A review of evidence, agreements, concepts and tools relating to participatory agricultural research

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Report Summary

This is a rapid desk based study to identify an overview of evidence, agreements, concepts and tools relating to participatory agricultural research. The review was undertaken using both peer reviewed and grey literature from the major development agencies (both multilateral and national), national and international research institutes and think tanks, and regional and subregional research organisations.

Reliable data are required to plan development interventions; the cost and potential irrelevance of questionnaire based surveys has created a momentum towards cheaper, more flexible survey methods – loosely classified as 'participatory'. These aim to be quick, accurate, and relatively cheap methods of collection of relevant information at a local scale. The scientists and researchers work as partners rather than experts.

A review at attempts at developing formal methods of creating typologies was undertaken. Generally it was found that these were complex, difficult to use, and were too focused on participation as the core objective, rather than being problem orientated. They did not provide guidance for implementation. Participatory research is important as a significant component of the research process but it, just as other approaches, has flaws. A balanced approach (using both conventional and participatory methods) with the balance determined by the problem set is ideal. In addition, there is an absence of discussion with respect to participation with the private sector. If farmers are going to move up the value chain, then those in trade, markets and finance need to be brought into the process as important participants.

To build real farmer involvement into the technology development process, a continuing exercise of discussing and coming to a consensus on options, obtaining routine and informed feedback on results, and exploring new avenues based on field experience is needed. Advances include farmer participatory breeding methods and the 'mother-baby' trial methodology. Almekinders and Hardon, 2006, observe that most participatory plant breeding activities are pilots, utilising different approaches, with little indication about which are most effective and indeed how effectiveness can and should be assessed. The mother-baby methodology, also used in participatory plant breeding, enables scientists to work in a participatory manner over large areas, and with considerable variation in ecology and other factors. Participatory methods have also been successfully employed with measurable outcomes in Integrated Pest Management (IPM) programmes.

Formal methodologies for the engagement of the private sector in participatory research are not well defined. However, since many developing countries have poorly performing mechanisms for the trialling, demonstration, dissemination and uptake of agricultural technologies, private firms and civil society organisations have entered the fields of both technology transfer and development. Often these have been facilitated by CGIAR centres.

There are notable successes in participatory research and these are illustrated throughout the report in a number of examples. The conclusion drawn is that there is no single 'typology' that provides a template for success. There is a strong international consensus that alleviating poverty in the developing world will require the improvement of a broad range of farming systems and that participatory methods are a significant contribution to these efforts. A balanced approach (using both conventional and participatory methods) with the balance determined by the problem set is ideal. An overview of the successes reviewed provides three important elements to creating an effective participatory research framework:

- Intensive interaction with farmers;
- Strong national level technology development and dissemination capacity;
- Strong and effective links to international science; and
- Involvement of private sector actors in the research process

The aim is to create an environment that facilitates integrated scientific and technical initiatives extending from the farmer to the lab and back again. Participatory research is an important tool in the scientist's box, but does not substitute for detailed conventional research investigations. The two exercises are highly complementary. An effective technology development programme will build strength and capacity in both areas.

This study also notes that too few research studies (both conventional and participatory) consider adequately the costs (in labour, cash, and other scarce resources) of change. Controlling costs depends heavily on making best use of the limited resources available to the typical smallholder. Principles for best practice and good engagement include effective networking to spread learning and best practice; creating the environment for change by involving low-income farmers, businesses, and consumers as active participants in the process; and building inclusive teams of specialists so as to create fruitful interaction between academia, government and industry. At the heart of all efforts will be a focus on reliability and efficiency, using the right inputs used in the right way. This creates broad based opportunities for the poor to benefit directly from effective access to the improved seed, fertilisers and other critical inputs that are the foundations of the essential growth in productivity.

SECTION 1

Terms of Reference and approach taken

This report is a rapid desk based study to identify an overview of evidence, agreements, concepts and tools relating to participatory agricultural research. The analysis includes a focus on the following areas:

- Typologies of participation in agriculture research with respect to the use of participation in different types of research, and at different stages in the research process. It also considers various levels of participation.
- An analysis of experience over the past 15 years, with a focus on the current international consensus on the objectives of participation, and best practice. A review of recent and ongoing initiatives is undertaken. The focus has been on efforts that have been effective and the lessons to be learned from these.
- Evidence of impact of participation on research quality and development outcomes. Given the diversity of approaches and the lack of a simple, practical typology, the evidence for impact is developed on a case by case basis, and then general principles derived in the conclusion of the report.
- Principles for best practice and good engagement.

The review was undertaken using both peer reviewed and grey literature from the major development agencies (both multilateral and national), national and international research institutes and think tanks, and regional and subregional research organisations. The Researchgate database was used extensively to acquire recent information and publications. An informal survey of leaders in the field was undertaken, involving senior researchers at European, US, and developing country universities and institutes.

The Researchgate data base was investigated using the search terms ‘participatory research’, ‘adaptive research’, ‘participatory methods’. The websites of the CGIAR Centres were searched – IFPRI, CIMMYT, ICRISAT, and CIAT[1] (using similar search terms) particularly yielded valuable sources. Informal discussions were held via email with Tom Jayne and Sieglinde Snapp of Michigan State University, Ken Giller of Waginengen University, John Dixon of ACIAR[2], Stephen Waddington (CIMMYT retired), John Lynam, Joyce Moock (both Rockefeller Foundation, retired), Howard Elliot (ISNAR[3], retired). The websites of GFAR, FAO, IIED, ODG, ODI[4] were explored using similar search terms as those for the CGIAR[5] Centres.

1 International Food Policy Research Institute; International Centre for Maize and Wheat Improvement (Spanish acronym); International Centre for Research in the Semi-Arid Tropics; International Centre for Tropical Agriculture (Spanish acronym):

2 Australian Centre for International Agricultural Research

3 International Service for National Agricultural Research (now closed)

4 Global Forum on Agricultural Research; Food and Agriculture Organisation, International Institute for Environment and Development; Overseas Development Group (University of East Anglia); Overseas Development Institute

5 Consultative Group for International Agricultural Research (see footnotes 1 and 2)

SECTION 2

Overview

The traditional approach to collect high quality data as the basis for intervention in any farming system is to undertake a detailed survey. Large scale field surveys are expensive and too frequently fail to distinguish the causes of spatial and temporal differences in poverty, agricultural problems and other key issues. Smaller, household surveys tend to be location specific (making extrapolation difficult or impossible) and there is a real problem of making comparisons across surveys due to issues of definition, data collection methods, or survey timing and focus (Ellis, 2000). Surveys are slow and expensive (which makes them unattractive to scientists working on tight budgets and with short delivery times) and, as importantly in terms of this exercise, are extractive – they extract data from the countryside. There is rarely much evidence at ground level of the benefits of participation in surveys, and they involve a considerable imposition on the time of participants.

The cost and potential irrelevance of comprehensive formal questionnaire based surveys has created a momentum towards cheaper, more flexible survey methods – loosely classified as ‘participatory’. The ‘participatory’ label comes from a general intention (although not always the practice) of significant farmer input to both the collection and interpretation of the survey data. Led in southern and eastern Africa by efforts by Collinson in the 1970s and 80s (building on work by a number of others, particularly in Asia and Latin America), farming systems research (FSR) was based around a farm management orientated informal survey process supplemented by secondary data from key sources and informants (Collinson, 2000). Variations on this theme – with a broader, less directly agricultural focus – have been developed by Chambers and others; rapid rural appraisal (RRA), participatory rural appraisal (PRA) (Chambers, 1981; Chambers, 1994; McCracken et al, 1988). The aim has been to develop quick, accurate, and relatively cheap methods of collection of relevant information at a local scale, including information on poverty, social, seasonal, personal and diplomatic dimensions (Chambers, 1994). Methods include group discussions, drawing maps, transect walks, time lines and trend analysis, seasonal calendars, wealth ranking amongst others. The intention is to encourage and facilitate active involvement of those being surveyed, with the outsiders taking the part of students and partners rather than experts. The data tend to be qualitative and ordinal and to focus on the ranking of options rather than producing quantitative data.

Ideally, participatory methods are not extractive but are “a family of approaches that enable people to express and analyse the realities of their lives and conditions, and to monitor and evaluate the results” (Chambers and Blackburn, 1996). In this context, the scientist facilitates the development of ideas and helps define options rather than entering with already identified solutions. The overall theme is that of encouraging participants to take control of the process of change and thus empowering them to become more active partners in development.

But the methods need to be used carefully and sensitively (and with due consideration of their limitations). Participatory methods are helpful in understanding temporal and seasonal aspects of rural life, and in defining major centres of local power, emerging problems, changing patterns of activity for the community as a whole, and key current constraints and opportunities (Ellis, 2000). They can, as all methods of data collection, be liable to incorrect interpretation. The use of groups in particular can result in misunderstandings:

- Researcher/community meetings may project what the community would like outsiders to see rather than the reality.

- Local power structures and conventions may influence the progress and outcomes of the meetings.

- Important groups for the purposes of the study (the poor, women, widows) may be excluded

Careful triangulation combined with verification from secondary sources and, where appropriate, the use of focused sample surveys may be necessary to ensure sufficient data quality. Participatory approaches are, therefore, best used with care and appreciation of their limitations as well as their strengths for optimum results (Ellis, 2000).

In terms of building farmer involvement in research design and priority setting, the key element is in the feedback provided. Too often so called participatory studies still simply extract information from the community. Regardless of how expertly this process is conducted, a single directional flow of information, by its nature, is bound to be limited in scope and quality. To build real farmer involvement (and therefore participation) into the technology development process, a continuing exercise of discussing and coming to a consensus on options, obtaining routine and informed feedback on results, and exploring new avenues based on field experience is needed. Despite much criticism to the contrary, researchers have been surprisingly innovative in developing the necessary tools although their application now needs to be much more widespread and routine. Participatory rural appraisal, in its various forms and guises, is part of the necessary interactive process with farmers; it is not a substitute for it. The current state of the art is comprehensively reviewed by Lele et al, 2010.

Typologies of participatory research

Neef and Neubert, 2011, have reviewed the development of participatory research – starting from its initial focus on a basic 'farmer first' approach to the more complex initiatives of the current day. Their intention is to develop a typology that provides a basis for agricultural researchers to optimise the use of participatory approaches in agricultural research. As participatory methods have become more accepted and widespread amongst agricultural researchers, the level of participation, the degree of engagement with various actors, and the need to adjust participation as the research continues becomes more complex. Typologies need to take into account the increasing diversity and multidimensional character of participatory research as the research agenda embraces elements of sustainable agriculture, food security, and natural resource management.

The typology proposed by Neef and Neubert, 2011, was developed after a comprehensive analysis of the shortcomings of earlier attempts by Sumberg et al, 2003; Sumberg et al, 2004. Their framework recognises that increasingly participatory approaches and conventional research are creatively and effectively combined (Pound et al., 2003; Lilja and Bellon, 2008). The framework is built around six dimensions – project type; research approach; researchers' characteristics; interaction between researchers and other stakeholders; stakeholders' characteristics, and stakeholders' benefits. This serves to address the criticism of Dixon and others (see Lilja and Bellon, 2008 and Lilja and Dixon). Lilja and Dixon, 2008, state that successful research does not depend just on the development of agricultural technology, but in the concurrent building of human and social capital - confidence, knowledge, networks, and capacity - which then allow technologies to have a full effect on livelihoods.

IFPRI analysis provides evidence for the necessity to incorporate a strong gender perspective (Meinzen-Dick and Quisumbing, 2012). These authors note that there are specific issues facing women in agriculture (domestic duties of child care, cooking, fetching wood and water). In traditional farming systems, some crops (for example, legumes) will be regarded as women's crops, while the food staple is a man's crop. Where access to land is controlled by men, introducing diversification crops, such as beans, can be difficult and lead to divisions in the community. These issues can be a serious constraint to uptake unless they can be understood and addressed as part of the research process. By understanding properly the role of gender in the farming systems, the role of all participants – and possible avenues out of poverty - can be better defined.

Given the shortcomings of available typologies – they are too complex, difficult to understand, and most importantly, do not provide reliable guidance for implementation, a simplified approach has been adopted in this report[6]. The starting point is that participatory research is not sufficient. It is necessary as an important component of the research process but it, just as other approaches, has flaws. A balanced approach (using both conventional and participatory methods) with the balance determined by the problem set is ideal. In addition, a truly participatory approach requires the active contribution of private sector actors. To get the outputs of research to farmers, there has to be an efficient and equitable value chain. Blackie et al, 2010, show that to get a researcher's work into broad based uptake, approximately 8-10 professionals in other fields (marketing, finance, outreach) are required. As noted later in the report, researchers, both participatory and conventional, have not addressed partnerships with private sector agents adequately.

Farmer Participatory Plant Breeding

Because crop varieties are usually developed by researchers who are rarely practicing farmers (or, even when they are, operate at a different scale and with different resources to many smallholders), regular input from practicing target farmers is needed to tune the selection indexes accurately. One of the most important recent changes in plant breeding for developing countries has been the increased participation of farmers in the selection process. This is most marked in marginal areas, where seed markets often do not operate efficiently and farmers are therefore less able to communicate their varietal preferences through the marketplace (DeVries and Toenniesen, 2001).

Farmer participatory breeding methods and the use of local knowledge for seed development and distribution are increasingly regarded as essential complements to scientific breeding programmes. There are several opportunities for meaningful interaction between farmers and researchers. Early inbred generations (F_4 or later) (Butler et al., 1995) are stages when farmers can be consulted on such issues as plant type, maturity, and grain quality. Surprisingly, rarely in participatory plant breeding programmes are farmers consulted prior to the genetic fixing of traits in candidate varieties in contrast to their involvement in priority setting for desirable characteristics (Almekinders and Hardon, 2006). Important factors determining the success of farmer participation in such schemes were the willingness and interest of farmers to set aside time for the work and a clear consensus on the needed crop traits among farmers consulted.

Greater farmer involvement can be achieved through training farmers in plant selection and stationing nurseries on farmers' fields to facilitate the evaluation by farmers of as many lines

[6] The author adopted this approach while developing programmes in the field, particularly with Rockefeller Foundation, and subsequently in research evaluation exercises.

as possible ahead of the choice of the "best" candidates[7]. This approach has the added advantage of exposing varieties to the full mix of biotic and abiotic stresses common to the local farming conditions. DeVries and Toenniessen, 2001, cite the example of the West Africa Rice Development Association (WARDA) using farmer participatory breeding to speed up the development of varieties following its breakthrough in the breeding of interspecific crosses between Africa rice (*Oryza glaberimma*) and Asian rice (*O. sativa*) (see box 1).

Box 1 WARDA; participatory plant breeding

WARDA (quoted in DeVries and Toenissen, 2001) used a combination of Asian and African rice genomes to produce a new rice species. The African rice genome contributed vigorous early growth for reduced competition from weeds and resistance to a number of important pests and diseases. Asian rice characters which were expressed included branching tillers which supported more grain. In order to determine which combinations of traits were of most importance to farmers, WARDA employed a three-year, participatory process, gradually moving from a large number of varieties to a limited number which could be presented for release and multiplication through national research programs.

In year one of the WARDA process, 60 interspecific crosses are introduced to farmers through trials grown in farmers' fields. WARDA scientists make three visits during the growing season to discuss with farmers the performance of each variety at critical stages of growth. In year two, the list is narrowed down to seven candidate varieties. Farmers evaluate each variety for various characteristics, and the WARDA Economics Unit records evaluations. In the final year of participatory selection, WARDA multiplies those varieties which have been selected by farmers and offers them for sale. Interspecific varieties have consistently been among those selected by farmers in tests which included both interspecifics and "normal" rice varieties. Breeders at WARDA are continuing to search through screening trials of interspecific progeny for varieties which may offer new, valuable plant types and resistance to intractable problems of rice production in Africa.

A second aspect of farmer participation in crop improvement aims at greater tapping of biodiversity and the large variation that exists within land races of crops grown in the developing world. It is known that resistance genes exist in low, but useful, frequencies in a number of 'orphan' crops but they are difficult to isolate so as to feed resistance sources back into breeding programmes. Through using rural training facilities to teach farmers to identify insects and diseases, it is possible to link farmers to breeding programmes, leading to a new form of "participatory gene discovery".

Thus gradually, a methodology is emerging for ensuring that the crucial ingredient of farmer preferences is included in breeding improved crops for poor farmers. Other examples include plant breeders working with farmer expert panels to develop bean varieties in Rwanda and cowpea varieties in West Africa (Almekinders and Hardon, 2006, Kitch et al., 1998; Sperling et al., 1993). Nevertheless, the complexities in terms of taking timely decisions and maintaining the rhythm and steady progress necessary to get improved lines moved through a programme, likewise, should not be ignored. Farmer participation and the use of local and farmer knowledge are catalysts, not substitutes, for scientific focused breeding programmes.

7 See also earlier work of Maurya in India: Maurya, D.M., Bottrall, A. and Farrington, J. (1988) "Improved livelihoods, genetic diversity and farmer participation: a strategy for rice breeding in rainfed areas of India", *Experimental Agriculture*, vol. 24, pp 311-320. Farming systems series - 14.

The most comprehensive analysis of current participatory plant breeding activities is by Almekinders and Hardon, 2006. Their report reviews the experiences of a range of selected pilot projects with a view to showing successes, failures, and avenues for improvement. They observe that most participatory plant breeding activities are pilots, utilising different approaches, with little indication about which are most effective and indeed how effectiveness can and should be assessed. They also note the scarcity of quantitative data, with little information on actual selection procedures such as population sizes, and intensity of selection. In the participatory plant breeding activities, data are not documented in the same way and with the same detail as in conventional programmes. Hence the technical analysis remains rather descriptive.

They conclude that participatory plant breeding can be successful and does offer realistic options that can benefit farmers thus far neglected in crop improvement programmes. While there are important potential benefits of closer involvement of farmers in crop improvement, the sustainability of approach requires the practices become integrated with national plant breeding institutions and national agricultural and social development policies and programmes. In particular, formal recognition is needed of farmer seed systems as an important component of national seed supply.

Farmer participation in other research activities

Probably because, as noted previously, farmers have had a long (although not always recognised) history of successful involvement in crop variety development, participatory plant breeding has been a leader in the direct involvement of farmers in research activities (Banziger and de Meyer, 2001). Involvement of farmers in selection of other technologies (soil fertility, pest management) has proved more problematic, with fewer successful models (Snapp and Pound, 2008).

Highly variable performance of technologies under differing ecological situations is an evident challenge; requiring significant local adaptation to optimise performance. Working intensely with many partners over a large area could require prohibitive levels of financial and human resource investment. These technologies may also require substantial farmer investment in the form of land, labour or cash which can be a barrier to local experimentation.

The 'mother and baby' trial design[8] developed by Snapp (see Benzer-Kerr et al, 2008; Snapp et al, 2002; Snapp et al, 2003; Pound et al, 2003) directly addresses these constraints. The design comprises 'mother' trials which test a number of different technologies, and 'baby' trials which test a subset of three (or fewer) technologies, plus one control. The design makes it possible to collect quantitative data from 'mother trials' managed by researchers, and to systematically cross-check them with 'baby trials' on a similar theme that are managed by farmers. The design is very flexible – Snapp et al (2003) report mother trials located on-farm at central locations in villages, but they could as easily (depending on need and logistics) be located at nearby research stations. Farmer participation in baby trial design and implementation can vary from consultative to collaborative.

Relatively simple 'one-farmer, one-replica' trials were managed by farmers, to act as satellites or 'baby' trials. These were linked to a central 'mother' trial managed by researchers that had "within-site replications". A trial design with a maximum of four plots and no replication within the farmer's field fits a small field size. It simplifies the design and makes it easier for farmers to evaluate technologies. Having many replicates across sites

8 The terminology is, in fact, the farmers', who were delighted to have responsibility for their own trials.

makes it possible to sample wider variations in farm management and environment. However, replication within a site and intensive, uniform management improves research on biological processes.

Data collected from trials included such quantitative information as planting date, emergence date and population density at emergence, early weed cover, and dates when plot was weeded. The farmers provided quantitative feedback on their evaluation of technologies to researchers through surveys, paired matrix ranking and by rating technologies. Qualitative feedback was obtained from meetings between farmers and researchers, and comments recorded at field days. The 'mother trials' were evaluated informally during discussions held at field days. This made it possible to integrate the farmers' assessment and improve research priority setting. Meetings were also held with senior stakeholders, conducted as part of an iterative process to maintain support and inform priority setting at every level. These included policymakers, supervisors of extension and NGO staff, senior researchers and industry representatives.

By facilitating hands-on experience for farmers, the clustered 'mother and baby' trials provided a relatively rapid approach to developing 'best bet' options. The linked trial approach provided researchers with tools for quantifying feedback from farmers, and generated new insights, such as the need to widen the research focus beyond soil fertility to include secondary benefits such as weed suppression (Snapp *et al*, 2003). In 2000, CIMMYT scientists adopted the method and conducted over 1000 mother and baby trials in six countries in southern and eastern Africa (Banziger and de Meyer, 2001). Scientists from other agencies and countries in Africa are either currently using the mother and baby trial design or in the process of adopting it – with adaptations to local circumstances (Morrone and Snapp, 2001). The primary reason cited for interest in the approach was the ability to involve many farmers systematically and to rapidly elicit evaluation of technologies and varieties.

Integrated pest management (IPM) is an effective tool for reducing the building up of resistance to crop pest control chemicals. But effectiveness requires widespread adoption. Through participatory exercises, there is evidence of success in India[9]. In the 1990s India accounted for 29% of the world's cotton area but only 15% of the total production. Yields per unit area were showing a sharp decline, in part due to weather but, as importantly, as the result of a debilitating cotton virus spread by insects is affecting production in the north and outbreaks of the American bollworm. Pesticides accounted for around a quarter of crop production costs. Spraying equipment was badly maintained and inefficiently used. Available pesticides were often poorly formulated by local companies, and farmers had only limited advice (usually from the chemical dealer) on what and when to spray. Insects were rapidly becoming resistant to the pesticides. This was partly countered by the development of novel pesticides, which act on the insects in new ways (for example by preventing them from moulting) or by growing genetically engineered cotton plants which produced bacterial toxins to kill pests.

IPM takes this a stage further by working with farmers to 'manage' resistance by combining a range of control practices. These include the use of resistant varieties, seed treatments, selective spraying of particular pesticides only when pest numbers are high, and the alternation of chemicals which work in different ways to avoid the build-up of resistance. From 1996-1999 researchers at NRI collaborated with farmers and scientists in the Central Institute for Cotton Research, Tamil Nadu Agricultural University and at ICRISAT to develop IPM strategies for Indian smallholders. In their pilot exercise, villages which used these practices showed very encouraging results, with a reduction in chemical use of at least 40%

[9] This section is drawn from Blackie and Gibbons, 2002, reviewing the results from the DFID funded Crop Protection Programmes using assembled data published by that programme

and yield increases of 20 to 40% (Russell, 1998). In three Indian States – Tamil Nadu, Andhra Pradesh and Maharashtra – NRI and Indian researchers and cotton farmers jointly developed and tested IPM “best-bet practices”. Village participatory methods were employed to ensure that the benefits encompassed the whole community. Trials involved over 1,000 farmers in 13 villages. The use of pesticides was reduced by almost half in two states, and almost entirely in one. It was also estimated that hazards to health due to pesticide use had dropped by between 77 and 98 percent. Yields rose in all three states (Blackie and Gibbons, 2002).

Case Study 1 Beyond participation – building farmer confidence

Participatory approaches are labour intensive (both for farmers and for development workers) and their impact localised. National extension services are generally regarded as poor and ill-equipped to work in a participatory fashion. Meanwhile, the potential of farmer to farmer contact in which the farmer’s own language and dialect are used, with face to face contact, further explanation, and demonstration, has not been adequately exploited.

This case study is a bean integrated pest management (IPM) project funded through the Crop Protection Programme of the UK Department for International Development (DFID) and led by CIAT[10]. The project was based in Malawi (Dedza district), Tanzania (Mbeya, Mbozi, Lushoto and Hai districts), Kenya (Kisii and Rachuonyo districts in Nyanza province) and Uganda (Kabale in south western Uganda). Beans - an important source of nutrition - were perceived as a low status crop, with little innovation in production systems, grown by marginalised groups, particularly women and the poor (Minja et al. 2005; Minja et al. 2006).

The scientists involved focused on working with farmers to enable them to find their own solutions and build their own farmer knowledge networks. As community groups learned how their knowledge could bring others benefit, scaling up and out became integral to the project as participants gained confidence to spread the ideas further. The emphasis in the implementation was, through building pride and interest in innovation, to engage the community by making participation enjoyable. This subtle, but important, change is, in fact, a significant shift in implementation of participatory approaches. Farmers cite their growing confidence and pride as the main reason why they attend farmer to farmer meetings and expand the sharing of information.

Initially farmers from Hai district in northern Tanzania reported bean crop yield losses from damage by the bean foliage beetles (*Ootheca* spp.). Researchers noted that indigenous knowledge existed which, with a little external support, could be used to develop effective pest management strategies (Ampofo et al. 2004). The project team interacted with the farmers in an enthusiastic manner, showing themselves open to farmers’ ideas and culture. As the farmers were driving the process, all aspects of the local culture were taken into consideration (Ver Beek 2000). Through humour, drama and music, the interaction between farmers and outside actors was made enjoyable. Facilitators were used to build confidence among participants. Farmers, especially women, were encouraged to volunteer for group leadership positions and group committees. The early adopters (farmers, extension personnel, community development staff and local leaders) sensitised the community to organise themselves into research groups to experiment to determine for themselves how new information and technologies worked in their own environment - improved bean varieties, organic and inorganic fertilisers, and organic and inorganic pesticides. Farmers volunteered pieces of land for experimentation so others could learn. This was especially

10 Ward A., Minja E., Blackie M., and Edwards-Jones G., (2007), “Beyond participation – building farmer confidence: experience from Sub-Saharan Africa?”, Outlook on Agriculture, 36:4. 259-266

appreciated by women, desperate for innovation, but with limited time for experimenting or participatory learning.

Field days brought in other community members, local and national leaders, neighbouring community members, service agents, and local and national officials. Experimental plots were strategically established near roadsides or school grounds for community members and visitors to observe and learn and discuss their views during field days. The farmer groups demanded extension materials and information that the illiterate could access through village information centres. In Tanzania the bean IPM project collaborated with Media Trust to develop a Kiswahili radio soap opera named 'Pilika Pilika' and an accompanying magazine series. This enjoyable drama had development messages woven into the story line and was aired across Tanzania. Farmer research groups were formed who began to manage their own resources and, as an unanticipated 'spill-over', started to seek out new and improved services.

Participating farmers developed a changed mindset; they embraced experimentation which linked external suggestions to local knowledge. Innovative bean farmers used improved technologies from service providers (such as pest tolerant high yielding varieties, fertilizers, commercial pesticides and improved cultural practices) to blend with local options (the use of wood ash, cow urine, cow shed slurry, and local plant extracts for pest control; animal and green manure for improving soil fertility; improved cultural practices such as mixed cropping, staggered planting and use of local crop cultivars). The immediate benefit was improved bean pest management. But the second, and broader and even more exciting achievement was the enhancement of farmer innovation and farmer to farmer communication. Farmers started actively to seek improved services (such as quality seed, markets, credit, improved livestock, fertilisers, tree nurseries, irrigation facilities, soil and water conservation methods) (Blackie and Ward 2005); raising these issues openly with local officials and visitors. Local officials, community leaders, NGOs and politicians used the research groups as an important and dynamic component in the local innovation system.

The project started in 1997 with no farmer groups, no activities, and no partners. By 2006, there were almost 80,000 farmers in almost 400 farmer groups. Over 60% of group members are women farmers who also play key roles in group leadership (Komba 2005). Participating farmers and partners organised and implemented cross visits to other locations for different lessons independently from the project. As a result of a joint IPM project/NGO (Concern Universal) sponsored visit from Malawi to Southern Tanzania, 5 Malawi farmers sensitised 380 other farmers in their own communities. Within two years there were 50 farmer research groups with more than 1500 active members in Dedza district of Malawi.

The Pan Africa Bean Research Alliance (PABRA), an umbrella organisation representing Phaseolus vulgaris bean researchers across Eastern, Central, Southern and West (Cameroon) Africa, has used the methodology in Rwanda, Sudan, Madagascar and Democratic Republic of Congo. It is likely that there are now over 100,000 farmers working together in farmer research groups.

Case Study 2 Participatory research in exploiting ecosystems services

Malawi has made valuable progress in contributing to the African green revolution. The problem of chronic food insecurity in this impoverished population of 13 million has been largely addressed through a subsidy programme for nitrogen fertilizer and improved maize seed provided to over a million farmers annually since 2006. Consequent increases in production have been heralded as a triumph for input intensification of rain-fed cereals. But the costs are high; the program has consistently exceeded its approved budgetary allocation (13 to 17% of the national budget), resulting in reductions in expenditure in other key areas such as education and health. There are clear issues of the sustainability of such a costly programme.

The current fertilizer and maize seed subsidy draws on experience from the Malawi ‘starter pack’, which was undertaken a decade ago. The starter pack served to demonstrate the impact on household and national food security of reliable improved access to seed and fertilizer by all Malawi smallholders. But at the time the starter pack was launched, the scientists who had developed the starter pack technologies hypothesized crop diversity to be a missing element in the maize seed/fertilizer approach. They consequently initiated a country-wide trial with thousands of farmers to test the ecosystem (dis)services associated with monoculture maize (as encouraged by the subsidy) versus diversified maize farming.[11] This was developed over the decade into a long term program of participatory research at sites in Northern (Ekwendeni) and Southern (Songani) Malawi. It has allowed for insights into farmer assessment of technology performance, and to support adaptation and adoption. Ecosystem service generation provides a useful, integrated framework for evaluating performance. In this study ecosystem services monitored were chosen for relevance to smallholder farmer livelihoods; in particular provisioning services of grain and protein yield, profitability, and supporting services of plant cover, soil organic carbon (C), and fertilizer efficiency.

The research team hypothesized that a perennial type of biodiversification with shrubby and viney leguminous crops that live longer than the ~ 4 months typical of annuals was needed. The legume had to be a vigorous producer of N-enriched roots and leaves. This (semi-perennial or SP) legume needed to produce grain that could then either be sold or consumed in the household. The SP-legume pigeonpea (Cajanus cajan), already grown as a shrubby intercrop with cereals in some parts of Malawi, met the other criteria. Other legumes were also tested to provide a wide base for evaluation by scientists and farmers.

The data from the starter pack evaluation showed that, under smallholder conditions, grain yields were improved and fertilizer use profitable (under the subsidized conditions) with small amounts of fertilizer. But, by improving biodiversity through the incorporation of legumes into the system, fertilizer use efficiency rose sharply – thus markedly reducing the level of subsidy needed to ensure national food security. SP legume systems could produce equivalent quantities of grain with half the amount of fertiliser, and on a more stable basis (yield variability reduced from 22% to 13%) compared to maize monoculture. Profitability was also assessed by calculating the value cost ratio (VCR) for each system, compared to the baseline system of unfertilized monoculture maize. This is a useful means to systematically compare disparate farming systems. The VCR of the SP-rotation systems remained attractive even under scenarios with substantially increased input costs.

Farmer surveys indicated consistently positive technology rankings across experiments, despite the diversity of years, locations and participants involved. About half of participating farmers rated the SP legume system as first (41-56%), one-third chose the groundnut-maize rotation (28-34%), 10-19% chose the intercrop, and 6-8% chose monoculture maize. When technologies were assessed in terms of specific benefits and costs, nutritional benefits of legume diversification were particularly valued by female farmers and the reduced labour requirements were frequently noted by poorer households. Overall, rankings of technologies remained generally consistent across the different sites and types of experimentation.

This is the first evidence in Africa that crop diversification can be effective at a countrywide scale, and that shrubby, grain legumes could transform the economic viability of fertilizer subsidy policies, and support key ecosystem services from agriculture.

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11 Snapp et al, 2010

Farmer participation and the private sector

As the cost of mobile communications has fallen, many of the poor now have access to the internet and its resources. This has served to bring the private sector directly into the development of participatory methods. East Africa has been a leader in this field:

- M-Pesa ('M' for mobile, 'pesa' is Swahili for money) is a mobile-phone based money transfer and micro-financing service for Safaricom and Vodacom, the largest mobile network operators in Kenya and Tanzania.
- Ushahidi is a non-profit technology company that specialises in developing free and open source software for information collection, visualisation and interactive mapping.

Both provide opportunities for the poor to improve access to markets and market information and are widely used throughout the territories.

Formal methodologies for the engagement of the private sector in participatory research are not well defined. However, since many developing countries have poorly performing mechanisms for the trialling, demonstration, dissemination and uptake of agricultural technologies, private firms and civil society organisations have entered the fields of both technology transfer and development. Often these have been facilitated by CGIAR centres (Snapp et al, 2003).

There are numerous NGOs active in support of poor people in rural areas, but few of them approach their activities from the perspective of developing markets and creating sustainable businesses. Nevertheless, imaginative private firms and NGOs have explored opportunities for creating partnerships between scientists, farmers, and the market. In Kenya, the Safe Use Pilot Project is a largely industry funded exercise to promote the appropriate use of agricultural chemicals. Working through the national extension service, it has trained 0.5million smallholders since its inception in 1995. At the same time it has trained 3500 stockists in the safe use of crop chemicals and in providing best advice to farmers. Its wide outreach has been through careful use of the national extension system, for which it has had excellent cooperation. A continuing audit of programme quality and effectiveness is maintained.

Developed by SCODP, a local NGO in Western Kenya, the Mini-pack method involves the packaging of agricultural inputs (initially appropriate seeds and fertilisers) in small affordable packages, combined with active promotion amongst small farmer communities in market places, schools, and churches. Costing as little as Ksh 5, farmers are encouraged to experiment themselves with recommended seeds and fertilisers, and having learned by doing and succeeded in their own small plots, return to their nearest stockist to purchase larger quantities. The method proved to be very successful at quickly stimulating the demand for farm inputs amongst the poorest small-scale farmers in Siaya district to such an extent whereby farm input supply quickly becomes profitable at the village level. In 2001, the Farm Input Promotional Service (FIPS) was to scale up the SCODP approach for the benefit of small-scale farmers throughout Kenya. Multinational companies cooperating with FIPS include Norsk Hydro, Kali & Salz, Dupont, Pannar, Monsanto, and Bayer. Local input suppliers are also active and include Kelchemicals, Farmchem, Vetagro, Da'kianga distributors, and Peron Agencies (Blackie et al, 2006).

Box 2 Participatory research addressing the value chain: Shambani Graduates

Three university friends conceived Shambani Graduates when they were visiting Morogoro rural district in 2003. They noted the lack of a link between the demand and supply of milk and signed up for a course on milk management. Together they conducted consultancies to generate initial capital for the company which became a limited liability company in December 2006. The business is based on the collection and selling of pasteurised milk. Milk is bought from Masai women who are trained to comply with quality standards. Today they are sourcing milk from over 200 farmers and the trust in the dairy system has given Shambani the security to expand into the Dar es Salaam market.

Their business endeavours have been acknowledged and augmented through the Technoserve award and the Dutch Business in Development Network award in 2006 and the 2008 Yara Prize. These have provided training as well as financial benefits which have enabled them to develop their capacity. This is of particular note as loans either cannot or have not been accessed. However, the operation is still at a relatively low level and is nowhere near matching demand. Further work is required to ensure increased supply in terms of quantity and quality.

Not only is this becoming a thriving business but the farmers, particularly Masai women, are reaping the benefits of a steady and reliable income from their milk which was previously considered a by-product. Consumers are also benefitting from a reliable supply of quality milk. The team are now keen to diversify the range of products that they supply.

In a further development, FIPS introduced Katumani bean (KB9) as part of their 'food security package' for drought prone areas. The KB9 is a drought- and heat-tolerant bean developed by the public sector research agency, Kenya Agricultural Research Institute – KARI, and is suitable for areas with a short growing season. But farmers neither knew of the bean, nor could they get access to the seed. Through local stockists, FIPS set up a promotion whereby if farmers bought one of their maize mini-packs, that farmer would also get a free 250g packet of KB9 seed to try (together with the necessary agronomic information). Farmers quickly saw that the KB9 bean was well suited to their area and returned the next year to buy more seed. FIPS initially contracted a local farmer to multiply the seed to meet the immediate anticipated future demand. Today, this open-pollinated variety is produced commercially by privately owned Western Seed Company, and marketed throughout the country (Blackie et al, 2006). FIPS introduces new technology options, including new seeds, fertiliser types, and weed control methods, and acts as an 'honest broker', helping farmers evaluate various technologies in an unbiased manner. Food security amongst poor farmers with whom FIPS was working nearly doubled within three years (from around 30% to 60% of the target population). But spillovers, largely in the form of farmer-to-farmer extension, meant that food security amongst those not working with FIPS also doubled (Blackie et al, 2010).

The IDEA program is an attempt to improve technology dissemination amongst smallholders in Uganda through the active involvement of the private sector. It is closely modelled on Sasakawa-Global 2000 lines. The aim is to provide access to improved inputs – primarily high yielding varieties of seed and fertiliser – through the careful linking of the processes of research, technology transfer, input supply, and output marketing. The private sector is brought in as a major player as soon as possible within the process.

IDEA operates through demonstrations of improved production practices, with two models – one based on 'low inputs' in which improved seed is the only external input but better crop husbandry practices are involved. The second 'high input' demonstration has fertiliser as an additional input together with pesticide as appropriate. This is linked to a concurrent program – the ATAIN program, which is aimed at improving market access to inputs. Wholesalers are assisted with bank guarantees to encourage them to invest in importing fertiliser. Distributors are trained in the business of handling farm inputs and getting them out to local stockists. Stockists are helped with further guarantees to enable them to obtain the necessary credit to purchase and stock crop inputs. Finally farmers are trained in the safe use of crop chemicals and seeds.

This market support is essential to the program and involves linkages at the regional as well as the national and local levels. Farmers are encouraged to form ‘groups’ to improve their purchasing power. The overall aim is to create an efficient and liquid marketing system for farm inputs and to eliminate speculative trading and bottlenecks in the supply chain. The results have been impressive. Nationally, sales of improved maize and bean seeds through the private sector have increased. Fertiliser sales have also risen without a concurrent increase in fertiliser price (despite the fall in local currency value by 20% over the period). Outputs claimed by the program include 4 maize hybrids and 10 bean varieties released, together with appropriate fertiliser and herbicide packages. The program has reached some 200000 smallholders and cooperating farmers now run half the demonstration plots. The initiative has assisted in the development of rural associations and claims to have raised rural incomes by US$7m/year and increased agricultural exports to US$20m/year. Some additional 200 new rural businesses have been established with earnings of US$1m/year and there are now 3 active private seed companies in Uganda. Future plans include the expansion of national commodity marketing and extending the input supply system. The technology transfer program will be broadened to include other crops such as upland rice, groundnuts, sesame, cotton, coffee, and bananas.

CARE is an NGO that has taken on the challenge of helping develop agricultural markets in Zimbabwe. The effort started with the establishment of input distribution systems development in 1995 with private sector collaboration. Before the economic crisis in that country and the collapse of much of the financial sector, there were over 500 agents linked to suppliers of agricultural inputs; loan repayment rates were impressive. The model is being adopted and adapted by others in other countries.

Pigeon pea is widely grown by smallholder farmers in eastern and southern Africa both for subsistence and as a cash crop. There is a significant domestic and regional trade in whole pigeon peas, and a local processing industry. In addition, the crop is exported to India and other overseas markets. The African harvest takes place slightly before the main Indian harvest which allows the crop to attract a better price in that country. TechnoServe Inc., a US-based not-for-profit organisation with country offices in Kenya, Mozambique and Tanzania developed a collaborative programme with ICRISAT and national agricultural researchers for a regional collaboration (Blackie, 2008).

Box 3 Groundnut Production and Marketing

Plan Malawi and the International Crops Research Institute for Semi-arid Tropics (ICRISAT) initiated collaborative work in 1999 to promote production of the improved groundnut variety CG7 in all Plan communities. ICRISAT provided technical and other assistance in CG7 groundnut production in Plan communities.

Within four years of the initiation of this work, the Plan communities realised appreciable increase in production, and therefore required an outlet for the surplus. The next phase, therefore, introduced an innovative strategy to community development by linking production to marketing through participatory methods that took full cognisance of roles and responsibilities within families and communities. The production, training, processing and utilisation components of the previous phase were retained in order to provide the necessary skills for new communities.

ICRISAT undertook to assist Plan communities in the identification of markets for groundnut and pigeon pea. A structure for marketing was developed to link the Plan communities to the National Smallholder Farmers Organization (NASFAM) - a key player in groundnut production and marketing in Malawi. ICRISAT undertook to carry out the quality assurance for NASFAM. The price to be paid for the produce was negotiated directly between NASFAM and Plan Malawi, with ICRISAT providing unbiased marketing information to both parties

The starting point was a detailed sub-sector analysis within each of the four major producing countries in eastern and southern Africa. In each country, a locally adapted strategy was developed. In Mozambique, a cotton-pigeon pea rotation was promoted, with improved pigeon pea inputs and marketing arrangements being linked skilfully with the cotton system. In Malawi and Tanzania, the focus was on high quality pigeon pea for the European market, with farmer groups carefully hand sorting the crop and then selling to traders from Europe. In Kenya, with its established horticultural export trade, fresh green or frozen pigeon pea to Britain was an attractive option. TechnoServe specialised in enterprise development while ICRISAT and its national research partners worked closely with farmers to develop the varieties and farming systems that could viably and sustainably serve the markets identified. Smallholder farmers were being linked to identified and significant markets through a range of institutional and market arrangements. This was combined with a regional strategy to introduce new technologies, along with simple and easily administered quality standards based on end-user needs, to help farmers, traders and exporters to benefit from higher quality and higher value markets (Jones, Freeman, and Lo Monaco, 2002).

SECTION 3

International consensus on methodologies and approaches

Farmers, despite a reputation for conservatism, have shown considerable talent for innovation and ingenuity. In East Africa, for example, they have developed complex cropping systems to fit environments ranging from the slopes of Mt. Kenya to the fringes of the Sahara, each with its unique mix of biotic and abiotic constraints (Dixon et al, in press). Traditional low risk, low-input, long fallow systems are becoming unsustainable as many of the poorest are pushed, through urban development or expansion of large scale farms, into marginal areas. Poor soils, short and unreliable growing seasons, and a challenging array of pests and diseases favour strategies that do not involve high inputs of labour, land, and cash; that are stable in bad as well as good years; and which are productive within the normal resources available to a farming household.

The challenge, therefore, for today's agricultural scientists is to create predictable and significant improvements in farming systems using soils which are fragile, very low in fertility, and subject to the further stress of periodic drought. The focus is not one of increasing yields. Farming systems must perform reliably and consistently in improving yield stability and safeguarding the investments of land, labour, (and what little capital is available) of some of the world's most vulnerable people. DeVries and Toennissen (2001) set the scene graphically.

> *"It is that of a single mother whose primary means of income is a one hectare plot of unimproved land on an eroded hillside…From each harvest she must provide for virtually all the needs of her family throughout the year, including clothing, health care, education costs and housing. Because she can afford few purchased inputs, the yield potential of her farm is low…perhaps 2000 kilograms of produce…*
>
> *In the course of a given season, innumerable threats to the crops appear….The impact of drought plus whatever combination of pests and diseases attacks the crop in a given year can often reduce the average harvest on her farm by perhaps 50-60%, to 1000 kilograms of produce.* ***At this level of productivity, the family is on the edge of survival.****" [emphasis added]*

Several factors are evident from this analysis. The family can shift from the 'edge of survival' at least to relative food security through the elimination of existing losses. The gains from such a strategy are significant and are sufficient to be attractive to poor households - while most in need of such technologies are those least able to pay for them. Reliability and consistency of performance are as important as absolute yield improvements and thresholds. Small-scale producers who depend on their own produce for nutrition and livelihoods often profit more from crop technologies which enhance and stabilise yields by limiting losses than technologies that are designed to generate higher yields (Herdt, 1991). A single mother hoping to harvest a ton of rice on a hectare of depleted upland soil can ill afford to lose 100 kg of her harvest to a crop pest or disease. Moreover, she has so many demands on her very limited resources of cash and labour that she needs to know, as far as it is possible, that any investment she makes in crop improvement will repay the labour or cash adequately.

The reason so many of the rural poor are living on the 'edge of survival' is that too many of their traditional approaches to agricultural production are breaking down. The fundamental productivity issues faced by many developing country farmers (who are smallholders) are often those for which agricultural experts have few, if any, realistic answers. Nor can the farmer turn elsewhere for counsel. In a period of unprecedented change, farmers find that their traditional wisdom provides limited guidance. Rural communities are under pressure on several fronts. Economic growth in rural areas has been insufficient to offer alternative means of employment for the rural poor. Profits from farming at low levels of productivity have been too small to allow farmers to reinvest in their farms and maintain productivity at acceptable levels (Eicher, 1990; Blackie, 1994). Meanwhile, continual increases in population have depleted both the available resource base and social entitlements which hitherto provided a state of equilibrium in rural areas (Lele, 1989).

There is a strong international consensus that alleviating poverty in the developing world will require the improvement of a broad range of farming systems. The consensus is fully summarised in Lele et al, 2010 as:

> *"A Transformed Agricultural research for development is one that helps to achieve sustainable food and income security for all agricultural producers and consumers and particularly for the resource poor households, whether they are in rural or urban areas. Sustainable agricultural intensification means producing more food and agricultural products from the same overall resources (e.g. land, labour and water) while reducing the negative environmental impacts and at the same time increasing contributions to natural capital and the flow of environmental services. Sustainable agricultural systems cannot be defined by silver bullets, i.e. acceptability of any particular technology or practice. There are no standard blueprints.*
>
> *AR4D [agricultural research for development] is research that:*
>
> - *Operates on the principles of subsidiarity: activities are best conducted at the level at which there are the responsibilities and accountabilities, and where research results need to be applied;*
> - *Builds its priorities from the bottom-up through socially-inclusive processes involving the poor and the disenfranchised;*
> - *Brings into play a diversity of approaches, technologies and practices, including combinations of traditional knowledge, conventional technologies, agro-ecological methods and modern biotechnology;*
> - *Exploits and integrates participatory approaches with scientific and experimental methods;*
> - *Ensures results-based management effectively integrated with innovative science and development;*
> - *Even at the local level routinely devises methods to assesses progress of implementation of processes through systematic independent monitoring and evaluation;*
> - *Maintains its identity and operation separate from development actors though seeks effective partnership strategies and linkages to all other relevant agricultural and rural development investments and policies at all levels.*
>
> *AR4D is not development but contributes to it through greater sensitivity, active partnerships, vigorous commitment to building the capacity of partners including particularly the beneficiaries and increased accountability for more and better results on all fronts: poverty reduction, productivity growth and environmental sustainability. It makes trade-offs explicit and helps decision-makers choose better options."*

There are notable successes in participatory research and these have been illustrated throughout the report in a number of examples. The conclusion drawn is that there is no single ‘typology’ or set/group of typologies that provide a template for success. There is a strong international consensus that alleviating poverty in the developing world will require the improvement of a broad range of farming systems and that participatory methods are a significant contribution to these efforts. Most development agencies require that a proper analysis of demand for research initiatives is included in any proposal. This analysis will typically require some form of participatory discussion with target groups. Overall, taking into account the implementation of funded projects, a pragmatic approach of using both conventional and participatory methods, with the balance determined by the problem set is the norm in most development agencies. This approach is supported in this paper which concludes that the important elements in creating an effective participatory research framework include:

- **Intensive interaction with farmers;** farmers are remarkably skilled at exploiting environmental niches on their own farms. Conway (1997) counted thirty different uses of plant species on a single, one-quarter hectare farm in Kakamega District of western Kenya. There are also many examples of exceptional farmer innovation in very difficult circumstances (Richards, 1985). The design and dissemination of technology that can really improve rural livelihoods across groups of farmers living in widely varied agricultural ecosystems, requires a good understanding of environmental variation. Farmers’ advice and skills regarding issues of growing environments and household utilisation needs to explicitly be incorporated into research agendas so that science is paired with the art of understanding people and the environment.

- **Strong national level technology development and dissemination capacity;** indigenous knowledge, combined with high quality science, provides an environment where local expertise and information can be linked to the national innovation system providing consistent and long term indigenous leadership and vision.

- **Strong and effective links to international science;** the role of research in creating answers to problems of a scale unprecedented in human history needs to be carefully and skilfully orchestrated, and will require an adventurous new collaboration between international assistance agencies, universities and scientific establishments in both the developed and developing world, and the private sector at both local and international levels. Broad-based food security will require sustainable productivity increases within systems based on maize, sorghum, cassava, millet, rice, pulses, and bananas, among other crops. The scale of the problems facing developing country agriculture will require long term continuing external scientific and technical support, but in a highly collaborative and interactive mode.

- **Involvement of private sector actors in the research process;** Blackie et al, 2010, show that to get a researcher’s work into broad based uptake, approximately 8-10 professionals in other fields (marketing, finance, outreach) are required.

The aim of participatory research is, therefore, to create an environment that facilitates integrated scientific and technical initiatives extending from the farmer to the lab and back again. The effort is guided by a commitment to improving the performance of farming systems at the lowest ends of the productivity spectrum. It is informed by the understanding that change typically needs a *combination* of improved production systems (irrigation, drainage, improved cultural practices, introduction of fertilisers) and the introduction of varieties that make more efficient use of limited and variable natural resources. Participatory research is an important tool in the scientist's box, but does not substitute for detailed conventional research investigations. The two exercises are highly complementary and an effective technology development programme will build strength and capacity in both areas (Pound et al, 2003).

Box 4 The failure of fertiliser recommendations

Nitrogen is the key driver for cereal crop performance across most environments, both in terms of yield and stability of yield (Vanlauwe et al., 2013). Nowhere is this more important than in sub-Saharan Africa where locked countries face fertilizer costs five to ten-fold higher than in the Global North. The economics of fertiliser use depend heavily on the expected response of the crop to the added nutrient.

Neither on-farm nor researcher managed trials provide reliable guidance on the best use of this critical resource. Fertiliser recommendations are typically based on data from maize plots following researcher management protocol. For the staple, maize, the response of maize to nitrogen can be in the range of 14 to 50 kg maize per kg nitrogen (N) and even higher in some cases (Whitbread et al., 2012; Vanlauwe et al., 2011). On-farm trials are also highly variable; typically in the range of 7 to 14 kg (Ricker-Gilbert et al., 2011; Chibwana et al. 2012; Snapp et al., 2013)

The magnitude of the difference between estimated response to nitrogen render it virtually impossible to derive reliable fertiliser recommendations for smallholder farmers.

This can be shown clearly in the case of expensive and risky technologies such as fertiliser use (see box 4). Too few research studies (both conventional and participatory) consider adequately the economics of change. The CIMMYT Economics Programme has provided long term and consistent leadership in this area, but too few scientists build the economics of the value chain into their research agenda. The costs of many of the improved technologies needed by smallholders, despite the ongoing efforts at market development, will remain high. Low cash cost technologies often have a substantial cost in terms of labour – which is also a scarce resource in many poor households. But an expensive input can be profitable if it is used efficiently. Profitability of input use depends heavily on making best use of the limited amounts that the typical smallholder is able to purchase. It is a scandal that the advice given to many poor farmers for the use of essential inputs such as fertiliser serves actively to discourage their use (see, for example, Snapp et al, 2014).

The importance of efficiency of input use is further emphasised by the fact that the poor need cheap food. Poverty alleviation and food security have to be arranged around low food prices. With low food prices, the poor can use their limited cash to invest in better housing, education, and health care. With high food prices, they are further trapped in poverty and the opportunities for livelihood diversification are few.

SECTION 4

Going to scale

Snapp *et al* (2010) report the process of partnership building as a development of preceding 'mother-baby' participatory work. This served to catalyse farmers, researchers and extension advisors into learning together through action research[12]. The exercise was led by University of Malawi staff and students who began by extensively reviewing the literature and selecting a site with high population density and intensive land use. They chose the Songani watershed, characterized by steep, eroded slopes and with a population density of around 250 inhabitants per km^2 - typical of much of southern Malawi districts.

The researchers organised community meetings to define current resource use, farmer constraints and opportunities. As with the 'mother-baby' trials, emphasis was placed on the inclusion of all members of the community, particularly female-headed households and the very poor[13] (Snapp et al, 2010). Through a series of subsequent community meetings, researchers and villagers jointly prioritised problems that could be addressed collaboratively and identified the criteria for trial site selection. Transect walks were used to choose each site. The farmers who cultivated the selected fields participated in the trials and, over the next five years, the researchers worked with these farmers in an iterative manner, conducting surveys, analysing and documenting indigenous knowledge[14] and implementing participatory research trials (Kamanga, 2011).

Once the new legume technologies were fully evaluated by both scientists and other stakeholders (communities; extension workers; input suppliers) they were scaled out into a watershed-based development initiative. This involved considerably increased investments of time and resources compared to the 'mother and baby' trials, particularly in the initial year. But the effort proved a powerful tool for linking research on biological processes to farmers' indigenous knowledge about land use (Snapp *et al,* 2010). It also served to develop technologies that were applicable to other regions similarly affected by erosion and land use intensity (Kamanga, 2011). The Songani watershed has become a platform for learning and action research for researchers from the University, who have continued to work with communities on defining their problems and developing long-term solutions (Snapp *et al,* 2010).

Snapp *et al,* (2002, 2010) suggest that a 'mother and baby' trial design can be used to rapidly test and validate technology options. The more costly (in terms of time and other resources) participatory watershed approach can then be used to integrate farmer and researcher assessment of most promising candidate technologies and to validate these for scaling up and dissemination over wider areas. Farmers often highlighted secondary

12 There has been a long history of coercion on soil and water conservation throughout colonial (and to some extent, post colonial) times. Zimbabwe, Kenya and Tanzania all have well documented cases of attempts to "stop the Africans destroying their environment" with punitive measures to insist on terracing slopes. The most famous case in Tanzania was the Morogoro riots when a policeman got shot during a protest. Modern attempts to work with peoples' ideas and energies in managing watersheds positively are a marked contrast.

13 This, as in the mother baby trials, proved remarkable successful and the data suggest that a representative sample of the community was indeed achieved (Snapp *et al, 2010*).

14 This documentation of farmer knowledge was particularly valuable in building up the capacity of researchers to communicate efficiently with farmers (Kamanga, 2011).

benefits from, and disadvantages of, the proposed technologies[15], thus building the agenda for further focused research. Importantly, the technologies chosen were robust and performed well across different agro ecosystems, from the semi-arid lakeshore to sub-humid, high altitude zones. Promising technologies from both participatory research experiences are being promoted widely in Malawi. By linking the mother baby exercise to the watershed approach, some of the concerns regarding the cost of implementing a wide scale participatory technology development and dissemination process can be addressed, although not eliminated.

In Bolivia, researchers and partners supported a significant range of research projects into potato-based farming systems on hillsides in the mid-Andean valleys. These projects were commissioned and implemented to address a range of biotic and abiotic constraints facing poor producers. The government of Bolivia was developing a new framework for agricultural research and extension (El Sistema Boliviano de Tecnologia Agropecuaria or SIBTA). Within SIBTA, four Foundations (FDTAs) were established, one for each of the principal agroecological zones (Chacos, Altiplano, Valleys and Humid Tropics). The FDTAs are responsible for resource capture, research prioritisation, and the management of competitive grant schemes (using national and donor funds) for agricultural research and extension. The aim was to develop an initiative directed towards achieving impact and maximising investments made to-date by validating and promoting outputs of past and present work.

The FDTA Altiplano, with an interest in potato, developed a strategy was strongly focused around improving the competitivity of the potato sector in the context of trade liberalisation under Mercosur. One of the activities in the plan was to identify demand, and put out a call for research and dissemination activities on potato and other Andean crops. The potato food chain is complex, and the FDTA Altiplano sought technical partners in both international research and the private sector to identify products and associated chains with commercial potential, and to identify the demand (explicit and implicit)[16]for technical innovation along those chains. Farmer participation was ensured through a network of farmer research committees (CIALs), a platform originally developed by CIAT Columbia (Ashby *et al.,* 1995; Braun *et al.*, 2000), which provided a mechanism exchange between researcher and end-users.

The Farmer Field School (FFS) approach is widely used to complete the farmer participation cycle in research. It is mainly used as education and extension approach which is successful in reaching small farmers, particularly women. Women typically undertake many field tasks (planting, weeding, harvesting) which are core to the FFS curriculum. Data from Kenya, Tanzania, and Uganda show female membership of FFS around 50 percent and that gender of the household head did not matter in the participation of FFS (Davis et. al., 2010). Adoption of promoted technologies was significantly higher among the FFS farmers for nearly all of the major technologies, with the major ones being improved crop varieties, soil fertility management, pest control, and livestock management. Pooled data from the three countries showed that participation in FFS increased income by 61 percent, with female-headed households benefiting significantly more than male-headed households in some cases. There is evidence to suggest that the high costs of the programme may compromise the sustainability of the approach (Davis et al, 2010).

15 For example, farmers noted some options gave better weed control but needed more labour.

16 Explicit demands are those that the poor can and will articulate to outsiders on request (e.g. "We need higher yields and better prices for the products we sell."). Implicit demands are those that require a more searching collaboration between the poor and outsiders (e.g. yields would be higher if nematodes etc. were controlled, and prices would be higher if the quality of native potatoes could be improved and an appropriate marketing strategy identified). Basing all research funding on explicit demand does not take into account knowledge and technologies that poor farmers are not aware of.

One of the most impressive 'scaling out' of participatory agricultural research was achieved in the years just preceding independence in Zimbabwe. Smallholders (black Zimbabweans mostly farming under traditional tenure) were largely marginalised by the pre-independence Rhodesian government. Yet, in the year of true independence, 1980, some 42000 smallholders produced nearly a third of the national cotton crop. A few years later the number of registered smallholder cotton growers had doubled and they were producing consistently more than half the national cotton crop. By 2000 (a record year), over 80% of national cotton production was produced by smallholders. Not only were smallholders growing more cotton than their large scale counterparts, typically they were producing a higher quality lint through careful picking and sorting before delivery. Cotton had become the biggest smallholder cash crop in Zimbabwe. But, just twenty years earlier, virtually no cotton was grown by smallholders (Blackie, 1986).

This transformation was created by a simple but skilfully implemented participatory process. In the mid-1960s, Rhodesia embarked on a major effort in agricultural diversification and, by 1968, some 75000 hectares of cotton were being grown (almost entirely by large scale growers). Tsetse fly had earlier precluded human settlement in some fertile areas in the past. An extensive programme of fly clearance had, over quite large pieces of land, removed this constraint and the decision was made to settle smallholders from some of the more densely populated farming areas to some of these remote, but potentially productive, new lands.

The senior extension officer in one of these settlement areas, through discussion with both farmers and scientists, devised a low cost cotton production system suited to the family labour and cash availability of the typical smallholder household in his area. He arranged training courses for farmers and for farm advisors, and ran regular field days to promote the crop. He also worked closely and effectively with the sole cotton marketing agency in Zimbabwe at that time, the parastatal Cotton Marketing Board (CMB). The CMB participated in courses for smallholders in cotton production, pest control, and harvesting methods so that the new farmers understood what quality factors were important and why. They also ran courses to explain how cotton was graded for quality and designed a dynamic marketing system that was helpful to smallholders. Payout was prompt, and there was an accessible and efficient disputes process. There was constant and effective liaison between the government cotton breeders, the CMB, and the farmers with respect to required varietal characteristics. A reliable system of cotton seed production was put in place.

Transit depots, where cotton was accepted and graded, were established in smallholder farming areas. Depot numbers rose from five in 1980 to sixteen by 1985. Producer prices were attractive. The proportion of the export parity price that Zimbabwe producers receive was then unrivalled in Africa (Dorward et al, 2001). Thus the programme did not require a large staff and was accomplished with the constraints of public sector funding at the time. The momentum for expansion was provided by the linkages to other agencies with expertise and interest in expanding cotton production.

SECTION 5

Principles for best practice and good engagement

The role of networking

Digital information and communications technologies have transformed the manner in which knowledge and technical know-how move around the world. Genetics and biotechnology are bringing about a new epoch of innovation in the agricultural sciences. There are new finance and investment models (for example, social enterprise and venture capital) which show enormous potential for turning knowledge into wealth, particularly for the poor and excluded. New approaches and technologies in agricultural science, especially the development of higher yielding, nutrient efficient, and locally adapted crop and livestock materials, along with market-friendly policies and improved national, regional, and international research institutions, are helping to create a new platform for progress for the rural poor (Moock, 2014).

There has been a major thrust in capacity building to meet these new challenges and opportunities. In Asia and Latin America, universities have played a central role in achieving successful agricultural transformation. The focus has been on building high quality institutions closely linked to the agricultural industries – farmers, suppliers, processors, and consumers. By contrast, in much of sub-Saharan Africa the pressure on teaching facilities is seriously compromising quality of university training in agriculture as enrolments have continued to rise without concurrent investment in infrastructure (Blackie et al, 2010).
The emphasis in capacity building needs to be on inclusion and openness – making the best use of talent and resources for the benefit of improving the livelihoods of poor rural communities. This will create the basis for agricultural research and outreach systems that address quickly and effectively the needs of these communities and open new opportunities to them. These objectives need to be facilitated through enhanced networking and coordination among research institutions with sector stakeholders. The catalytic World Bank 2008 World Development Report and Calestous Juma's book, The New Harvest: Agricultural Innovation in Africa (Juma, 2011) argue persuasively that transformation will come from the change in the mission and vision of advanced research and learning institutions to respond effectively to new local and global contexts.

Central to this change is the building of strong stakeholder involvement (and investment) in graduate education and agricultural research – hence the important of 'mainstreaming' participation in agricultural research. Students will work directly with farmers, communities, and industry on mutually developed research agendas, to speed up and intensify positive impacts on the agricultural industries of poor countries. These changes will require careful and tactful intervention, and support from experienced regional and international agriculturalists. There is a real opportunity for the regional university and research networks to provide leadership and vision to this change. Transformation in China, India, Indonesia, Brazil, Mexico, and Argentina has relied on substantial and effective investment in agriculture, and, in particular, building capacity in all aspects of agricultural change – from technology development and transfer through infrastructural development and the processing of agricultural commodities into consumer products . China has 90,000 scientists and a complex of different structures from national science academies, through provincial and local institutes and centres. The Indian Agricultural Research Council, ICAR, overseeing a system of more than 16,000 scientists, involves more than 90 different research institutes with independent disciplinary, crop, and ecoregional mandates. More than 50% of the agricultural scientists work in 42 agricultural universities – the product of an early investment, supported by the US, in national capacity building. Brazil has a two-tier system of federal- and state-based agencies. The Brazilian Agricultural Research Corporation (EMBRAPA), a semiautonomous federal agency administered by the Ministry of Agriculture and Food Supply, is the apex of a system that includes 42 research centres throughout the country. EMBRAPA had a budget of US$1 billion in 2009. 17 of Brazil's 26 states operate state agricultural research agencies. Countries such as Brazil and China have managed to develop their agriculture sectors by creating dynamic research institutions that are focused on finding solutions that suit their local context – environmentally and socio-economically. Importantly, these countries have been able to develop research systems that are also able to adapt and change as markets (and nations' position within them) changes (Blackie et al, 2010).

A current real world example of implementing this process in practice is the Regional Forum for Capacity Building in Agriculture (RUFORUM) headquartered at Makerere University in Uganda (www.ruforum.org). The RUFORUM network (some 40 public and private African universities) has chosen to follow a strategy of building "networks of specialisation" as the first stage in creating centres of excellence. The leaders are the universities that have greatest expertise and most up to date facilities in a certain area of instruction or research. Facilitators are universities with specialized, but incomplete capacities within that area. Needy members are those who acknowledge their weakness in that area and seek to collaborate within the network in order to broaden their services and capacities. By pooling their efforts through networking, RUFORUM members have greater abilities to achieve their strategic goals in terms of training and impact-oriented research. The outputs are graduates well versed in the chosen discipline and increased capacity at the less well-endowed universities. This last is then further enhanced by the stronger universities bringing in the weaker into the overall thematic research networks so as to enable them to build their field skills and reputations. Thus all participating universities gain strength, and the less well-endowed are helped actively to build themselves into high quality institutions.

Creating the environment for change

Pro-poor agricultural development involves low-income farmers and consumers as active participants in setting priorities for, and in the implementation of, development initiatives. Implicit is the central role of technology and markets to provide a route out of poverty (the role of the market has, too often, been ignored or under-emphasised). The scientist facilitates the development of ideas and helps define options rather than entering with already identified solutions. The overall theme is that of encouraging participants along the value chain to contribute actively to the process of change. Participatory research involves creating strengthened commodity value chains that boost productivity, coupled with new forms of collective action and seismic change in farmer accessibility to low-cost information technologies to create exciting opportunities to use agriculture to promote development.

Participatory research, therefore, needs to move well beyond the famer-based consultative processes that dominated initiatives in the field in the last two decades of the 20th century. Participation requires a continuing probing of 'over the horizon' issues which will be missed in narrowly focused farmer consultations (see Case study 3 and Pound et al, 2003).

Case Study 3 Initiating a Nitrogen Use Efficiency study with farmers

In the late 1990s, a team of Malawi scientists proposed setting up a farmer-based programme to improve nitrogen use efficiency using leguminous trees with poor households. The standard consultations were carried out, transect walks undertaken, and the community priorities and needs assessed through dialogue and inclusive meetings. The day came for the programme to be finalised and agreed with the community. The villagers congregated in the school room and the scientists explained carefully and thoroughly their programme. At the end of their presentation, the senior elder stood up; "Trees are all very good for university professors, we want fertiliser" – and walked out. He knew that, if he could get it, fertiliser would increase his yields; he did not think the proposed alternatives were reliable as they were based on knowledge 'over his horizon'.

The scientists persuaded the community to allow them to proceed with their programme. Today, that community is productive, using an innovative legume management system to achieve outstanding nitrogen use efficiency, and are promoting their system to neighbours and visitors.

See Snapp et al, 2010, and Kamanga B, 2011

Building inclusive teams

Participatory research needs teams of specialists, engaging a broad range of individuals and institutions, to focus on addressing the central theme of rural development in poor countries – the alleviation of poverty and the development of sustainable livelihoods for the poor and excluded. Delivering the outcomes of innovation to remote and poor communities requires close and effective collaboration between 'public good' research and the market. While increasing the demand-led component of the research agenda is important, this will not, on its own, act sufficiently fast to lift the technologically disconnected rural poor out of poverty. Leaders of participatory research will encourage the fruitful interaction between academia, government and industry, which has led to the technology explosion in the wealthy parts of the globe; they will facilitate strong and effective partnerships between national and international science, and between science and the user of science (typically the resource-poor smallholder).[17]

A focus on reliability and efficiency

A participatory research effort is based around the highly efficient use of the right inputs used in the right way. This creates broad based opportunities for the poor to benefit directly from effective access to the improved seed, fertilisers and other critical inputs that are the foundations of the essential growth in productivity. Efficiency and consistency are the guiding principles to developing a productive, commercialised and profitable agricultural sector, with broad based participation, and specifically involving the poor and vulnerable in creating realistic and profitable options for change. The viability of any change must be thoroughly tested (in terms of cash and other constraints – especially labour) and across seasons and other major sources of variation.

[17] This already exists for cash crops such as tobacco in Africa (and in non-African countries for a wide range of cash-earning commodities). The need now is to create the conditions that make it happen for staple crops also.

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Annotated bibliography of key studies

Study	Focus	Synopsis
Almekinders C. and Hardon J. (eds.), 2006, Bringing Farmers Back into Breeding. Experiences with Participatory Plant Breeding and Challenges for Institutionalisation, Wageningen: Agromisa Special 5, Agromisa,	Review of evidence of state of art of participatory plant breeding	This is a comprehensive and up to date review of participatory plant breeding initiatives, with solid analysis of problems and issues. Essential reading both with respect to participatory plant breeding and to participatory research more widely
Ampofo, J.K.O., Mziray, H.A., Hollenweger, U., Minja, E.M., Massomo, S.M., and Ulicky, E.W. (2004), 'Scaling up and out integrated pest management with bean growers: Some experience from eastern and southern Africa'. In: Pachico, D.H., Fujisaka, S. (eds.). Scaling up and out: Achieving widespread impact through agricultural research. Centro Internacional AgriculturaTropical (CIAT), Cali, Colombia p133-142. (CIAT Publication No. 340). (Economics and Impact Series 3).	Experiences in scaling out of agricultural research	The chapter cited is the best example of widespread uptake. Dr. Minja has an excellent track record of achievement in participatory research. Her experience is well documented and provide a template for successful scaling out implementation. There are other chapters that are useful.
Bezner-Kerr, R., Snapp S., Chirwa M., Shumba L., and Msachi R., 2007, "Participatory research on legume diversification with Malawian smallholder farms for improved human nutrition and soil fertility". Experimental Agriculture 43:437-453	Field implementation of participatory research	Well documented and relevant material on the design and implementation of participatory research; especially in a situation where this is a very new was of doing business for researchers. Should be read in conjunction with the other Sieglinde Snapp papers in the reference list – she is one of the most innovative and thoughtful practitioners of combining conventional and participatory research to produce results on the ground.
Chambers R., 1994, "The origins and practice of participatory rural appraisal", World Development, 22: 953-969	Review of PRA	Robert Chambers is one of the leaders in the development of participatory appraisal methods. He was written extensively in the field but this piece provides solid background to the origins and early focus of participatory research. Very linked to social science analysis and less useful with respect to addressing core science.
Collinson M., 2000, A history of farming systems research, Wallingford: CABI	An overview of perspectives in changing mindsets in the research community	Mike Collinson was a pioneer in bringing social science and biological research into an integrated programme through what he termed 'farming systems research'. The field has moved on since his early work but the simple methodologies he developed and implemented, combined with reskilling of conventional researchers provides valuable insights into how to improve performance in today's efforts.
Davis K., Nkonya E., Kato E.,	Analysis of	FFS have been widely used to improve

Study	Focus	Synopsis
Mekonnen D., Odendo M., Miiro R., Nkuba J., 2010, Impact of Farmer Field Schools on Agricultural Productivity and Poverty in East Africa, IFPRI Discussion Paper 00992, June 2010	impact of farmer field schools	uptake of improved technologies and, as such are an important component of participatory research. This paper provides a solid evidence-based analysis of their performance in terms of farmer productivity and research uptake
DeVries, J. and Toennissen, G., 2001, Securing the harvest, Wallingford: CABI	Research uptake review	A thoughtful piece on the role of agricultural research on poverty. The focus is largely on conventional and high-end research.
Dixon J et al, in press, Farming systems and poverty: improving farmers' livelihoods in a changing world (2nd edition), Washington DC: World Bank and Rome: FAO	The first edition is probably the best overall picture available of world farming systems	The first edition was published in 2001. This is being reissued with a focus on African farming systems this year. It will a comprehensive analysis of the state of African farming systems and priority intervention points. Essential reading for understanding agricultural interventions not only in Africa but in comparable ecologies across the world.
Ellis, F.,2000, Rural livelihoods and diversity in developing countries, Oxford: Oxford University Press	A very good overall analysis of rural livelihoods in the developing world	Frank Ellis has published widely in this field. This book is well documented and remains relevant today.
Juma C., 2011, The New Harvest: Agricultural Innovation in Africa, Oxford: OUP	Successes and opportunities to transform African agriculture	Calestous Juma is a foremost thinker in African development. This provocative and challenging book is essential reading for all involved in using agriculture as a route to changing the lives of the rural poor – and not just in Africa although that is the focus of his work
Kamanga B, 2011, "Poor people and poor fields? Integrating legumes for smallholder soil fertility management in Chisepo, Central Malawi", unpublished PhD thesis, Waginengen	Field experience in using participatory methods	This should be read in conjunction with the Snapp papers referenced. It is an excellent PhD study, well referenced and provides good insights into implementation of participatory research. It is available in published book form from Waginengen University.
Kitch L.W., Boukar O., Endondo C. and Murdock, L.L. (1998). Farmer acceptability criteria in breeding cowpea. Experimental Agriculture 34: 475-486.	Farmer participatory plant breeding	A well written paper outlining issues faced in the early days of attempting this approach, but remains relevant today
Lele U., Pretty J., Terry E., Trigo E., 2010, Transforming Agricultural Research for Development, The Global Forum for Agricultural Research (GFAR) Report for the Global Conference on Agricultural Research (GCARD) 2010	Review of options for research approaches	Very good on problem description and provides a solid background to the state of the art with respect to research designs and technology transfer approaches. Weaker in terms of recommendations for change and actual implementation.
Moock, 2014, Network innovations: building the next generation of agricultural scientists in Africa, paper presented at the 10th Biennial RUFORUM conference, Maputo, July,	Review of the role of networking in agricultural research	An outstanding and very thoughtful paper. Provides a clear vision of networking and its central role in scaling out innovation to dispersed poor communities and institutions. Available

Study	Focus	Synopsis
2014		on the RUFORUM website www.ruforum.org
Neef, A., & Neubert, D., 2011, “Stakeholder participation in agricultural research projects: a conceptual framework for reflection and decision-making”. Agriculture and Human Values, 28: 2, 179-194.	Reviews and recommends research typologies	A very comprehensive review and the authors come up with a revised typology to address the case today where participatory and conventional research often work in partnership. A little difficult to put into practice and the focus is primarily on biological rather than comprehensive applied research.
Pound, B. Snapp S., McDougal C., and Braun A. (Eds.), 2003, Uniting Science and Participation: Managing natural resources for sustainable livelihoods. Earthscan, U.K. and IRDC, Canada	A relevant and well documented compilation of research experiences	Essential reading in the context of this report. Provides excellent documentation on the approaches to, and successes/problems in combining participatory and conventional research
Snapp, S., Kanyama-Phiri G., Kamanga B., Gilbert R., and Wellard K., 2002, “Farmer and researcher partnerships in Malawi: developing soil fertility technologies for the near-term and far-term”. Experimental Agriculture 38:411-431	Participatory research practice	An early publication of the ‘mother-baby’ methodology that has served to link biological and participatory research
Snapp S., and Pound B., eds., (2008), Agricultural Systems: agroecology and rural innovation for development, Amsterdam: Elsevier	An outstanding compilation of experiences in research applications	This book is widely used in graduate courses as a core text. It is being issued in a second edition and will be available later in the year. Accessible and with a wide range of relevant material
Snapp S., Blackie M., Gilbert R., Bezner-Kerr R., Kanyama-Phiri G., (2010), “Biodiversity can support a greener revolution in Africa”, PNAS, 107 (47): 20840-20845	Long term impact analysis of combined participatory and conventional research	One of a very few papers published in PNAS dealing with on-farm research. A nice use of economic and biological information to inform policy
Sumberg J., Gilbert E., and Blackie M, (2004), “Income diversity, technology choice, and agricultural research policy in SubSaharan Africa”, Development Policy Review, 22,2:131-146	Typologies of agricultural research and their use in policy	A useful analysis which can be read in combination with the Neef and Neubert paper
Ward A., Minja E., Blackie M., and Edwards-Jones G., (2007), “Beyond participation – building farmer confidence: experience from Sub-Saharan Africa?”, Outlook on Agriculture, 36:4. 259-266	Experience in implementation of participatory research	To be read in combination with the other Minja papers. Pulls together field experience to provide a framework for improved implementation of agricultural research through participation