NATURAL RESOURCES SYSTEMS PROGRAMME

FINAL TECHNICAL REPORT

DFID Project Number

R 7515

Project title

Knowledge Dissemination Domains in the Forest Agriculture Interface

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NRSP Production System

Forest Agriculture Interface

Date

28-02-02

R7515 - Knowledge Dissemination Domains in the Forest Agriculture Interface

Final Technical Report

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1. Executive Summary

This two-year project sought to address the gap between technology development and adoption in the FAI. Specifically, the project used the case of soil fertility management, and natural resource management more broadly, in southern Ghana to explore both new conceptual frameworks and practical tools to help researchers and research managers more effectively address the interests and needs of farmers. The innovative conceptual framework focused on relevant characteristics of proposed technologies and potential technology users. This framework then served as the base for a Access-based decision support system (called 'Interface') which allows *ex ante* assessment of the policy relevant impact of alternative technology development options. The framework and decision support system were explored in detail at a workshop in Ghana toward the end of the project. Both were received with considerable interest. Tentative plans for a follow-on phase which would validate the new 'knowledge-engineering' approach to market segmentation were developed, but NRSP decided not to continue this line of research

2. Background

R7515, 'Knowledge Dissemination Domains in the FAI', originated as a response to a call for concept notes issued by NRSP in the autumn of 1999. Thus, the 'demand' for the project was embodied in the call itself, with NRSP being the organisation defining that demand. In responding to the call and in subsequently developing the RD1, the project team did not attempt to independently determine if there was any demand for the project outside NRSP. The call highlighted the fact that despite 'a lot' of previous work on the development, testing and evaluation of soil fertility management practices for the FAI, including testing with farmers on their own fields, 'adoption has been limited'. Thus, the call concluded that there was a 'knowledge gap between technology design and dissemination'. The implication was that the soil fertility management techniques which had been developed did not 'work' (either technically and/or economically and/or in relation to the potential users' interests and capabilities). Thus, this 'knowledge gap' was limiting the positive contribution that future investments in research could make to sustainable livelihoods in the FAI.

The idea that agriculture and natural resource management research had delivered relatively few concrete benefits to (particularly poor) farmers in the region was certainly not new; nor was the proposition that the links between problem identification, technology development and dissemination were inadequate. Indeed, over the previous three decades a number of steps were taken within the agriculture research and development community to try to address these very concerns. For example, both farming systems research and farmer participatory research tried to integrate end-users more effectively in various stages of research and dissemination processes. In terms of targeting, the farming systems research sought to address the gap in part through the notion of the 'recommendation domain'. In practice a recommendation domain was usually based on simple combinations of agro-ecological and socio-economic variables, and was meant to identify the most appropriate target groups (the domain) for particular, usually already existing, technology packages (the recommendations). The variables used to identify these domains were often quite rough-and-ready: in sub-humid and semi-arid West Africa, for example, it was not uncommon that the only socio-economic variable used to group farmers was the level of their use of animal traction, which yielded domains such as 'non-mechanised', 'semi-mechanised' and 'fully mechanised'. The thrust of much farmer participatory research was better problem identification, and greater farmer involvement in the evaluation of technical alternatives.

Neither farming systems nor farmer participatory research grappled effectively with the fact that many poor farmers in the developing world combine crop and/or livestock production with a complex suite of other natural resource based and off-farm (rural and urban) economic activities. These high levels of income and livelihood diversity have been highlighted by authors such as Ellis (2000) and Bryceson (2000). The implication of this diversity, which has not yet been fully grasped by policy makers or agricultural research and extension, is that to conceive of the rural population primarily as 'farmers' can be a fundamental error (see Tripp 2001). Rather, high levels of diversification, where agriculture and natural resource activities may account for less than 50% of household income, will likely have major implications for individual and group decisions about technology choice and investment patterns. Thus, the apparent lack of uptake, which was at the heart of the original NRSP call, cannot be seen as independent of this link between diversification and technology choice. In other words, the 'knowledge gap' was, probably in some considerable way, related to the complexity and diversity of livelihoods in the West Africa FAI.

In focusing on the apparent lack of uptake of research results addressing 'soil fertility management techniques', the call embodied two assumptions: (1) that at a bio-physical level present soil fertility management practices were significantly constraining the productivity and sustainability of agricultural systems in the FAI, and (2) that the goal of increasing the productivity of these systems was compatible with both the perceptions and the broader livelihood aspirations of FAI residents. It is fair to say that implicitly, if not expectedly, the first of these assumptions has been central to many analyses of the dynamics of agricultural systems in the West Africa FAI. This assumption is rooted in a concern with the sustainability of bush fallow systems, particularly in the face of increased population pressure and shorter fallow periods, and a sense that crop yields were relatively low (and declining). The concern over soil nutrient management in the FAI that is evident in NRSP documentation (the Call made reference to two soils-related workshops: 14-16 Sept 1997, Reading, UK, NRSP-funded; April 1998, Bhopal, India, ICAR-funded, that clearly influenced the NRSP agenda) echoes many other analyses. However, as indicated above, the second assumption is potentially quite problematic, particularly related to the conception of rural residents 'primarily' as farmers.

Thus, the apparent gap between the production and use of research results relating to soil nutrient management – the 'knowledge gap' – could be explained by one or more of the following:

1. FAI residents do not perceive soil fertility as an important issue;
2. The proposed, 'improved' soil nutrient management techniques do not consistently deliver observable benefits to a degree sufficient to attract the interest of large numbers of users;
3. The proposed, 'improved' soil nutrient management techniques are not economically attractive;
4. The proposed, 'improved' soil nutrient management techniques are not compatible with other economic activities or with broader livelihood strategies;
5. Pathways for the dissemination of the 'improved' soil nutrient management techniques are not sufficiently functional.

In addition to R7515, NRSP commissioned two other projects to help address the various possible elements of this 'knowledge gap':

- R7560 ('Review of technologies being evaluated for the FAI') essentially sought to address points (1), (2), (3) and (4) above. 'The purpose of the project was to step back and make a thorough evaluation of the various techniques proposed as ways of ameliorating the decline in productivity in the shifting cultivation systems in the FAI' (R7560 FTR). Specifically the project set out to provide an enhanced understanding of

the biophysical and socio-economic conditions required for success of techniques for stabilisation of the soil and vegetation resources of the FAI. This enhanced understanding was to be derived from 'a detailed analysis of the ability of the techniques to address the constraints to increased production of soil fertility and weed encroachment, as well as socio-economic constraints to their adoption by farmers'.

- R7516 ('Bridging the gap between soils research and dissemination in Ghana') essentially sought to address point (5) above. The purpose of the project was 'to develop effective dissemination strategies for soils research outputs in Ghana in order to produce higher adoption rates for soils technologies through the provision of methodological guidelines for inclusion of explicit consideration of dissemination when research is being planned' (R7516 FTR). This purpose was to be achieved through three outputs: (a) an understanding of the reasons for low adoption of soil fertility management technologies in the forest and transition zones of Ghana, (b) a suite of tools for linking agricultural research and dissemination to rural livelihoods, and (c) a generic framework and a specific framework adapted to Ghana suggesting how the tools can be implemented.

Both R7560 and R7516 involved some field work in Ghana (R7560 was concerned with Ghana, Nepal Brazil and Bolivia, and field visits were also made to Nepal).

The call which eventually resulted in the commissioning of R7515 sought 'conceptual and methodological approaches to relating the characteristics of technologies to factors within the adoption environment'. The call suggested that 'this is an analytical exercise that might involve aspects of modelling, the use of primary and secondary data, agro-ecological data etc., has both methodological and conceptual elements, and requires an understanding of agro-ecological and livelihood sustainability'. Further the call specified that 'the outputs…should force researchers to think strategically about technical options before even beginning to work on these in specific locations and with specific categories of clients. It should also lead to more strategic thinking about the meaning of the systems themselves, within a livelihoods and poverty framework.'

It was clear that there would likely be some overlap between the proposed outputs of R7515 (as indicated in the call) and outputs (b) and (c) of R7516.

Thus, in response to the call the research team proposed a piece of research that would have strong conceptual and methodological elements and that would involve no field work.

The R7515 project team consisted of Dr James Sumberg (Principle Investigator, 2 months input), Dr David Reece (Senior research Associate, 24 months input), Mr Ludovic Pommier (Occasional Research Assistant) and Dr Anthony Wilson (Occasional Research Assistant).

3. Project Purpose

As stated in the project logframe, the purpose of R7615 was to 'decrease the knowledge gap between technology design and dissemination to assure greater impact of research outputs'. This Purpose was to support the larger Goal of 'livelihood security of poor farmers in FAI increased through improved soil nutrient management techniques'. The project Purpose is linked to the Goal by the logic discussed above, that (1) at a bio-physical level soil fertility was significantly constraining the productivity of agricultural systems in the FAI, and (2) that the goal of increasing the productivity of these systems was compatible with both the perceptions and the broader livelihood aspirations of FAI residents.

A conceptual project, R7515 was based on the assumption that (1) those new technologies that had not been taken up by the people of the FAI were in some sense inappropriate for the circumstances under which they lived and worked, and (2) this situation arose because the researchers who had developed such technologies lacked an adequate appreciation of the full circumstances of the intended beneficiaries of their work. In other words, in proposing R7515 the project team discounted the idea that limited use of 'improved' soil nutrient management techniques was due to problems with the dissemination pathways.

The object of this project, then, was to enable researchers engaged in technology development for the FAI to appreciate key aspects of the circumstances of the intended beneficiaries (or end-users) of their work. This was to be achieved by developing a conceptual framework and a related methodology that would highlight those aspects of a proposed new technology that would make it suitable (or unsuitable) for use by the majority of members of specific social groups within the FAI.

4. Outputs

As indicated in the logframe the project had two main Outputs:

1. 'A state-of-the-art review and synthesis of conceptual issues and practical methods relating to the assessment of the factors that affect the use of innovations by anticipated end-users'.

2. 'An innovative analytical framework and methodology for identifying the nature and characteristics of the 'knowledge dissemination domain' of proposed FAI research outputs'.

The project team considers that both outputs were achieved (although further field verification of the method proposed as part of Output 2 was recommended by the team).

Output 1

This output[1] reviewed changing understandings of the relationship between the processes and products of innovation and the individuals and groups that eventually make use of these innovations, considering in turn the literature from both agriculture and industry. Key points emerging from the industrial and commercial literature were:

- The process of innovation within firms is seen as one of continuous interactive learning, both from internal and external sources.
- Innovation is an inherently uncertain process, with only a small proportion of development projects being successful in commercial terms. In a situation where the prospective users of technological innovation have a choice, a high degree of failure may be inevitable, with success depending upon 'understanding user needs'.
- Obtaining such understanding generally involves developing effective methods of assessing innovations vis-à-vis particular groups of potential end-users. Such methods range from empathic design (based on a deep understanding of the client group), through a variety of market research approaches, to various forms of user involvement. Under certain circumstances, then, client participation can be vital, but when the developers of the innovation are already well-informed about the user environment, user involvement does not seem to be necessary.
- User involvement is not simple: the selection of the type of user to be involved raises a number of issues, since most innovations are intended for a heterogenous user

[1] Reece, D. and J. Sumberg. 2000 (October). 'Research, Technology and Changing Practice: A Review of Experience in Agriculture and Industry.' Project report.

population.
- The diversity of potential users is handled by market segmentation – defining groups of users, each of which is sufficiently homogenous to be treated as a single market, making it possible to 'tailor' technologies and products to the needs of each segment.

The report then considered the sources of innovations for agriculture, noting that while industry itself is seen as being responsible for generating the bulk of the innovations that it requires, within agriculture this task has traditionally been seen as the responsibility of (usually public sector) research institutes. This view has been challenged, however, with some authors pointing out that there are 'multiple sources' of innovations, and that farmers actively test and adapt new technologies that become available to them and innovate within the limits of their technical capacity.

The report presents three stylised models of agricultural research: the 'abundant resource' model (associated with the 'Green Revolution') is seen as inappropriate for areas of low-resource agriculture (such as the FAI) because of its focus upon maximising yield under near-optimal conditions; socio-technical models (the tradition of Farming Systems Research) which make possible a clearer focus on the potential users of the technology but proved unable to respond adequately to the diversity of low-resource agriculture; and User-centred models, which see farmers (like firms in the industrial case) as contributing actively to the process of innovation as well as using new technology. It notes, however, that the vast majority of farmers in the developing world have neither the resources nor the capabilities to undertake significant technology development, but will continue to rely upon a limited number of public-sector research institutes. As in the industrial case, such research institutes will require strong links with (at least some) of their prospective clients so that research activities may be informed by an appreciation of users' needs.

The very large number of farmers who are clients of any given research station means that it is impossible for research to respond to the requirements of any individual farmer. Instead, standard solutions to the problems faced by large numbers of farmers must be sought, although there may well be scope for farmers themselves to modify such standard solutions to fit their own particular circumstances. Such 'customisation' by farmers themselves takes on an increasing importance when research seeks to serve the highly diverse areas of low-resource agriculture, containing as they do a large number of very small market segments.

Output 2

The first part of Output 2 (the 'innovative analytical framework') was presented first as a report [2] and subsequently an article for publication.[3] Both consider the processes involved in the development of new agricultural technology by building upon the understanding that both resource-poor farmers and the formal research system have important but different parts to play and argues that the contribution of each may be optimised if the task of developing new technology is passed on to farmers *at the earliest stage at which doing so is feasible*. They suggest ways in which this stage may be identified, and then develop a conceptual framework for identifying the people who are likely to be able to make use of the knowledge about a new technology that will be generated by a 'formal' research project. This framework may be applied at an early stage of each project in order to direct research resources away from those projects that are unlikely to generate technologies that would help an acceptable number of people.

[2] Reece, D. and J. Sumberg. 2001 (March).'Toward A Definition of Knowledge Dissemination Domain'. Project report.

[3] Reece, D. and J. Sumberg. 2002. 'More clients, less resources: toward a new conceptual framework for agricultural research in marginal areas'. *Technovation* (in press) (Annex 1).

The key elements of this framework are:

Technology (including Benefits & Required Resources): Represents *knowledge* about how to do things... And at a more practical level, can be viewed as a bundle of 'benefits' accruing to whoever uses it, and 'resources' that are required for its use.

Solution Space (i.e. Management Range): Refers to the 'area' around an optimal set of operator-influenced conditions within which a technology will still yield 'positive' results. In other words, Solution Space refers to all combinations of values of operator-influenced, critical management variables that deliver positive results when a particular technology is used within a given environment.

Environmental Range: Refers to the range in key bio-physical characteristics within which a particular technology will still yield 'positive' results. Key bio-physical characteristics might include rainfall, soil type, temperature, and the range can be described in terms of acceptable upper and lower limits.

Social Groups (Interests & Capabilities): Refers to a notional population of individuals defined by a unique combination of values for a limited number of key socio-economic variables including wealth, age, gender and residency status. For example, Poor, Older Men who are Strangers would be regarded as constituting a social group.

Market Segments: Refers to a group of people with some similar characteristics which means that they are likely to respond in a similar fashion to changes in the characteristics of products (i.e. technology), while the members of other segments are likely to respond differently.

Farming Precision: Refers to farmers' ability to implement their decisions or plans; which is a product of their ability to exert effective control over key aspects of the farming system. Farming systems where farmers exercise relatively little control are *low precision* systems, and those where they exercise more control are *high precision* systems.

Agricultural Logic: Refers to the kind of development (or resource use) trajectory with which a technology (or a geographical area) is associated, and can be described in terms such as intensification or extensification. According to Snetch, Agricultural Logic is a function of both human population density and access to markets.

Policy Relevant Impact: Refers to the impact of a new technology on those social groups that are of particular policy interest (e.g. the poor, women etc). a crude estimate of Policy Relevant Impact is simply the number of individuals belonging to targeted social groups who are likely to use a particular new technology.

The second part of Output 2 (the 'methodology') built on the conceptual framework outlined above as it provided a basis for the development of an approach to 'matching' the interests/capabilities of individuals and the characteristics of proposed technologies.

The methodology took the form of an Access-based decision support system called 'Interface'. Interface was designed to enable researchers and research managers to optimise the policy-relevant impact of the agricultural and natural resource research for which they are responsible. It does so by providing information to guide decisions as to which proposed new technologies are worth developing (although it is applicable only to new technologies that represent an incremental improvement upon those currently in use). While it was developed in order to appraise technologies for use in the FAI, the software is not limited to this zone and can forecast the likely policy relevant impact of new technologies upon any part of Ghana. Interface holds expert knowledge about the rural population of Ghana, knowledge that is obtained by working with one or more expert

panels. This knowledge concerns (1) the capacity of different people to gain access to the various resources that may be needed to use a new technology; (2) their interest in the benefits that accrue to the users of various technologies. Interface uses all the information that it holds, together with a description of a proposed new technology, in order to identify the groups within the rural Ghanaian population that are likely to make use of the technology that has been described. This analysis is presented using several media (simple displays, reports or maps).

The most innovative aspect of Interface is the use of 'Expert Panels' to establish relationships between a person's position within society, and the 'generic' characteristics of agricultural technologies that are likely to be suitable or unsuitable for that person to use. These relationships are then used to identify market segments, groups of people who are likely to be interested in a similar set of benefits associated with technology use, and are likely to have access to a common set of resources required by a technology. We termed this a 'knowledge engineering' approach to market segmentation. This method replaces the 'data-mining' approach of conventional marketing with a form of 'knowledge-mining', and relies upon the quality of the judgements made by a panel of experts rather than the statistical data that is usually used to segment markets.

Although it was anticipated in the RD1 that the analytical framework and methodology would be tested using secondary data, the project team found that the relevant characteristics of new technologies and of their anticipated users (including those that had been developed through NRSP-financed research) were not adequately documented, making such testing impossible unless extensive collection of primary data was first undertaken. Unfortunately The FAI technology database which was an output of R7560 was of little use in this regard. Nevertheless, during the Ghana workshop a number of technologies were described by the participants and entered into Interface; Interface indicated that these candidate technologies would be expected to have widely different levels of policy relevant impact.

The methodology as operationalised through Interface does enable users to define groups of people who are likely to respond in a similar fashion to a range of new technologies ('market segments'). However, the knowledge engineering approach to market segmentation needs to be verified using simple market research methods, before the methodology can be disseminated to the institutions most likely to benefit from using it. A proposal to undertake such testing was submitted to NRSP as part of the Ghana workshop report, but it was subsequently declined.

5. Research Activities

The project logframe indicated four research Activities:

1. Review and synthesise concepts, methods and experience relating to various approaches to the assessment of innovations vis-à-vis particular groups of potential end-users.

2. Elaborate the concept of the 'knowledge dissemination domain', including accessible ways of describing and representing the nature and characteristics of knowledge dissemination domains.

3. Develop an analytical framework and a working methodology, incorporating agro-ecological, livelihood and economic factors, for characterising the knowledge dissemination domain of potential research outputs (information, knowledge and/or technologies) in relation to a specified geographical areas of target group.

4. Present the outputs of this research to researchers and research managers concerned with natural resource management in the FAI at a workshop in Ghana.

Activity 1 (contributing to Output 1)

This was essentially an initial literature review.[4] It was completed on time and circulated for comment. Dr Adam Pain was contracted to provide detailed comments on the report. This review provided the substantive base for Activity 2.[5]

Activity 2 (contributing to Output 2)

This activity built directly on Activity 1 and resulted in a report[6] that became the basis of the *Technovation* article. It was completed on time. The activity essentially entailed the definition of a series of new concepts and conceptual relationships.

Activity 3 (contributing to Output 2)

Building on the concepts developed in Activity 2, this activity entailed the development of an Access-based, GIS enabled decision support system, and was completed on time. Mr Ludoovic Pommier was contracted to develop the software. Other assistance was provided by Dr Anthony Wilson.

A test of the Expert Panel methodology was organised in which Dr Paul Francis, Mr James Agyisi and Dr Christine Okali, all of the UEA School of Development Studies, participated.[7]

Activity 4 (contributing to Output 2)

This activity was originally planned to include two workshops, one in Ghana and one in the UK. On 5-6 December 2001, the Ghana workshop was held at CGIG in Kumasi. The workshop was opened by the CRI Deputy Director, Dr J. N. Asafu-Agyei, who, although not able to participate in all the sessions, showed considerable interest in the work. There were 15 participants from CRI, FORIG, CRIG, UST and Sunyani Polytechnic. A detailed documentation pack[8] was provided to each participant, as was a CD of the Interface decision support system.

During the workshop participants were introduced to key concepts, engaged in Expert Panel and technology description exercises, and were introduced to the Interface software.

[4] Reece, D. and J. Sumberg. 2000 (October). 'Research, Technology and Changing Practice: A Review of Experience in Agriculture and Industry.' Project report.

[5] Pain, A. 2000 (November). 'Review of: Research, Technology and Changing Practice: A Review of Experience in Agriculture and Industry. Project report.

[6] Reece, D. and J. Sumberg. 2001 (March).'Toward A Definition of Knowledge Dissemination Domain'. Project report.

[7] Reece, D. 2001 (June). 'Knowledge Dissemination Domains in the FAI (R7515), Report on first expert Panel Workshop'. Project report.

[8] Reece, D. , J. Sumberg and L. Pommier. 2001 (December). 'People & Technology: A workshop on increasing the impact of natural resource management research'. Pre-workshop documentation pack'

Immediately following the workshop a workshop report was prepared and submitted to NRSP.[9] This report contained a detailed (and highly positive) workshop evaluation and a draft plan for a 12 month follow on period to field test the proposed market segmentation methods.

A second workshop had originally been planned for researchers and research managers in the UK, but the NRSP office indicated it would not be appropriate to hold this workshop.

6. Contribution of Outputs

The Goal of the NRSP is 'to generate benefits for poor people by the application of new knowledge to natural resource (NR) systems'. The programme's website indicates that 'this will be achieved through delivering new knowledge that can enable poor people who are largely dependent on the NR base to improve their livelihoods. The central focus of knowledge generation is on changes in the management of the NR base that can enhance the livelihood assets of the poor over a relatively long timeframe, thus providing greater livelihood security and opportunities for advancement of poor individuals, households or communities.'

Within the revised FAI logframe, R7515 fits within Activity 1.2: 'Livelihood security increased through improved land use strategies' (at the time the project was commissioned this read: 'Livelihood security increased through improved crop, livestock and agroforestry interactions); and Sub-Activity 1.2.3, 'Improved soil management techniques assessed and dissemination issues identified (at the time of the project was commissioned this read: 'Improved soil nutrient management techniques developed').

Within this context R7515 sought to 'decrease the knowledge gap between technology design and dissemination to assure greater impact of research outputs'. The logic was that reducing the gap between technology design and dissemination would result in greater uptake of improved soil management techniques, which would in turn impact positively on livelihood security.

R7515 produced a new and innovative framework for conceptualising the relationship between a technology and the group of potential end users. This conceptual framework is general in the sense that its relevance is not limited either to technologies for soil nutrient management, or to the Ghana FAI. As evidenced by the report of the Mid-Term Review, the general applicability of the framework may have been the cause of a certain level of misunderstanding as to whether or not the project was straying from its original objectives. In any case the framework was then used to structure a decision support system with the objective of assessing the potential uptake (in terms of numbers of particular groups of people) of proposed natural resource management technologies. The decision support system represents the project's concrete contribution to closing the gap between research and farmer uptake. With further development the decision support system has the potential to make natural resource management research in the FAI (and beyond) more effective and more efficient. Given that many rural poor people are still largely reliant on natural resources, it is logical that anything that helps target research and to make it more effective and efficient also has the potential to have a positive impact on poor people.

The project logframe identified one OVI at purpose level: 'improved uptake of FAI research outputs', which was to be verified through 'review of FAI Research Reports and commissioned reviews'. Two assumptions were associated with this OVI: (1) the NRSP logframe successfully identifies and addresses key issues for poor FAI producers; and (2)

[9] Reece, D. J. Sumberg and L. Pommier. 2001 (December). 'People and Technology: A workshop on increasing the impact of natural resources research'. Workshop report. (Annex 4).

FAI research reports and commissioned reviews have sufficient detail to detect uptake patterns. In relation to assumption (1) is was interesting to note that few of the participants at the project's Ghana workshop considered soil fertility to be a major issue in the FAI.

We are aware of no evidence that R7515 has improved uptake of FAI research results. In any case, it would only be reasonable to expect this kind of impact in the years following the project. Immediately following the Ghana workshop the project team proposed an additional one-year programme aimed at field testing key aspects of the project's outputs (i.e. the identification of market segments using an Expert Panel) so that they could then be widely disseminated with confidence (see Annex 4). This proposal was not acceptable to NRSP; the programme made a decision not to pursue this line of research. Given this yet unverified element of the method, no further promotion or dissemination can be recommended at this time.

On the other hand, peer-reviewed publications from the project (one in press, one under review, one in preparation; Annex 1 and 2) have the potential to impact on thinking and policy around the question of research targeting. But again, the extent of any such impact could only be judged at a point in the future. On the other hand, the project team has already incorporated key ideas from the project's outputs into other work relevant to agriculture and natural resource management in the West Africa FAI.[10]

7. Publications and other communication materials

7.2.2 Journal articles pending publication

Reece, D. and J. Sumberg. 2002. 'More clients, less resources: toward a new conceptual framework for agricultural research in marginal areas'. *Technovation* (in press)

7.2.3 Journal drafted

Reece, D., J. Sumberg and L. Pommier. 2002. 'Using market segmentation to increase the impact of agricultural technology development: methodological considerations'. Manuscript submitted to *Agricultural Systems*. (Annex 2).

Reece, D. J. Sumberg and L. Pommier. 2002 (February). 'Matching Natural Resource Management Technologies with Potential End Users: A Knowledge Engineering Approach'. Unpublished manuscript. (Annex 3).

7.4 Symposium, conference, workshop papers and posters

Reece, D. and J. Sumberg. 2000 (December) 'Knowledge Dissemination Domains at the Forest Agriculture Interface (R7515)'. Project poster. Presented at the international conference 'Global Agriculture 2020: Which Way Forward?' at the John Innes Centre, Norwich, 18-20 April, 2001.

7.10.2 Internal project technical reports

Pain, A. 2000 (November). 'Review of: Research, Technology and Changing Practice: A Review of Experience in Agriculture and Industry. Project report.

[10] e.g. Sumberg, J. 2002. "The logic of fodder legumes in Africa", manuscript under review by *Food Policy*; Sumberg, J. 2002. "Toward a dis-aggregated analysis of crop-livestock integration in West Africa", manuscript under review by *Agriculture, Ecosystems and Environment*; Sumberg, J., C. Okali and D. Reece. 2002. "Agricultural research in the face of diversity, local knowledge and the participation imperative: theoretical considerations", unpublished manuscript.

Reece, D. and J. Sumberg. 2001 (March).'Toward A Definition of Knowledge Dissemination Domain'. Project report.

Reece, D. and J. Sumberg, 2001 (May). 'Knowledge Dissemination Domains at the Forest Agriculture Interface (R7515), mid-term review presentation'. Project presentation.

Reece, D. 2001 (June). 'Knowledge Dissemination Domains in the FAI (R7515), Report on first expert Panel Workshop'. Project report.

Reece, D. and J. Sumberg**.** 2001 (November). **'**Knowledge Dissemination Domains at the Forest Agriculture Interface (R7515), a presentation to NRSP'. Project presentation.

Reece, D. , J. Sumberg and L. Pommier. 2001 (December). 'People & Technology: A workshop on increasing the impact of natural resource management research'. Pre-workshop documentation'

Reece, D. J. Sumberg and L. Pommier. 2001 (December). 'People and Technology: A workshop on increasing the impact of natural resources research'. Workshop report.

7.10.3 Literature reviews

Reece, D. and J. Sumberg. 2000 (October). 'Research, Technology and Changing Practice: A Review of Experience in Agriculture and Industry.' Project report.

7.10.5 Datasets, software applications

Interface, Version 1.0 (see accompanying CD)

8. References cited in the report

Bryceson, D. F. 2000. "African rural labour, income diversification and livelihood approaches: a long-term development perspective". *Review of African Political Economy* 80: 171-189.

Ellis, F. 2000. "*Rural Livelihoods and Diversity in Developing Countries*". Oxford University Press, Oxford.

Tripp, R. 2001. "Agricultural Technology Policies for Rural Development". *Development Policy Review* 19 (4) 479-489.

9. Project logframe

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
Goal Livelihood security of poor farmers in FAI increased through improved soil nutrient management techniques	As given in the revised NRSP FAI logframe.	[Given the nature of the project no attempt will be made to measure these Goal-level indicators]	Soil nutrient management represents a key livelihood constraint for poor farmers in FAI
Purpose Decrease the knowledge gap between technology design and dissemination to assure greater impact of research outputs.	Improved uptake of FAI research outputs	Review of FAI Research Reports and commissioned reviews.	NRSP logframe successfully identifies and addresses key issues for poor FAI producers FAI Research Reports and commissioned reviews have sufficient detail to detect uptake patterns
Outputs 1. **A state-of-the-art review and synthesis** of conceptual issues and practical methods relating to the assessment the factors affecting the potential use of innovations by end-users. [See Activity 1]	1. Review disseminated by Month 8	Project Research Report	There exists sufficient and conceptual background and experience in NR and non-NR related fields to build upon
2. **An innovative analytical framework and tested methodology** for identifying the nature and characteristics of the 'knowledge dissemination domain' of proposed FAI research outputs. [See Activities 2-4]	2. Framework and methodology tested by Month 20	Project Research Report	The framework and methodology are actually integrated into the research planning and evaluation process

Project logframe (continued)

Narrative Summary	Measurable Indicators	Means of Verification	Important Assumptions
Activities	**Milestones**		
1. Review and synthesise concepts, methods and experience.	1. Review completed by Month 8	Project research report & journal papers	Appropriate Research Associate identified and employed on time.
2. Elaborate the concept of the 'knowledge dissemination domain'.	2. Concept elaborated by Month 12	Project progress reports	The initial analysis and concept of the knowledge dissemination domain is sound
3. Develop an analytical framework and a working methodology.	3. Framework and methodology developed by Month 16	Project progress reports	Research team is capable to developing a usable framework & methodology
4. Use examples of outputs from previous FAI research to test and modify as necessary the analytical framework and methodology.	4. Framework and methodology tested and modified by Month 20	Project research report & journal papers	Active participation of FAI researchers
5. Present the outputs of this research to researchers and research managers	5. Workshops held by Month 22 **Budget Summary:** Activity — Cost (£) 1. — 28,617 2. — 22,451 3. — 18,285 4. — 22,451 5. — 21,750 **Total — 113,554**	Project workshop report	Active participation of FAI researchers and research managers at workshop

10. Keywords

Adoption, priority setting, Ghana, technology

11. Annexes

1. Reece, D. and Sumberg, J. 2002. 'More clients, less resources: Toward a new conceptual framework for agricultural research in marginal areas'. *Technovation* (in press)

2. Reece, D., Sumberg, J., and Pommier, L. 2002. 'Using market segmentation to increase the impact of agricultural technology development: Methodological considerations'. Manuscript submitted to *Agricultural Systems*.

3. Reece, D., Sumberg, J., and Pommier, L. 2002 (February). 'Matching natural resource management technologies with potential end users: A knowledge engineering approach'. Unpublished manuscript.

4. Reece, D., Sumberg, J., and Pommier, L. 2001 (December). 'People and Technology: A workshop on increasing the impact of natural resources research'. Workshop report.

5. Final project inventory sheet

Accompanying CD containing final version of the 'Interface' decision support system.