAP (½ DAP ½ MAN and ½ DAP ½ TIT) became accessible to some farmers. Manure and ashes were easy to access by most, depending on the availability of cows in the household or on a neighbouring tobacco or sugarcane transforming units. Farmers underestimated the burden for *Tithonia*. Indeed, about 325 kg ha^{-1} is required to reach 20kg P ha^{-1}, requiring about 88 days for cutting and 90 US$ to transport it to the field.

Point-placing seeds (L) required 6 times more labour than broadcasting (BC), planting in trenches (T) 4 times more. The total labour requirement over the season doubled from BC1 to L2.

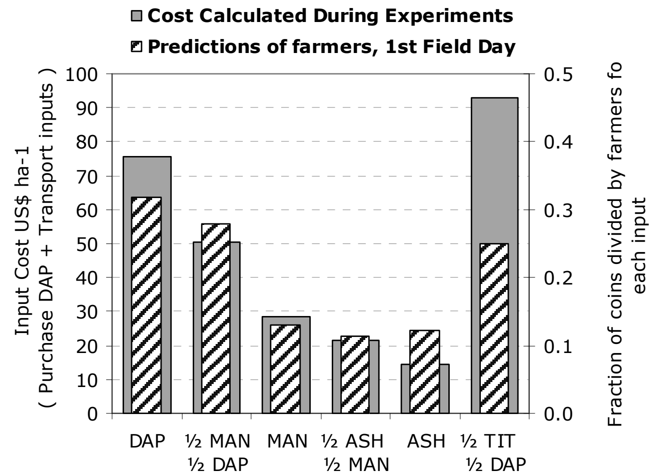

Figure 1: Comparison of the input cost calculated during the experiment (US$ ha^{-1}) and the farmers' predictions during the 2nd field days, for the collection and transport of different inputs, DAP being purchased in town. DAP = di-ammonium phosphate, MAN = manure, ASH = ashes, TIT = Tithonia. All inputs applied at a total rate of 20kg P ha^{-1}, or 10 kg P ha^{-1} for each ½ input.

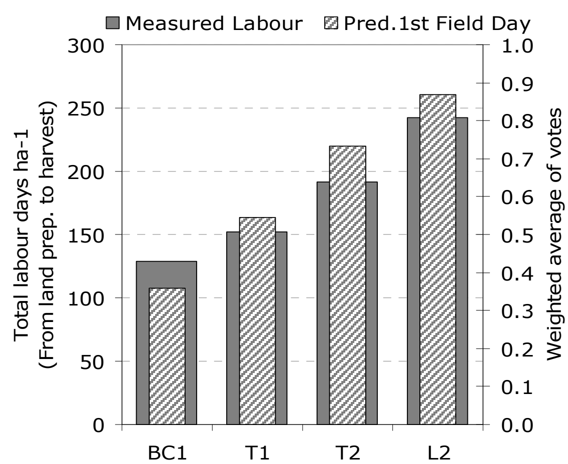

Figure 2: Comparison of the total labour time calculated during the experiment (days ha^{-1}) and the farmers' predictions during the 1st field days, for all activities from land preparation to harvest. BC= broadcasting; T= point-placing in trenches; L= point-placing in planting holes; 1-2 = 1-2 times weeding

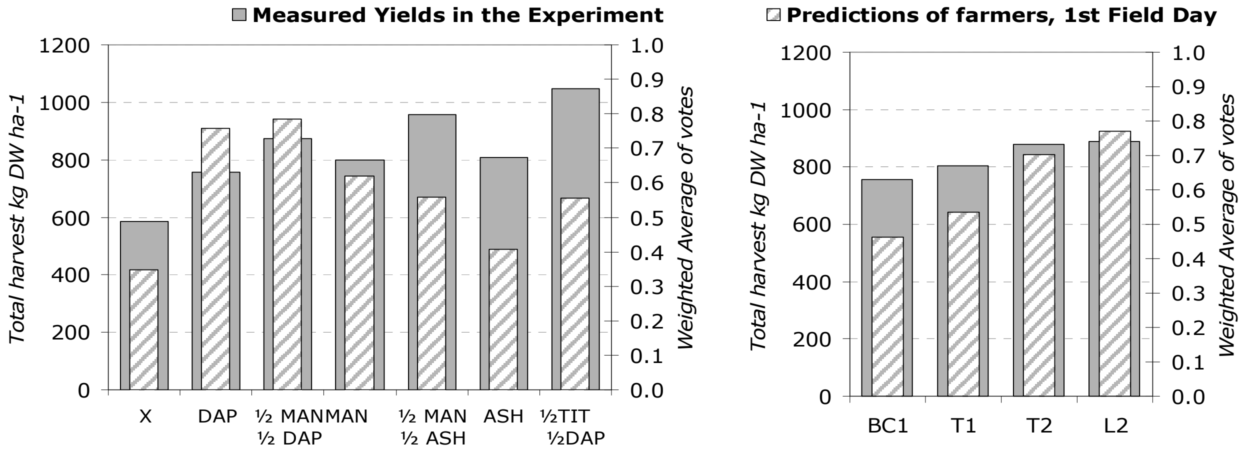

Figure 3: Comparison of the yields measured during the experiment (kg DW ha^{-1}) and the farmers' predictions during the 1st field days. DAP = di-ammonium phosphate, MAN = manure, ASH = ashes, TIT = Tithonia. All inputs applied at a total rate of 20kg P ha^{-1}, or 10 kg P ha^{-1} for each ½ input. BC= broadcasting; T= point-placing in trenches; L= point-placing in planting holes; 1-2 = 1-2 times weeding

Although farmers predictions of the feasibility of the different treatments was accurate (cost and labour), farmers had more difficulties in predicting the yields which would be obtained from the different treatments (Figure 3). They overestimated the potential of "modern" technologies, such as chemical input and such as planting in nice lines. At the other hand, they underestimated the potential of unknown technologies, such as the use of ashes and *Tithonia* as input, and or of "local" technologies, such as weeding only once or broadcasting seeds. Farmers commented they would never have wanted to try those technologies in their own land if it had not been demonstrated to them during the experiments, as they fear comments of neighbours.

Table 1 shows the final preference of farmers when seeing the results of the harvest of 2006. No women voted for any of the inputs using DAP, as there access to the money required to purchase DAP is a problem. Only a few men opted for treatments of full DAP or DAP combined with cow dung or *Tithonia*. Most men and women preferred the ashes, manure or the combination of ashes and manure.

None of the farmers voted for point-placing seeds with two weeding (L2). Depending on their labour availability at home, farmers opted for broadcasting or planting in trenches with one or two weeding.

Table 1: Farmers' choice of treatment during the post-harvest field day, when seeing the results of the experiments (n=93).

Women	X	DAP	½ MAN ½ DAP	MAN	½ MAN ½ ASH	ASH	½ TIT ½ DAP	
BC1	3%							9%
T1				20%	9%			29%
T2				26%		9%		34%
L2						29%		0%
	3%	0%	0%	46%	9%	37%	0%	Total

Men	X	DAP	½ MAN ½ DAP	MAN	½ MAN ½ ASH	ASH	½ TIT ½ DAP	
BC1	2%							7%
T1			12%	10%		17%		40%
T2				10%	10%	3%	2%	26%
L2								0%
	2%	5%	16%	28%	22%	21%	2%	Total

Note: DAP = di-ammonium phosphate, MAN = manure, ASH = ashes, TIT = *Tithonia*. BC= broadcasting; T = point-placing in trenches; L = point-placing in planting holes; 1-2 = 1-2 times weeding

IV. DISCUSSION

A. Successes of CE as an Experimental Approach

1) Farmers were able to predict the relative cost and labour requirements of different treatments. They are thus able to predict if treatments will be feasible in local conditions and can filter out non-feasible treatments during the design stage of the

CE, and avoid wasting time and resources on treatments which will never be adopted.

2) The Collaborative Experiments were seen by farmers as an opportunity to test those "unpopular" or unknown treatments without creating gossip.

3) The CE was successful in changing farmers' prejudices. Initially, many farmers believed that "modern" treatments would have higher yields than "local" treatments. After seeing the results of the experiments farmers opted for "local" treatments.

4) The strong collaboration allowed correcting problems in the experimental design before planting. It was initially agreed to use 50kg P ha^{-1}, but when looking at the quantities of inputs required, farmers commented that few would be able to gather this much. The input was thus reduced to 20kg P ha^{-1} to make the technologies adoptable by farmers.

B. Impacts of the CE approach

1) The CE approach built capacity of both farmers and researchers. Farmers learned about *experimenting*, researchers learned about *farming*. Researchers gained respect from the farmers when getting "dirty like them" during field activities. It provided a chance to experience the labour involvement and to better understand farmers' lives. Participating farmers gained self-esteem and participated spontaneously in soybean promotion.

2) When farmers looked at the yields obtained by the different treatments tested, they concluded that the experiment had produced treatments accessible to both poor and rich people. Wealthier famers could use chemical inputs and hire labour for planting and weeding. Others can get similar yields by using locally available ashes and manure.

3) As a result of the strong collaboration, farmers and technicians felt responsible for the experiments. When researchers were unable to go to the field during the political crisis in early 2008, the farmer technicians harvested the experiments alone and informed researchers that the samples were ready.

4) As a result of the strong field presence the number of farmers registered in the soybean cooperative rose from a few 100 to 4500 members that year.

5) The strong collaboration led to a strong knowledge and belief in the benefits of soybean: bringing wealth, soil fertility and health. It allows to send their children to school and to build the immune system of young and old, an important factor for HIV/AIDS patients. Women see soybean as an accessible source of protein for their children.

V. CONCLUSSION

CE lead to EFFECTIVE and USEABLE research. The CE allowed to shortcut the long and costly process of in-depth anthropological analysis. No one can understand better than the farmers themselves the complexity of their environment, culture and socio-economical context. Their share in the decision making process allows to integrate these elements in the experiment without the need for the researchers to fully understand them. Farmers *know* the conditions they live in, Researchers *know* experimentation, *together* they have all necessary knowledge.

ACKNOWLEDGMENT

Many thanks to the many volunteers of the Uriri Farmer Cooperative Society for the good and fruitful collaboration over the last 2,5 years and to the students who assisted in this project.

REFERENCES

1. TSBF-CIAT (2003) Exploring the multiple potentials of soybean sin enhancing rural livelihoods and small industry in East Africa. Project Proposal. Tropical Soil Biology and Fertility Institute, Nairobi, Kenya.
2. UNDP (2006) Kenya National Human Development Report 2006. Human Security and Human Development: Deliberate choice. United Nations Development Programme.
3. Migori District (2005) Migori Development Plan 2005-2010. Ministry of Planning and National Development, Republic of Kenya.
4. Chambers R (1983) Rural Development: Putting the Last First. Longman, Harlow, UK
5. Chambers R (1997) Whose Reality Counts? Putting the First Last. Intermediate Technology Publications, London
6. http://www.uq.net.au/action_research/as/argyris2.htm

Use macro [author address] to enter the address of the corresponding author:

- Author: Isabelle Vandeplas
- Institute: Tropical Soil Biology and Fertility Institute of the International Centre for Tropical Agriculture (TSBF-CIAT) and Katholieke Universiteit Leuven , Department of Earth and Environmental Sciences, Leuven, Belgium
- Street: Celestijnenlaan 200 E - bus 2411
- City: 3001 Leuven
- Country: Belgium
- Email: i.vandeplas@cgiar.org; isabelle.vandeplas@biw.kuleuven.be