Grounding agricultural research in resource-poor farmers' needs: a comparative analysis of diagnostic studies in Ghana and Benin

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Received 21 June 2004; accepted 16 November 2004

Abstract

Eight researchers from Ghana and Benin, with different backgrounds but all co-operating within the Convergence of Sciences project, conducted diagnostic studies as a first step of their research aimed at developing technologies together with resource-poor farmers. The purpose of including diagnostic studies was to increase the likelihood that the resulting technologies would be grounded in the needs and opportunities of these farmers. To better understand the potential of diagnostic studies for improving the contribution of agricultural research to farmers' livelihoods, a comparative study was conducted of the diagnostic studies carried out by the eight researchers. This research on agricultural research was participatory in that its results were arrived at in consultation with the eight researchers. The comparison revealed that diagnostic studies identified and established forums of stakeholders, especially of farmers, who were to play key roles in the co-construction of knowledge during the field experimental phase that followed the diagnostic studies. The diagnostic studies gave farmers a say in the design and conduct of the experimental phase which allowed them to influence the research process in the direction of developing and testing technologies that work in their circumstances and that satisfy their needs and priorities. In addition, the diagnostic studies have led to transparent choices with respect to the selection of sites, farmers and experiments. Furthermore, the conditions for negotiation were created. Finally, the diagnostic studies played a crucial role in making the partners within the Convergence of Sciences project aware of the importance of contextual framework conditions in determining the relevance of the project.

Additional keywords: research on agricultural research, participatory technology development, innovation, co-construction of knowledge

Introduction

The Convergence of Sciences (CoS) project tries to contribute to agricultural development and poverty alleviation of small-scale farmers by creating convergence in technology development. Convergence should take place between natural and social scientists and between societal stakeholders (including farmers) and scientists. The Convergence of Sciences project has deliberately included diagnostic studies in the design of each of eight field experimental studies that aim to develop technologies together with resource-poor farmers in Ghana and Benin. The purpose of including a phase of diagnostic study was to increase the likelihood that the eight technology development efforts were grounded in the needs and opportunities of their intended beneficiaries. The rationale for the diagnostic studies has been explained by Röling *et al.* (2004). This article focuses on the question whether the diagnostic studies made a difference.

The present article uses the eight diagnostic studies as case studies to carry out an exploratory and comparative analysis. The focus of this analysis was not the content of the eight diagnostic studies, but *research on research.* What was the role the diagnostic studies played in the eight studies? How did inclusion of a diagnostic study in the design of each of the research projects affect the entire project? At the time of writing, the experimental work with farmers was still in full swing. So it was impossible to use criteria that were based on the quality of the innovations that each research project produced. This meant that we needed to develop other criteria to be able to answer the main questions this article addresses: Was including the diagnostic study worth the trouble? Including a diagnostic study in a PhD research project is a considerable investment in time and effort. The eight comparable studies that started all at more or less the same time had similar purposes and were conducted in similar circumstances. They provide a good, if not fairly unique opportunity to systematically examine the added value of diagnostic studies, especially with respect to their impact on the process of making pre-analytic choices (Giampietro, 2003). As we saw in Röling *et al.* (2004), pre-analytical choices were made prior to actual experimental technology development work. Such choices are inevitable and neither good nor bad in themselves. However, it is important to make them explicitly and deliberately because they determine the research design, and the feasibility and acceptability of the innovations developed with farmers. The purpose of the diagnostic studies was most of all to make explicit choices with respect to the key issues that determine the extent to which the research effort leads to useful outcomes for the intended beneficiaries.

Our examination starts off with a description of the methodology on which this article is based. It was a challenge to carry out research on research that led to outcomes that were recognized by the main protagonists, the researchers themselves. The article then describes some issues relating to how the diagnostic studies were carried out in the two countries. Our fieldwork made apparent some aspects of the implementation of the diagnostic studies that had escaped notice at first and that we must report here. Then we present a framework for comparing the eight diagnostic studies and use it to carry out the actual comparative analysis. The article ends with conclusions and some suggestions for further research.

Before we continue, we would like to emphasize that this is very much an

exploratory effort. Although the CoS project provided a rare chance to compare eight diagnostic studies that were carried out under similar conditions, we are still dealing with eight different efforts in two different countries. Our data are not suited to quantitative, let alone statistical analysis. We provide insights that hopefully stimulate reflection on the importance of including a diagnostic phase in agricultural research and of negotiating pre-analytical choices with farmers.

Also, this research is part of a broader PhD project that aims to identify factors that allow research to benefit resource-poor farmers. The PhD project analyses case studies to draw lessons for research and uses the key issues derived from these studies in analysing the experiences with the CoS project, which deliberately experiments with innovative types of research. The study belongs to the whole field of tradition on science and technology (Kuhn, 1970; Knorr, 1975; Chambers & Jiggins, 1987; Funtowicz & Ravetz, 1993; Engel & Salomon, 1997; Latour, 2001). This subject is dealt with in greater detail elsewhere (Nederlof, in prep.).

This article was written by members of the CoS project. We have tried to be reflective and self-critical but that effort cannot replace the critical examination of a disengaged outsider. Our article has been thoroughly reviewed by external referees, and a further external review of our analysis is foreseen in a later phase of the project. The advantage of the approach taken in this article is that it is the outcome of a collective effort in the sense that the eight researchers and some of their supervisors collectively have gone through the article and amended it in long discussion sessions. In that sense, this article is an account that reveals how the protagonists themselves experienced the diagnostic studies. Such an account has the advantage of disclosing motivations, reasons and experiential learning, but the disadvantage of possible bias and self-interested selectiveness.

The researchers who carried out the diagnostic studies and their topics per country are summarized in Table 1 for easy reference.

Table 1. The topics and the main diagnostic-study researchers per country.

Country	Topic	Main researcher
Benin	Integrated pest management (cotton)	A.A.C. Sinzogan
	Soil fertlity management (e.g. using cassava in the rotation, impact of land tenure on soil fertility management)	A. Saïdou
	Weed management (*Striga* in sorghum, spear grass)	P.V. Vissoh
	Genetic diversity management (cowpea and yam)	A. Zannou
Ghana	Integrated crop management and institutional analysis (cocoa)	E.N.A. Dormon
	Organic pest and disease management (cocoa)	G.K. Ayenor
	Soil fertility management (e.g. cassava in the rotation, impact of land tenure on soil fertility management)	S. Adjei-Nsiah
	Genetic diversity management (sorghum), role of sorghum in livelihood strategy	C.Y. Kudadjie

Materials and methods

The collection of data for the exploratory comparative analysis reported below was quite extensive. The task was not made easier by the fact that the written accounts of the diagnostic studies that were analysed had the same deadline as the present article. In other words, a systematic comparison of the written accounts was not possible until quite late in the process. Several methods of data collecting were deployed. These include:

1. Participant observation by the first author as a member of the CoS research team gave her a thorough insider understanding of the overall design and process in general terms before and during the diagnostic studies.
2. Visits to the individual researchers, including participation in their fieldwork with farmers and in their inter-institutional and validation meetings. Also direct observations were made, but for logistical reasons this was only possible in the case of the four Ghanaian researchers.
3. Individual semi-structured interviews and focus group discussions with the researchers were conducted.
4. A Strengths-Weaknesses-Opportunities and Threats (SWOT) analysis of the diagnostic studies was undertaken with a focus group of the researchers. A difficulty encountered was the protectiveness of some researchers with respect to their results in the early phase of their PhD research. The results of the SWOT analysis were validated through a feedback session with a wider audience.
5. Semi-structured individual interviews were held with supervisors within the CoS project about experiences with, and characteristics of the diagnostic studies.
6. The written reports on the diagnostic studies were systematically compared, using qualitative interpretative content analysis methods.
7. The findings on which this article is based were submitted to the criticism of the researchers. The senior author developed a framework for the comparative analysis of the diagnostic studies. She then compiled answers for each topic of the framework for each researcher as she saw it. This compilation was fed back to the researchers for verification and discussion. In addition, previous drafts of this article were distributed for criticism and ideas.

The key content of the article is the systematic comparative analysis based on a number of criteria that were derived from various sources. In the first place, we used the criteria that emerged from the work of Van Schoubroeck (1999), Hounkonnou (2001), Tekelenburg (2002) and others (see Röling *et al.*, 2004). The senior author also participated in a case study of an entirely different project (Nederlof & Dangbégnon, in preparation) that sensitized her to key issues involved in making pre-analytical choices and the consequences of misconceived choices for the outcome of an entire research project. But the comparative framework that we used was also elaborated on the basis of what emerged from the data. This approach gives our comparative framework a recursive and exploratory character. In other words, our comparative framework was not *tested*, but *emerged* from the comparison and should be seen as a result of our study.

The framework for comparison

Based on the work of Tekelenburg (2002), Röling *et al.* (2004) suggest the following key questions that need to be answered for participatory experimental technology development with farmers to have a development impact. These questions should guide decisions about key pre-analytic choices.

1. What are useful abiotic and biotic relationships (result of fundamental research)?
2. What is the best technical means (result of applied research)?
3. What can work in the context (taking into account e.g. markets, input availability, agro-ecological zone and other aspects that affect opportunities and potential for innovation at the macro level)?
4. What can work in the farming system (taking into account e.g. labour availability, land tenure and access to markets, at the micro level)?
5. What will be acceptable to intended beneficiaries (taking into account e.g. culture, priorities and preferences)?
6. Can the innovations that were produced be scaled up?

These questions were used to develop a framework for comparing the eight diagnostic studies. This was not a straightforward exercise. Since the experimental work had not been completed at the time of writing, there was no evidence for many of the above questions. For example, it had not been proved that the diagnostic studies had identified innovations that can work in the context (question 3). This meant that we had to rely on categories for the framework that could be considered as proxies or that indicated processes that could possibly lead to the desired outcomes implied by the questions above. The following are the categories of the comparative framework that we settled upon:

1. Purpose of the diagnostic study in the research process. How was the diagnostic study used for subsequent interactive experimental research?
2. The methodology used for the diagnostic studies (criteria for selecting research sites and (categories of) farmers; procedures for entering communities, including the intermediaries used to approach local people; extent to which multiple stakeholder were engaged).
3. Extent to which the context was taken into account in the diagnostic studies (e.g. economic and ecological conditions, ethnic diversity, policies, and wealth differences in the community).
4. The process for negotiating the experimental research programme with farmers and other stakeholders that was used in the diagnostic studies (to the extent applicable, given the phase of the diagnostic studies at the time of writing).
5. Interaction between the technical and socio-economic domains. How did the involvement of social and natural supervisors influence the research process?
6. The extent to which the diagnostic studies led to change in the design of the research proposal, and the aspects that were involved. (We look at this item in the concluding remarks to this article).

These categories provided us with the best information that we could get at the moment about the kinds of pre-analytical choices that were made and the processes involved in making them.

As for the way of collecting information on each of these items, we had to rely on opinions and reasons, especially those of the eight researchers whose spoken and written testimony we used to gain insight into their respective diagnostic studies. We used a participatory procedure, in that we developed an initial list of observations based on our understanding of each of the eight. We then submitted this list, specified for each diagnostic study, to the eight researchers, adapted the list on the basis of their reactions and re-submitted the list to their scrutiny and intensive discussion during a CoS meeting in April 2004.

Background to the diagnostic studies

As explained by Röling *et al.* (2004), the diagnostic studies were influenced by the technographic studies that preceded them. The importance of the technographic studies for several of the pre-analytical choices made in the CoS project became clear only in hindsight and is therefore discussed here. The diagnostic studies were carried out differently in Ghana and Benin, so a short description of the processes in the respective countries precedes the comparative analysis.

Technographic studies

Technographic studies (Richards, 2001) were included in the CoS project to identify domains and opportunities for innovation at a macro level. So the technographic studies represented an opportunity for the CoS project to make systematic and explicit pre-analytical choices before the eight research programmes had even started, although, as we shall see, the timing of the reporting on the technographic studies and the start of the eight diagnostic studies did not always allow the latter to optimally benefit from the technographic studies.

The technographic studies in both countries focused on three categories of crops by level of institutional interest: public, private and grassroot crops (Anon, 2004). The choice to divide crops according to sector or level of institutional interest was a pre-analytical choice in itself. Alternatives would have been to choose according to agro-ecological zone, farming system, administrative boundary, gender sensitivity, poverty, food security impact, etc. Table 2 presents the characteristics of each category of crops.

Dividing crops according to level of institutional interest allowed the CoS project to capture a diversity of theatres for agricultural research. An implicit advantage of selecting different crops was the diversity of agro-ecological zones that were covered. The choice of crops was deliberately intended to also allow comparison of similar crops across the two countries with their different, i.e., Anglophone and Francophone traditions. The disadvantage of an approach based on crops is that it remains to be seen whether it allows the 'technological landscape' (Richards, 2001) to be understood. For example, a focus on crops might well detract from a systems-based understanding of the complex livelihood strategies that small-scale farmers usually rely on.

As it was, the decision was made that the technographic studies would focus on the crops chosen. The technographic studies were not carried out by the eight

Table 2. Categories of crops and their characteristics.

Category	Role in the rural household economy	Principal stakeholders	Nature of intervention
Public crops (cocoa, cotton)	Cash crop	(Partly) in the hands of the state	Intensive public research and extension
Private crops (cowpea)	Cash or food crop, important in rural areas	Private commercial initiative	Controlled by private actors (development organizations, NGOs) and traders
Grassroot crops (sorghum)	(Formerly) main food crop	Crop for the poorer strata of society	Private and public development organizations pay little attention; relatively small research investment

researchers who conducted the diagnostic studies, but by CoS senior research staff contracted for the purpose. At the time, the eight researchers were engaged in preparing their proposals and their theoretical and methodological chapters. This did not always allow for a perfect connection between technographic studies and diagnostic studies.

The eight researchers were asked to focus on one of the crops studied during the technographic studies. For some this meant they had to drop preferred subjects and accept the CoS collective decision. As already mentioned by Röling *et al.* (2004), this led to replacement of cashew by cocoa, tomato by sorghum, and banana by cassava. The narrow focus on *one* crop did, in one case, lead to an initial inability to focus on the shifting relationship *among* crops, which turned out to be more important for understanding the dynamics of the innovation strategies of farmers (Kudadjie *et al.*, 2004).

Three major innovation domains were chosen, taking into consideration the findings of the technographic studies, interest and background of the student and the university departments involved. These domains related to (1) pests and diseases, including institutional issues impacting on integrated pest management (IPM), (2) declining soil fertility, including emergence of pernicious weeds, and (3) genetic diversity management by farmers and the introduction of improved varieties. A clear relation was assumed between the category of crops chosen for the technographic studies (e.g. public, private and grassroot) and the domain identified for the eight studies. The researchers working on a public crop all focus on IPM, a combination that is understandable given the fact that the use of pesticides, and hence cost reduction through developing alternatives, is especially relevant in public crops. The researchers who work on the 'grassroot crops' focus on genetic diversity management, while those working on soil fertility management and weeds initially focused on private crops.

The initial relationship between the industries chosen in the technographic studies and the major domains explored by the eight researchers is illustrated in Table 3. The diagnostic studies led to a considerable adaptation of this initial 'neat' scheme. For example, soil fertility and weed researchers included grassroot crops as an outcome of both the technographic studies and their own diagnostic studies. The public-crop researchers had to consider weeding as part of an IPM approach. And the grassroot crops could not be fruitfully considered without taking cash generation into account.

Table 3. From industries to domains for innovation needs: the initial scheme before and after the diagnostic study (DS).

Category of crop	IPM[1]		Soil fertility		Genetic diversity	
	Before DS	After DS	Before DS	After DS	Before DS	After DS
Public crop	▫	▫				
Private crop			▫	▫		▫
Grassroot crop				▫	▫	▫

[1] IPM = integrated pest management.

The four Beninese researchers preceded the Ghanaian ones in developing research proposals as a requirement for enrolling in the CoS research programme at a time when the findings of the technographic studies were not yet available. So the results of the technographic studies only reached the Benin researchers when they were in a more advanced stage of proposal writing than in the case of Ghana. It would, of course, have been desirable had the technographic studies been concluded before proposal writing by the eight individual researchers so as to help focus their studies on problematic issues and opportunities for innovation. Proposal writing in an early stage of research was a prerequisite for enrolment in a research programme. This requirement obviously conflicted with a process that grounds research in farmers' opportunities and needs. It was an institutional constraint that emerged from a blueprint, rather than a process approach to a research *project* cycle (see Röling *et al.*, 2004).

Experiences in Benin

In Benin a substantial number of both supervisors and CoS researchers was involved in a previous research project in collaboration with Wageningen University, called the 'Cowpea IPM Project'. One of the four Benin researchers actually had been employed in the diagnostic phase of this project. All other researchers were also aware of the Farmer Field School approach used in that project through numerous exchanges and written background information (Anon., 1999; Kossou *et al.*, 2001). Considered a success, the Cowpea IPM Project took on the character of a 'model' for the CoS project in Benin.

The Cowpea IPM Project included a diagnostic phase comprising two steps. During step one, villages for the study were selected on the basis of such criteria as the importance of cowpea production and the absence of other projects. During the second step, researchers followed the crop and the farmers during an entire growing season to document farmers' current practices, perceptions and knowledge. The purpose was to scale up promising local innovations. The first step was called 'exploratory diagnostic' and the second 'in-depth diagnosis'.

Other sources of insight used by the four Benin researchers were on-farm research approaches (Werner, 1996; Mutsaers *et al.*, 1997; Defoer & Budelman, 2000). Furthermore, the experience on diagnostic studies in Benin was coloured by the experience with FIDESPRA, later called FAR (Formation à l'Appui à l'Auto-Promotion Rurale). Since the 1990s, a number of the current CoS supervisors working for the Department of 'Economie et Sociologie Rurale' of the University of Abomey-Calavi had been involved in this training course designed to introduce development workers, policy makers and academics to participatory approaches in development planning and technology development. The first step in the course was a participatory diagnostic using Rapid Rural Appraisal tools. The social science supervisors of the four Benin researchers facilitated a considerable number of such diagnostic exercises. The four diagnostic studies in Benin benefited from this experience.

In all, the diagnostic studies in Benin were based on a two-step approach in which the first phase served the purpose of identifying major constraints on production at a regional (provincial) level and of selecting villages for future research intervention. The second phase consisted of an exploration of the situation in one or more key villages selected after the first stage for further intervention. In line with the two-step approach, most of the Benin researchers reported especially on the exploratory phase and, at the time of writing, were undertaking or finalizing the in-depth analysis of the villages selected for further research intervention. Only some of the results of the second phase were reported in the articles on the diagnostic studies (Röling *et al.*, 2004). For example, at the time of writing, in some studies negotiations with selected farmers about the ways forward in the experimental phase were still in progress. Due to the replacement of one of the Benin researchers, the diagnostic study on cotton production (Sinzogan *et al.*, 2004) started much later than the other ones so that the diagnostic study could not report on the phase of negotiation with farmers and plans for further research. This makes the diagnostic study unsuitable for the comparison on some of the criteria used below.

Experiences in Ghana

The experiences with diagnostic studies in Ghana are diverse. No general meetings with the researchers and their supervisors were organized to discuss the diagnostic studies, but support was given to them individually. Based on the results of the technographic studies, the four Ghanaian researchers immediately proceeded to one or a few villages to explore in detail the situation regarding the subject areas that they had finally decided to work on. So in Ghana a one-step approach was followed, mainly inspired by Van Schoubroeck (1999) who did an 'incidental diagnostic study' when he

realized that the topic that had been assigned to him was not the most relevant one for the farmers he was supposed to work for (for more details see Röling *et al.*, 2004). In addition, some researchers used insights from Defoer & Budelman (2000) for their methodology. The Ghana group took the village entity as an entry point and subsequently explored the problematic domain and negotiated common grounds for research with farmers and other stakeholders in the selected communities.

Comparison of experiences in Ghana and Benin

The CoS research approach was not cut and dried during the first year of the project. Due to its process-driven nature and the joint learning process that emerged, the approach evolved from one stage to another. As a result, the understanding and operationalization of the technographic studies and diagnostic studies differed considerably between the two countries, which in turn meant that the interactions within the CoS Working Groups (i.e., the supervising faculty) and between the Working Groups and the researchers also differed. The diversity in approaches to diagnostic studies among the Ghanaian researchers can be attributed both to the little previous experience of the Ghana group with diagnostic studies, and to the smaller influence of the Ghana Working Group on the four researchers' diagnostic studies. This created space for the researchers in Ghana to innovate in their diagnostic studies, while, as a result of the greater involvement of the supervisors and the greater experience with diagnostic studies, those in Benin followed a more uniform approach.

Whereas, in general terms, the Benin technographic studies identified domains of innovation needs in different pre-selected industries (Anon., 2004), the Ghana team looked at promising existing innovations in different industries in some selected regions and villages (Abekoe *et al.*, 2002, Sakyi-Dawson *et al.*, 2002). For example, the technographic studies in Ghana identified a village in which an interesting innovation had been developed (using cassava for soil fertility improvement as an adaptation to the need for continuous cropping under population pressure). One of the Ghana researchers, Adjei-Nsiah, is now working in that village. In other words, the Ghana technographic studies can be compared to the exploratory phase of the diagnostic studies in Benin.

Findings: the comparative analysis

Variation in objectives of the diagnostic studies

The diagnostic studies differed in several respects whilst in other they shared purposes. All researchers mentioned that the diagnostic study helped to create a responsive environment for their subsequent experimental work. Their presence in the village(s) and their interest in the lives of the local people established good rapport. The diagnostic studies in both countries helped to identify possible linkages between social and technical issues and to understand the context in which the proposed research topic is embedded. This in turn provided some initial insight into the relationship between the

activities proposed by the researchers and the extent to which these would lead to innovations that would work in the context and farming system and would be acceptable by local people. We elaborate on these points below.

As explained above, the diagnostic studies in Ghana and Benin differed in a number of respects. In Benin the diagnostic studies explored the production systems in relation to the topic chosen. This exploration included farmers' current conventional and innovative practices and baseline information on their knowledge on the topic. Understanding production systems helped to establish whether the chosen topic was indeed an issue. So an important purpose of the diagnostic studies in Benin was to crosscheck the importance of the topic with the farmers. Also, the diagnostic studies helped to select a specific representative village or villages for further interactive research. During the in-depth exploration within the selected village(s), specific experiments were negotiated with the local people, often based on innovative practices developed by farmers themselves.

In Ghana the diagnostic studies were used to identify critical problems with respect to the industry and topic selected, and to explore causes of these problems in a village or villages in order to negotiate agreements about experiments with stakeholders. In some cases the importance of the topic was confirmed, whereas in other the subject was negotiated through demonstrating the rationale behind a certain choice. The diagnostic study by Ayenor *et al.* (2004) provides an example of a negotiation process, including the use of a cage experiment that convinced collaborating farmers of the importance of the research topic chosen (capsids in this case). In Ghana, a small sample of villages was selected for thorough investigation. The village(s) chosen was (were) not necessarily representative for a larger population because the criteria were not cross-checked with a larger sample of villages. The diagnostic studies were mainly used to establish aspects of the topic that were considered important by farmers and to determine what farmers would like to do within the scope of the topic selected. In summary, the diagnostic studies in Ghana aimed (1) to justify the choice of a problematic domain, (2) to ground the subsequent phases of the research in farmers' needs through negotiation of the purposes of, and activities for inclusion in subsequent experiments, and (3) to reach agreement on the roles of the different stakeholders.

Variation in methods of engaging farmers

Selecting communities

Selecting communities in which to work required careful attention. All PhD researchers started with a review of available documents. In addition, expert advice was sought to determine the possible areas for research, based on the extent to which the crop chosen was cultivated and on whether the topic seemed relevant. In one case (Adjei-Nsiah *et al.*, 2004), the choice for the village was suggested by the technographic studies. Additional communities were added as a result of the diagnostic study, which revealed differential soil fertility management strategies between migrants and natives, who were found to be living in different communities. Soil fertility management strategies appeared to be strongly related to security of land tenure.

Some researchers went to all selected areas while others visited only some and

consulted mainly with the extension services to select a shortlist of villages. Criteria used to select villages were, amongst other ones, the importance of the crop in terms of production, accessibility of the site during the whole year, and proximity of a research institute. Implicitly, the quantity of the crop produced was considered an indication of the importance of the crop for the farmers, although that importance might not be a good reason for investing in research. It assumes that increased production is desirable, which may or may not be the case from the point of view of the farmers. Additional incidental criteria for selecting rural communities were previous project interventions (mainly with respect to cocoa and cotton), diverging agro-ecological conditions, the influence of neighbouring countries, and the proximity to a market (mainly used in the case of grassroot crops). The enthusiasm of farmers to collaborate in subsequent participatory experimentation was considered an important criterion for selection of one or more villages by all researchers.

Compared with focusing immediately, starting in many villages and then zooming in on a few has both advantages and disadvantages. An advantage is that it was more likely that the researcher ended up with villages in which he/she could respond to farmers' needs in terms of having something to offer. In addition, the village was more likely to be representative for a larger population, which was relevant from the point of view of replication. A disadvantage was that work in several villages in which no future activities were undertaken contributed to the already bad image of scientists. One of the researchers (A. Saïdou, personal communication) described the surprise of the villagers when he returned for follow-up work: *"We thought you were lying, just as all of those who preceded you"*. In one case, a researcher who had selected areas that were very far apart was told by his supervisors to focus on a more manageable area from a logistical (cost, time, transport) point of view.

One researcher in Benin, Sinzogan, started later than the other ones. The main lesson he claimed to have learned from his colleagues was that more than one village needed to be explored to ensure representativeness but that studying many villages was time-consuming and created expectations that could not be met. He therefore selected seven villages for exploration and two for further research.

Approaching local people

Approaching the local people required careful consideration. In general, each of the PhD researchers started the diagnostic study fieldwork with a community meeting, i.e., with a group selected by the village chief, the president of the 'Groupement Villageois' (GV), or the extension worker (see below). This group was asked to answer some preliminary questions to determine the potential for collaboration. In all cases, this first community meeting was used to establish whether there was a ground for collaboration.

Beyond this initial interaction, the introduction to the villages in Ghana was different from that in Benin due to differences in the institutional context. In Ghana, government extension workers were an evident entry point into the community, while in Benin the (cotton) extension service (Centre d'Action Régionale pour le Développement Rurale – CARDER), had recently been reduced in size and its tasks partly delegated to farmers in the GVs. In Benin the GVs were therefore used as an additional

point of entry.

In Ghana the extension agent usually introduced the researcher to the village chief who then organized a community meeting. The extension worker was usually present during the first meeting. Introduction through an agricultural extension agent can affect the nature of the issues raised by local people. This was demonstrated by Dormon *et al.* (2004) who experimented with different ways to approach the local people. Three modalities were used. In area X all cocoa farmers were invited to the meeting; in area Y the extension agent selected two farmer groups, while in area Z the Chief selected representatives from different hamlets. Depending upon the method followed, different results were obtained. In area X, involving the whole community, socio-economic issues dominated the discussion about the causes of low cocoa yields, including the lack of access to electricity (leads to emigration of youths, labour scarcity and hence lack of, for example, plantation maintenance). In area Y, involving an extension agent, technical agricultural issues dominated the discussion. The group in area Z selected by the Chief had to be dropped because different people kept turning up to attend the meetings.

Considering their likely long-term presence in the area, the Ghana researchers also contacted other local authorities such as village elders and the assemblyman (local government representative) through courtesy calls and involved them in meetings with farmers.

In Benin the researchers often consulted the CARDER office for short-listing potential villages. The CARDER agent often introduced the researcher to the president of the GV, who in turn organized a community meeting. The extension worker did not always physically accompany the PhD researcher but in some instances sent a message to announce the arrival of the researcher. The village chief was not always present at the meeting and the community meeting often gathered members of the GV.

Since these GVs had been started with the express purpose of distributing inputs for cotton production and later for all crops, this method of selection favoured relatively better-off producers, not necessarily average or poor farmers. Also, using extension workers to select farmers is likely to lead to a biased selection since extension workers tend to interact with the top 10–20% of the farmers (Röling, 1988).

Most of the CoS researchers introduced themselves as students although farmers do not always make a difference between researchers, extension workers and students. S. Adjei-Nsiah (personal communication) explained that the farmers saw him as an extension worker because "*only extension workers work closely with the farmers*". Some cotton farmers held A.A.C. Sinzogan (personal communication) responsible for delayed seed cotton payments. A village authority had to intervene to explain that the researcher was 'just a student', who did not have influence on such matters. Farmers assessed the role of the researchers and the benefit they might derive and subsequently oriented their choices vis-à-vis the researcher accordingly. Farmers might think that the researcher could solve some of their problems or provide other short-term benefits (fertilizers, contacts with influential people or organizations, etc.). One of the Ghanaian PhD researchers, Dormon, actually did have a double role in that he did his research in his (widely-known) capacity as an employee of the Ministry of Food and Agriculture. Most PhD researchers discussed the results of their diagnostic studies

with the community, sometimes as part of further action planning for the research.

Some researchers spoke the local language and could therefore directly interact with the local people. In other cases the researchers could not speak the local language. This language barrier sometimes caused communication problems and researchers had to rely on an interpreter.

Selecting farmers

In all cases, the farmers participating in the diagnostic studies were selected from the farmers participating in the community meeting. Either the community meeting suggested farmers to be involved or volunteers were asked.

Multiple stakeholder process

The Ghana researchers used the diagnostic studies to establish forums for collaboration with other stakeholders, invited from the start to meetings to reflect on the research proposed. The mechanism used was an inter-institutional meeting organized every three months. The Benin researchers considered such multi-stakeholder processes beyond the scope of the exploratory phase of the diagnostic studies and were later exploring possible ways of collaborating with a wider set of stakeholders.

In two of the diagnostic studies, a public research organization had a direct role (Ayenor *et al.*, 2004; Kudadjie *et al.*, 2004) and a scientist from the organization regularly attended the meetings with the experimental group and participated in negotiating the research design.

Towards farming systems that work in an existing context

The diagnostic studies helped the researchers to understand the wider context and the importance of the context in determining what could be possible improvements in the problem situations identified.

In the cotton and cocoa sectors of Benin and Ghana, respectively, farmers were accustomed to external interventions through projects, regulatory measures, or the attempted introduction of science-based innovations (e.g. Anon., 2004). So innovation processes in these public crops often take another course than in the case of, say, crops like cowpea or sorghum for which most innovations originate from the farmers themselves. In the case of innovation in export crops, different scale levels are involved. A researcher working on an export crop has to negotiate with a large group of stakeholders with diverging interests. Farmers tend to be little motivated to make a contribution themselves. For example, in the case of Dormon *et al.* (2004), the farmers argued that the government uses the *abusa* system in dealing with them, i.e., they feel like sharecroppers in their own plots as a result of the high taxes imposed on farmers' cocoa returns. As a result, they are not very interested in investment and maintenance. In the case of cotton, the responsibilities for marketing and input supply have recently been transferred to the private sector, but farmers in that sector experience the consequences of the reorganization of the sector in the form of late payments and other inconveniences. In recent years cotton prices have collapsed, partly as a result of export subsidies by the USA and Europe and partly because of the enormous increase

in cotton exports from China.

Also the cocoa sector can be called dynamic, but in a more positive sense. The producer price has been increased but extension tasks have been shifted from the specialized Cocoa Services Division, a subsidiary of the Ghana Cocoa Board (COCOBOD), to the general public extension service. Mass spraying with pesticides and a hi-tech programme (e.g. a credit-based programme for fertilizers and inputs to increase cocoa production) have been introduced. These changes have created a situation in which farmers find it again in their interest to innovate.

The importance farmers attribute to certain crops depends on the time of the year in which the questions are asked. In both genetic diversity studies (C.Y. Kudadjie, personal communication; A. Zannou, personal communication) farmers tended to attribute more value to grassroot crops at the end of the dry period when food crops are scarce and many traditional and cultural ceremonies take place, than at the time of harvesting when financial benefits are derived.

Both soil fertility studies (Adjei-Nsiah *et al.*, 2004; Saïdou *et al.*, 2004) showed the importance of the land tenure system. Even though the specific tenure systems and resulting regulations differ in the two countries, their impact on farmers' willingness to invest in soil fertility was equally evident. This effect was not observed for weed management (Vissoh *et al.*, 2004) probably because ethnologically homogeneous villages were selected. But the same weed study did show that because of low soil fertility farmers find that the time invested in weeding does not result in a proportional increase in yield, and does not pay as well as off-farm activities. So weeding is limited to the minimum required for subsistence production. Developing time-saving weed management strategies seems a window of opportunity for a research contribution.

Leeuwis & Van Den Ban (2004) argue that innovation often is instigated through (1) changed perceptions of reality, (2) changed aspirations, (3) changes in the social environment, (4) changes in natural or physical circumstances, and (5) changes in socio-economic or technical opportunities. The first two are seldom autonomous but often induced by changes in (3), (4) and (5), i.e., in the contextual changes. The diagnostic studies showed that population pressure and soil fertility declined. They also showed that the availability of off-farm paid employment and related labour scarcity and emergence of opportunity cost calculations, land tenure arrangements and insecurity of tenure, as well as price fluctuations, played predominant roles in determining whether the contribution of agricultural research is feasible and useful. The diagnostic studies played a crucial role in revealing the importance of these contextual factors to the researchers and made it all but impossible to ignore them in the subsequent participatory experimental work.

Negotiating experimental research programmes

A crucial proxy for such questions as 'What can work in the farming system?' and 'What will be acceptable?' is the *de facto* influence that intended beneficiaries can exert on all aspects of the research process. Diagnostic studies play a crucial role in this respect. They establish regular interaction with the intended beneficiaries, they provide opportunities for taking into account local knowledge and needs, and, most

importantly, they allow farmers' veto power to be brought to bear *before and during* the experimental research and development work.

In this process, the demands of a PhD thesis that can be defended against the objections of an academic forum and the demands of farmers are not necessarily additive and require trade-offs and risk-taking on the part of the researchers. Farmers have to make a similar calculation: 'Do we trust the researcher and invest time and energy in research, or do we go for short-term benefits?' In other words, the two parties have very different interests and it is not misplaced to regard the initial interactions as negotiations that hopefully lead to a 'contract' that is more than a compromise dictated by convenience, courtesy, or strategic calculation. The diagnostic study is a crucial occasion for conducting such negotiations. Yet, being selected as a suitable PhD candidate does not automatically mean that the researcher is equipped to conduct such important negotiations with farmers who do not necessarily understand what research is all about in the first place.

The CoS researchers differed a great deal in terms of experience and skills that could be brought to bear in such negotiations. Some were in their forties or fifties and were well known or even highly regarded in their areas of work. Others had ample experience in village work. They spoke the local language fluently, if it was not their mother tongue to begin with. Others were much younger and had less experience. For example, Kudadjie worked as a young woman with older farmers whose language she was just beginning to understand. Initially she had no means of transport and had to rely on the goodwill of others. The depth of the insights she and her co-researchers gained was testimony that such handicaps could be overcome. The fact that she was not as yet engaged in experimentation at the time of writing was partly due to the fact that her interaction with farmers and her subsequent understanding led her to totally change her original research idea. In her case, the diagnostic study played a crucial role in re-formulating the research proposal.

In three other cases the contracts with farmers were also still under discussion at the time of writing, either because the researcher started late or because the specific experiments had not yet been agreed upon. In the remaining four cases, the negotiations led to the addition of experiments to the initial ones foreseen by the researcher, based on farmers' current practices and their suggestions. Contracts also related to such issues as time for meeting (in most cases every fortnight on market day, in some cases on request of the researcher), the mutual roles and labour input, the access to experimental fields, the use of controls (usually not considered necessary by farmers) and the decision whether to experiment on collective versus individually owned plots.

In the case of cocoa, the contracts with farmers led the researchers and other stakeholders to actively intervene in the context. In Ayenor *et al.*'s (2004) case, pressure from potentially organic cocoa farmers activated the researcher and other stakeholders to avert mass spraying of the experimental area. The bankruptcy of the prospective buyer of organic cocoa removed the entire rationale from the IPM in cocoa work and necessitated urgent action by the researcher and other stakeholders to open new marketing options. E.N.A. Dormon *et al.* (personal communication) decided that effective scaling up of his work required engaging in the development of a regular neem production and distribution system.

The researchers working on genetic diversity management had more difficulties in selecting relevant issues and entering contracts with farmers. Farmers inherited extensive knowledge from their ancestors about growing grassroot crops, and their price so far did not warrant new approaches and investments. In Ghana, Guinness Breweries was experimenting with buying sorghum from farmers and this could open interesting opportunities. So far, farmers tended to replace sorghum by maize (Kudadjie *et al.*, 2004) due to the increased monetary value of maize, and as a consequence during certain times of the year considered this crop more relevant than sorghum.

An important issue is the nature of the farmers who did, in the end, determine the outcome of the research. This is an old issue. As could be expected, the diagnostic studies confirmed that communities were not homogeneous so that choices had to be made as to who should benefit from the research programme (assuming some benefit, of course). One of the interesting issues that emerged from the diagnostic studies is the importance of tenure arrangements for determining the outcomes of agronomic issues. Both migrant *and* native farmers (Adjei-Nsiah *et al.*, 2004; Saïdou *et al.*, 2004) or landlords *and* caretakers (E.N.A. Dormon, personal communication; Ayenor *et al.*, 2004) needed to be involved in the research in order for its outcomes to be relevant for these different categories. None of the diagnostic studies reported explicitly on efforts to include the poorer farmers. In the absence of explicit effort it can safely be assumed that the farmers involved were those who were relatively better off (Röling, 1988).

If no explicit effort was made to include women, chances were that the research ended up dealing with male farmers. Only one researcher in the diagnostic studies, Kudadjie, is female. Our analysis shows that she was the only one of the researchers who insisted on the participation of women in the research group. The male PhD researchers tended to explain the weak representation of women by cultural and social norms and values of the societies in which the work was undertaken. For example, in the case of yam (Zannou *et al.*, 2004), a constraint on including women was the cultural taboo on their entering the field when they are 'impure'. This suggests that men tend to find excuses for low participation of women and accept it as a given rather than trying to do something about it. A local development worker reasoned: *"It is because there is a tendency to explain and accept cultural practices as something that needs to be respected and should not be disputed, whilst it is rather changing such a context that will allow for innovation and change. Tolerating such a context rather contributes to keeping us poor".*

Three of the Benin researchers carried out the interactive experimental research with a selection of farmers who already belonged to a group before the diagnostic studies started (for example groups formed by the Cowpea IPM Project, the National Agricultural Research Institute (INRAB), or by a GV). Only in the case of A. Zannou's (personal communication) project a group was constituted specifically for the purpose of the research because no previous group existed. In Ghana, new groups were formed, based on voluntary participation of farmers often elected by the larger community to represent them in the research. Ayenor *et al.* (2004) analysed the reasons why communities elected members to represent them. In one case in Ghana (Dormon *et al.*, 2004), the group of an extension worker was used for further research activities.

Linking technical and social factors

The CoS project deliberately aims to learn more about the link between natural and social issues, reason why each student has both natural and social science supervisors. Whether a researcher is a natural or social scientist depends on several factors including educational background, professional experience, and importantly, his/her enthusiasm. All CoS researchers received additional training in the field in which they were considered to be weak. Nevertheless, the CoS scientists with a social science background felt they would have done a similar analysis for their diagnostic studies without the additional training, even though the training enhanced understanding of the technical content. It would be normal to assume that researchers with a social background have a basket of data-collection tools at their disposal that differ from those of natural scientists. However, the methodological tools applied by the two types of scientists seemed not to be significantly different.

Adjei-Nsiah *et al.* (2004) state that co-operation between social and natural scientists has mainly helped to generate new questions. This confirms experiences of social science supervisors who often pointed out important socio-economic aspects of the work the researchers were involved in. For example, social science researchers suggested one researcher for trying to understand how local farmers adapted their farming systems in order to successfully, it seems, cope with the historical population increase and the reduction of the fallow period. Similarly, another researcher was urged to establish the history of the emergence of pernicious weeds in the farming systems as a result of the relatively recent need to use land continuously. Social scientists have insisted that explorations of the context cannot only provide credible dissertation chapters but also essential insights. For example, a good insight into the experience with organic cotton in Benin can help in making important choices with respect to the nature of the experimental IPM work by Sinzogan.

At the start of the CoS project it was agreed that innovation has social, institutional, economical, technical and political dimensions. Innovations can include procedures, forms of organization, new ways of interacting, and institutions (in the sense of sets of rules), as well as technologies. A comparison of the diagnostic studies on this point leads to the inevitable conclusion that most of the contracts with farmers focus on technical change. However, in a number of cases this technical change was pursued through socio-economic changes. For example, Dormon's work on setting up a system of neem input delivery will help farmers to implement IPM in cocoa. Negotiations between owners and caretakers envisioned by Ayenor would simplify pruning and weeding of cocoa to combat Black Pod disease. Increasing the security of tenure arrangements between native and immigrant farmers through the work of Adjei-Nsiah in Ghana and Saïdou in Benin could substantially improve soil fertility and the sustainability of farming.

Concluding remarks. Have the diagnostic studies made a difference?

We conclude this paper by examining item no. 6 discussed in the chapter on 'the

comparative framework'. T.W. Kuyper (personal communication) made the following inventory of the pre-analytical choices that the CoS project made, before the diagnostic studies were even started:

1. Science (carried out differently) matters to African farmers.
2. This science needs to include both social and natural science.
3. This science needs to include both 'southern' and 'northern' scientists.
4. Each individual investigation needs both the social and natural sciences.
5. Problems that have often been mentioned with respect to farming in Africa are genuine problems (weeds, pests, soil fertility, etc.).
6. Pest problems can be tackled by entomologists (and therefore virologists are not included in the project) and soil fertility problems by soil biologists (and therefore soil chemists or plant nutrition scientists are not involved).
7. It is possible to understand local problems by taking a local view (the *a priori* choice to leave out economics and political science).
8. Farmers are considered as a homogeneous group with regard to issues such as migration and land tenure.
9. An individual scientist with a background in one domain and some knowledge in the other, supported by scientists from north and south and from social and natural sciences, can usefully tackle the issue under investigation.
10. Problems in the domain of the social sciences are social also in the sense that their solution depends on collective learning and experimentation.

To this impressive list, we can add (11) the choices made through the technographic studies with respect to crops and related domains, as we mentioned earlier.

Given these choices before the diagnostic studies were carried out, what difference have the diagnostic studies made? Were they worth the effort? Have they substantially changed the earlier intentions of the researchers as laid down in their research proposals? Have the diagnostic studies led to systematic and explicit pre-analytical choices in negotiation with farmers? In response to these questions, we would like to make the following points:

1. The comparison revealed that diagnostic studies identified and established forums of stakeholders, especially farmers, academic supervisors, scientists from national research institutes, local administrators and national rulers, who were engaged in learning from a concrete experimental activity. The outcome of research will emerge from the interaction within this community and is not the end-of-pipe product of a linear science-driven process. So far, establishing such communities has not often been part of the scientific research methodologies repertoire taught in universities or used in assessing the quality of scientific contributions.
2. The diagnostic studies gave farmers their say in the design and conduct of agricultural research. It stands to reason that this allowed them to bend its outcomes in the direction of producing innovation that works in their circumstances and that satisfies their needs and priorities. So the diagnostic studies led to a situation in which researchers had to make a deliberate trade-off between the interests of farmers and their own interests in obtaining a doctorate. It is to be hoped that academic criteria for excellence will include the extent to which farmers were given a say. Research needs to be grounded in the needs of intended beneficiaries as much as

in the scientific discourse and the traditions for constructing scientific 'facts'.

3. The diagnostic studies have led to transparent choices with respect to the selection of sites, farmers and, in a number of cases, to the inclusion of more experiments than envisioned at first, in one case even to a complete revision of the original research proposal.
4. The diagnostic studies created the conditions for negotiation that sometimes led to adaptation of the research to farmers' knowledge (e.g. including experimentation with cassava as a soil fertility enhancing crop), and sometimes to convincing farmers (e.g. the importance of capsids in affecting cocoa yields). In a number of cases, the diagnostic studies confirmed the original choices made by the researcher (e.g. the importance of weeds as an emergent problem seriously affecting farmers' livelihoods).
5. The diagnostic studies played a crucial role in all research projects in establishing the importance of the context for the relevance of the project. In fact, it has become clear that in the dynamic situation in West Africa, a researcher cannot afford to consider the diagnostic phase closed.

In conclusion, we would like to make a few suggestions for further questions for analysis of the diagnostic studies that we have neglected in this article. One important question that needs to be answered relates to the cost in time and money involved in carrying out the diagnostic studies. What does the inclusion of a diagnostic study imply for the budget and time allocation of agricultural research? A second question, which can only be answered once the experimental studies have been completed, is: Does the establishment of a community of stakeholders that learns from a shared concrete experimental activity lead to outcomes that are scientifically acceptable in the traditional sense of the word? And what is gained in terms of the relevance and appropriateness of the research outcome? A further question is how researchers re-define their roles if the aim is to benefit resource-poor farmers? A final question that interests us a great deal is whether the intensive learning experience of the farmers who were engaged in the research projects leads to their empowerment, and whether it is possible to share this experience with other farmers.

Finally, this comparative analysis of the CoS diagnostic studies research process hopefully has allowed to critically reflect on the importance of diagnostic studies for enhancing usefulness of agricultural research for farmer's livelihoods. Diagnostic studies seem critically important for adequately making pre-analytical choices that shape the design of agricultural research, but as this study has shown, many factors impinge on the quality of diagnostic studies.

Acknowledgements

First of all we would like to acknowledge the eight researchers – Samuel Adjei-Nsiah, Godwin Ayenor, Emmanuel Dormon, Comfort Kudadjie, Aliou Saïdou, Antonio Sinzogan, Pierre Vissoh and Afio Zannou – and their supervisors, who devoted their precious time to interviews and group discussions during student meetings, and gave us an inside view of their research work. They also commented on an earlier version

of this article. At the time the study was carried out, the senior author was employed by the Food and Agriculture Organization (FAO) through the Dutch Ministry for Development Co-operation (DGIS) and we would like to thank these institutions for their support. We are also grateful to Prof. N.G. Röling, Dr A. Van Huis, Dr M. Owens and Dr T.W. Kuyper for their critical comments on an earlier version of this paper.

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