The UK Department for International Development (DFID) Strategy for Renewable Natural Resources Research for the period 1995–2005 aims to contribute to poverty elimination by enhancing productive capacity in the renewable natural resources sector in an economically and environmentally sustainable way. Research activities are undertaken in agriculture, animal health and productivity, forestry, and fisheries. The Crop Protection Programme (CPP) is one of the research programmes within the agriculture sector and is taking forward research funded by DFID and other agencies over the preceeding years. The CPP is managed for DFID by Natural Resources International Limited. (www.nrinternational.co.uk)

Enhancing impact originates from a CPP review of current initiatives that promote crop protection research outputs – both knowledge and products – to African farmers. The report draws on examples from Bolivia, India, and Africa, in order to demonstrate progress CPP has made in enhancing the impact of its best research findings in the most suitable and sustainable way. The report also includes experience from other development agencies and programmes, including efforts to link in with processors and suppliers, and a critical look at the farmer field school approach.

CPP
CROP PROTECTION PROGRAMME

DFID Department for International Development

nr international

Natural Resources International Limited
Park House, Bradbourne Lane, Aylesford, Kent ME20 6SN, UK
Tel: +44 (0)1732 878670 (direct line) 1732 878686/7 (switch board) Fax: +44 (0)1732 220497
Website: www.nrinternational.co.uk and www.cpp.uk.com Email: info@nrint.co.uk

Enhancing impact

Strategies for the promotion of research technologies to smallholders in eastern and southern Africa

A report to the DFID Crop Protection Programme

The Department for International Development (DFID) is the UK government department responsible for promoting development and the reduction of poverty. The policy of the Government was set out in the White Paper published in November 1997. The central focus of the policy is a commitment to the internationally agreed target to halve the proportion of people living in extreme poverty by 2015, together with associated targets including basic healthcare provision and universal access to primary education by the same date. A second White Paper on International Development, published in December 200, reaffirmed this commitment, while focusing specially on how to manage the process of globalisation to benefit poor people.

Natural Resources International Limited (NR International) specialises in managing programmes and projects in the natural resources, environmental and rural development sectors, as well in cross-cutting areas such as institutional development. The company is owned by the University of Edinburgh, Imperial College of Science, Technology and Medicine and the University of Greenwich, and draws on the expertise of these and other institutions, both in the UK and overseas. In addition to the CPP, NR International also manages the Crop Post-Harvest, Livestock Production, Forestry and Post-Harvest Fisheries research programmes on behalf of DFID.

About the authors

Malcolm Blackie has been involved with smallholder agriculture most of his working life. In 1980 he became Professor of Agricultural Economics and Dean of Agriculture at the University of Zimbabwe. In 1988 he joined The Rockefeller Foundation and was responsible for the establishment of its Southern Africa Agricultural Sciences Programme. Today he works as an independent consultant and is also a Visiting Research Fellow at the University of East Anglia.

David Gibbon has 40 years experience in agriculture and rural development, monitoring and evaluation, research and education, in both the South and the North. He is currently working as a freelance researcher, participatory systems trainer and consultant in farming and rural livelihoods systems. He is a Visiting Professor, Systems Discipline, Open University, UK, a Member of the Scientific Committee of the European Farming Systems symposium and on the Editorial Board of the Journal of Experimental Agriculture.

Cover photograph: **Ugandan farmers participating in a maize trial**

Enhancing impact:

strategies for the promotion of research technologies to smallholders in eastern and southern Africa

A report to the DFID Crop Protection Programme

By
M. BLACKIE and D. GIBBON

nr international

Natural Resources International Limited
Park House, Bradbourne Lane, Aylesford, Kent ME20 6SN, UK

2003

This publication is an output from the Crop Protection Programme of the UK Department for International Development (DFID) for the benefit of developing countries. The views expressed are not necessarily those of DFID.

BLACKIE, M. and GIBBON, D. (2003) Enhancing impact: strategies for the promotion of research technologies to smallholders in eastern and southern Africa, Natural Resources International Limited, Aylesford, UK. 60 pp. ISBN: 0-9539274-6-6

The Communications Manager
Crop Protection Programme, Natural Resources International Limited, Park House, Bradbourne Lane, Aylesford, Kent ME20 6SN, United Kingdom

Tel: +44 (0)1732 878670 (direct line)
Tel: +44 (0)1732 878686/7 (switch board)
Fax: +44 (0)1732 220497
Website: www.nrinternational.co.uk and www.cpp.uk.com
Email: info@nrint.co.uk

Contents

Executive summary

Poor farmers in Africa do not want to be poor. The reason so many are living on the 'edge of survival' is that too many of their traditional approaches to agricultural production are breaking down. The development challenge is to create predictable and significant improvements in cropping systems that are grown on soils which are very low in fertility and subject to the further stress of periodic drought. **Crops and cropping systems must perform reliably and consistently to *improve yield stability and safeguard the investments* of land, labour (and what little capital is available) of some of the world's most vulnerable people.** The aim is to create an environment that facilitates integrated scientific and technical initiatives extending from the farmer to the laboratory and back again. This effort is guided by a commitment to improving the performance of cropping systems at the lowest ends of the productivity spectrum. It is informed by the understanding that change typically needs a **combination** of improved production factors (irrigation, drainage, improved cultural practices, introduction of fertilisers) together with the introduction of varieties that make more efficient use of limited and variable natural resources. Three central components can be identified:

- **Intensive interaction with farmers**
- **Strong national-level technology development and dissemination capacity**
- **Strong and effective links to international science and the markets.**

African crops are threatened by a daunting array of production constraints, many of which are related to pests and diseases. Improving food security in Africa will require the improvement of a broad range of cropping systems. The UK's Department for International Development (DFID) Crop Protection Programme (CPP) has a portfolio of pest-management technologies and experience, developed not only in Africa but also in Asia and Latin America that can be exploited to benefit the poor and excluded in eastern and southern Africa.

Pro-poor agricultural research must provide low-income farmers and consumers with real choices and options. Participatory methods, in various forms and guises, are part of the necessary interactive process with farmers; they are not a substitute for it. Farmer participation and the use of local and farmer knowledge are catalysts, not substitutes, for focused scientific programmes. Farmers, like many scientists, have a deep knowledge about small, specific areas. To create change that will affect many poor farmers, different broad-based partnerships need to be developed and sustained. Actors whose concern is to reach out to thousands (and hundreds of thousands) of farmers need to be brought into the process. Despite much evidence to the contrary, there is a widespread perception that too much research is produced on the basis of researcher interest (i.e. it is supply-driven) rather than on farmers' needs (i.e. demand-driven). Researchers have been surprisingly innovative in developing the necessary tools to encourage and sustain farmer input into the research agenda, although the application of such tools now needs to be much more widespread and routine, with due consideration being paid to their limitations.

The challenge of conducting participatory research with many clients over an extended geographical area (common in pest and natural resource management research) is considerable. Researchers have come up with imaginative solutions to the issue. The Mother and Baby trial design makes it possible to collect quantitative data from Mother trials managed by researchers and to systematically cross-check the results in Baby trials on a similar theme that are managed by farmers. Benchmark sites (BSs) used in banana research in Uganda have been valuable in accelerating the uptake of promising improved technologies. The Soil Fertility Network led by Centro Internacional de Mejoramiento de Mäiz y Trigo (CIMMYT) has adopted a 'best-bet' approach, involving a regular set of field tours during which researchers and farmers using a rigorous process of peer review, review ongoing technologies in the field, with inputs from scientists and farmers, as research moves from a researchable idea towards a potential adoptable technology. The process is very open, consultative and inclusive. It is intended to provide a challenge to the best scientists and a learning process for younger entrants, as well as a way of bringing farmer voices into the exercise in a continuing, rather than a one-off, manner.

With a focus on scaling up of promising technologies and reaching large numbers of farmers, the issue of building coalitions becomes important. In Bolivia, CPP and its partner agencies have been highly active in promoting a collaborative effort for the promotion of improved potato technologies using the new national policy framework and engaging potential and existing partners. The outcome has been an innovative, imaginative and impressive exercise that links demand with supply for agricultural research, while at the same time taking into account evolving market factors. In Zimbabwe, a soya bean task force successfully promoted the crop amongst smallholders. The Malawi 'starter pack' effort was designed to improve the productivity of smallholder maize-based cropping systems by a strategy of providing **all** smallholders with small 'starter' packs of improved seed and fertiliser for farmers to use (and appropriately modify for their own circumstances), on their own fields in accordance with the new area-specific recommendations from the work of the Maize Productivity Task Force. In Kenya, a locally based network, the Forum for Organic Resource Management and Agricultural Technologies (FORMAT), has been established as a platform to stimulate the sharing of ideas and technologies involving more efficient use of under-utilised organic resources.

The farmer field school (FFS) approach has been widely adopted in Asia as a means of promoting integrated pest management (IPM). Those farmers who have participated in an FFSs have managed to reduce their use of pesticides, improve their use of such inputs as water and fertiliser, realise enhanced yields and experience increased incomes. Although conventionally the costs of running an FFS are high (which has implications for the sustainability of the approach in cash-strapped African economies), modifications developed in Kenya show promise, particularly in the intensive horticultural industries, and may provide a viable mechanism for providing smallholders with opportunities to participate in the valuable export sectors of these industries.

There is a growing interest in the potential of non-governmental organisations (NGOs) who are perceived, not always correctly, as participatory systems focused on and favouring low-input technologies and with an institutional structure that gives them an advantage in responding to the needs of the rural poor. However, they are often poorly coordinated among themselves and with the wider development process. The Western Kenya Consortium (WKC) was formed to design a strategy for scaling up technological options to the majority of western Kenyan smallholder farmers by building successful partnerships among research organisations, extension agencies and NGOs. The key working principles were a shared vision, voluntary and neutral membership and active collaboration and networking.

While smallholders in Africa are desperate for new and improved agricultural technologies, their ability to express this demand is weak. The consequent market failure means that the private sector, in general, finds few attractive investment options. But it is also pertinent to realise that, even if markets were more efficient, the capacity of the private sector to adequately address the chronic and increasingly severe problem of African rural poverty is untested and the expectations placed upon it are unrealistic.

Rapid growth and consolidation in the private-sector agricultural research and development (R&D) business has resulted in a situation where five integrated multinationals (the Big 5) dominate the world market for commercial agricultural technologies, with the balance of expertise held within a residue of small Organization for Economic Community Development (OECD)-based biotechnology companies and in publicly funded advanced research institutes and universities. A long-term collaboration between advanced 'First World' institutes, the Big 5 and public (or private) agencies in the developing world is an opportunity yet to be explored. The development of such partnerships from concept to policy will, inevitably, be a tough and tortuous process. However even if these partnerships do provide improved access to existing technologies and the technologies can be successfully adapted for local conditions, **the** major challenge for developing countries is achieving uptake and use by local agribusiness and agricultural producers, including resource-poor smallholders.

Ahead of all these possible changes, there are opportunities well-suited to imaginative partnerships between scientists, farmers and the market. CPP has already explored several of these and further possibilities exist. The challenge to agriculture-led, poverty-reducing growth is greater in today's poor rural areas as they face the combination of increased risk and uncertainty with increased costs and/or lower returns to agricultural investment. It is unfortunate that an already difficult task has been made harder by broader processes of change (for example, by HIV/AIDS and some aspects of globalisation and the biotechnology revolution). In such a context, therefore, it is unlikely that research activities on their own, will be able to comprehensively address the poverty alleviation agenda. However, significant impacts have been consequent upon the implementation of high-quality, focused research activities. The CPP has been involved, at some level, with several of these efforts and is well-placed to build on this experience for the future benefit of poor communities in southern and eastern Africa.

CPP has already made considerable progress in incorporating farmer participation into its activities. This needs to be strengthened and explicitly made an important part of the process rather than either a marginal or a one-off consultation exercise. To stimulate local ownership (by farmers and researchers) and to encourage innovative explorations and collaborations, CPP should consider either setting up its own African network on the FORMAT model, or linking with an existing network. Ongoing peer review, perhaps incorporating some of the experience of the CIMMYT Soil Fertility Network, could be invaluable in building up and strengthening institutional memory. A small budget for preparation grants might be set aside to allow promising ideas to be developed into proper proposals.

Crop diversification is an obvious opportunity for improving rural livelihoods. There is effective market demand for cash and food crops which smallholders either already grow, or those which they could quite readily bring into their farming systems. Groundnuts, pigeonpea, chickpea, cowpea, maize and a range of other crops have both local and international markets that are open to skilful exploitation. Horticultural crops have evident local and international markets that smallholders can exploit. Both traditional and introduced crops exist, which, once important technical obstacles have been removed, have been taken up with enthusiasm by smallholders. This should be combined with bringing experience from CPP's work in Asia and Latin America to bear on the African problem. Strategic partnerships will have to be developed between the private sector and institutions involved in technology development and promotion to focus the research agenda, to stimulate farmer demand for new technologies and to explore and develop market opportunities.

The HIV/AIDS pandemic in southern and eastern Africa will impact heavily on rural families. Labour, already critically short at important periods of the cropping season, will become even more so. A focus on such labour-saving technologies as the use of herbicides for weed control or low-cost, low-labour methods of pest control are an obvious priority. Efforts in the control of *Striga* and cereal stem borers are showing considerable promise and efforts to validate and scale up the best control technologies will be important.

Future development should focus on building on the experience of CPP's ongoing promotional programme to incorporate additional features, particularly:

- Developing partnerships with training and education institutions to help build the research/extension/training linkages necessary for farmer/client-driven participatory research and development
- Identifying 'best-bet' technologies and developing 'tool boxes' for appropriate interventions
- Refining dissemination technologies
- Implementing pilot projects
- Setting up a forum for sharing information and experiences and a 'who's who' database (directory of institutional and individual capabilities)
- Providing small grants to catalyse and facilitate community involvement.

Scaling up should bring experience from Bolivia and elsewhere to contribute to opportunities (such as those in Uganda) where institutional change provides a chance for innovative and imaginative coalitions.

Overview

The relatively under-developed, non-globalised state of African agriculture presents scientists, farmers and development agents with challenges at a number of levels. This report will show that real livelihood gains resulting from enhanced food availability and agricultural productivity in Africa are possible. These gains can be realised, not only by the better-off producers, but also by the poor and excluded through a strategy directed by farmers' needs and informed by the ecosystems in which the new products will be used. Moreover, it appears likely that the privatisation and globalisation processes that have resulted in the distribution of better seed and input-based technologies to farmers in other parts of the world will continue to have problems in reaching large numbers of farmers in Africa. Public sector based strategies for technology transfer, often (but not exclusively) in partnership with private-sector agencies, will continue to be critical to broad-based rural development and poverty alleviation in much of Africa for the immediate future.

Knowledge transfer and interchange

The task of this report is to explore practical and affordable options for engaging a broad range of individuals and institutions capable of contributing to the central theme of rural development in Africa – **the alleviation of poverty and the development of sustainable livelihoods for the poor and excluded.** Many countries and communities in Africa are caught in a poverty trap. Their greatest problems include infectious tropical diseases, low agricultural productivity and environmental degradation. Solutions to these problems are simply beyond the means of the concerned countries. Where useful technologies are available from abroad, countries find themselves too poor to afford them. But foreign technologies are inappropriate for local conditions and poor country markets provide scant incentives for research and development.

Innovation requires close and effective collaboration between 'public good' research and the market. While increasing the demand-led component of the research agenda is important in the developing world, such an approach will not, on its own, act sufficiently fast to lift the technologically disconnected rural poor out of poverty. The same need for fruitful interaction between academia, government and industry which has led to the technology explosion in the wealthy parts of the globe is needed in the developing world. A balance between allowing the poor to help focus the research agenda, while permitting the brightest and best to explore new and interesting opportunities is essential.

What is being sought is a strong and productive partnership between African and international science and between science and the user of science, who in Africa, is typically the resource-poor smallholder. In terms of wealth, resources and often (but not always) skills, the scientist (and frequently the overseas partner) has in the past tended to dominate the relationship. In Africa itself, it has been difficult to build long-term partnerships between universities and the national agricultural research systems (NARS) and to ensure that the voice of the smallholder is not lost. What is being proposed here is a much more even partnership than has been typical in the past, with all sides playing full roles in the design and implementation of programmes. Particular attention needs to be paid to ensuring that adequate note is taken of the concerns and experience of the weaker partners at all stages of programme implementation.

Farmers in crop protection technology transfer in Africa

African agriculture in the early 21st century is a highly complex system where a single component rarely has a consistent overriding influence. Improved varieties that yield impressively on research stations often fail to replicate their performance in farmers' fields. Pests, diseases, rainfall and soil fertility combine to produce a risky and variable production environment. The poor find themselves trapped in low-input, low-risk, low-productivity systems with few consistently reliable options for pulling themselves out of poverty. Biophysical signals within and between cropping systems substantially check the success that could be enjoyed by any single component of the system.

Female-headed households can easily be excluded from research

African farmers, as do their counterparts in other regions, have shown considerable talent for innovation and ingenuity. They have developed complex cropping systems to fit environments ranging from the slopes of Mount Kenya to the fringes of the Sahara, each with its unique mix of biotic and abiotic constraints. Many can be characterised as low-risk, low-input, long-fallow systems. Poor soils, short and unreliable growing seasons and a challenging array of pests and diseases favour strategies that: (a) do not involve high inputs of labour, land and cash, (b) are stable in both bad and good years, and (c) are productive within the normal resources available to a farming household.

The challenge, therefore, for African crop scientists is to create predictable and significant improvements in cropping systems growing in soils that are very low in fertility and subject to the further stress of periodic drought. The focus is not simply one of increasing yields.

Crops and cropping 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) graphically set the scene:

"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 so 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"**.

Several factors are evident from this analysis. The family can shift from the 'edge of survival' to at least 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 those 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

Field trials and demonstrations involve farmers in the research process

profit more from crop technologies which enhance and stabilise yields by limiting losses than from technologies that are designed to generate higher yields (Herdt, 1991). A single mother hoping to harvest 1000 kg of rice on a hectare of depleted upland soil can ill afford to lose 100 kg, i.e., 10% 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 adequately repay the labour or cash inputs involved.

Yield-stabilising traits come in many forms, but usually translate to an increased ability of plants to resist or tolerate such biological and environmental stress factors as pests, diseases, drought and low soil fertility. African crops are threatened by a daunting array of production constraints, many of which are related to pests and diseases. Table 1 illustrates production constraints[1], that farmers can do little to change, on some of the most important food crops on the continent. Table 2 compares the disease incidence on some of these crops between tropical and temperate areas.

Table 1. Production constraints on important African food crops

Focus crop	Trait
Maize	*Striga*, stem borers, phosphorus uptake
Sorghum	*Striga*, anthracnose, phosphorus uptake
Millet	*Striga*, head miner, downy mildew
Rice	Gall midge, rice yellow mottle virus
Cowpea	Maruca pod borers, bruchids, thrips
Cassava	Root rots, green mite
Banana	Banana weevil, nematodes, black Sigatoka

Table 2. Crop disease incidence in temperate and tropical areas

	Number of diseases	
Crop	Temperate	Tropical
Sweet potato	15	187
Rice	54	500–600
Beans	52	253–280
Potato	91	175
Maize	85	125

Source: Dover and Talbot (1987) quoted in DeVries and Toennissien (2001)

Poor farmers in Africa do not want to be poor. The reason so many 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 most African farmers (who are smallholders) are often those for which agricultural experts have few, if any, realistic answers. Nor can the farmer turn elsewhere for

1. Storage losses add a further dimension to these constraints

counsel. In a period of unprecedented change, farmers find that their traditional wisdom provides limited guidance. Rural communities in Africa 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 or to maintain productivity at acceptable levels (Eicher, 1990; Blackie, 1994). Meanwhile, continual increases in population have depleted both the available resource base and the social entitlements which hitherto provided a state of equilibrium in rural areas of Africa (Lele, 1989). Finally, steady increases in agricultural productivity in developed regions of the world (increasingly facilitated by biotechnology) have continued to push world grain prices downward, making it increasingly difficult for marginal-land farmers to operate profitably (FAO, 1999).

In stark contrast with Asia's food challenge of the 1960s and 1970s, improving food security in Africa will require the improvement of a broad range of cropping systems. Three central components can be identified:

- **Intensive interaction with farmers.** Farmers are remarkably skilled at exploiting environmental niches on their own farms. Conway (1997) counted 30 different uses of plant species on a single, 0.25-ha farm in Kakamega District, 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 in Africa. Farmers' advice and skills on issues of growing environments and household utilisation need to be incorporated explicitly into research agendas so that science is paired with the art of understanding people and their environment.
- **Strong national-level technology development and dissemination capacity.** Indigenous knowledge, which is the fundamental construct upon which this report relies, is an active and dynamic concept. It draws on expertise and information from within and outside farming communities, but with consistent and long-term indigenous leadership and vision providing direction and guidance.
- **Strong and effective links to international science.** The role of research in creating answers to problems on a scale unprecedented in human history needs to be carefully and skilfully orchestrated. It will require 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. Whereas Asia's struggle largely hinged on the ability of researchers and farmers to devise more productive rice- and wheat-based farming systems, in Africa, 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 African agriculture is such that the continent will require long-term continuing external scientific and technical support in a highly collaborative and interactive mode.

The aim is, therefore, to create an environment that facilitates integrated scientific and technical initiatives extending from the farmer to the laboratory and back again. The effort is guided by a commitment to improving the performance of cropping 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, application of fertilisers) and the introduction of varieties that make more efficient use of limited and variable natural resources. The introduction of improved wheat and rice varieties in Asia coincided with the wider availability of inorganic fertilisers and irrigation (Herdt and Capule, 1983). Cheap and widely available inorganic fertiliser facilitated rapid expansion and intensification of maize production in Nigeria following the introduction of improved, adapted varieties in the 1970s (IITA, 1995). More recently, improved maize varieties and increased fertiliser applications in Ethiopia during 1994–96 produced a dramatic, 31% increase in average yield (Quinones *et al.*, 1997). Such experiences provide continued justification for the integration of research efforts aimed at improving sustainability within low-input farming systems.

Privatisation of agricultural input markets has eliminated much of the capacity of governments to use subsidies to encourage the use of combined packages of improved seed and such other inputs as fertilisers (Cromwell, 1996). To an increasing degree, therefore, poor farmers are also left with fewer options. Higher input prices following the removal of subsidies have led to reduced input use in several African countries (Holden and Shanmugarathan, 1994; Bumb and Baanante, 1996). Higher seed prices in Malawi have reduced sales of maize seed (Smale and Heisey, 1995).

Soil fertility researchers have responded to reduced fertiliser usage among smallholder farmers by focusing research on the cycling of nutrients in low-input systems and the use of lower-cost ways of adding nutrients, such as through green manures and improved fallows (Sanchez *et al.*, 1997). In a similar vein, other crop researchers need to explore crop improvement strategies focused more on limiting losses due to common constraints in low-input farming systems than on increasing yields *per se*. The resulting convergence on issues of sustainability would present an opportunity for farmers, scientists and extension teams in Africa to combine their efforts and perhaps achieve some measure of the exponential yield response of a combined package.

Crop protection research successes in Africa

Agricultural research has had a considerable impact on poverty in Africa. Cassava yields increased dramatically in Nigeria following the introduction of improved varieties in the mid-1980s (Nweke *et al.*, 1994). Maize production in West Africa over the same period increased by an average of 4.1% following the development of early-maturing, drought-resistant varieties (IITA, 1995). Rapid adoption of hybrid maize in western Kenya during the 1960s and 1970s led to dramatic increases in productivity (Gerhart, 1975). Chapman *et al.* (1997) reported yield increases in sorghum, sweet potato, cowpea and maize in Mozambique when improved, adapted varieties were introduced.

The following sections outline some of the outstanding crop protection successes in Africa. Several very clear lessons emerge. In the late 19th century, European occupation and settlement of African lands resulted in significant long-term effects that continue to play out today. Importantly, colonial authorities developed long-distance transport and communications, opening up a whole new range of possibilities to Africa's farmers. As a result of increased access to new crops and outside markets, agricultural production from African smallholders boomed in the early part of the 20th century. Cocoa, coffee, cotton and groundnuts became major smallholder export crops. Agricultural change and experimentation blossomed. Farmers diversified into new crops and new varieties were readily accepted and tested.

But at the same time, populations were growing at an unprecedented rate throughout the continent,[2] mainly as a result of the introduction of modern medicine and hygiene. Farmers found it harder to move to new lands. Soon, over large parts of the more-densely populated countries of Africa, the traditional long rotations were no longer possible. In the search for new areas in which to live, farmers found themselves forced into areas that are clearly marginal for agricultural production.

As indicated previously, the data show that African smallholders have a very real capacity for developing new varieties to meet changed needs as these arrive, the banana story is particularly impressive in this regard. But this faculty is increasingly challenged by external events. On the one hand, the rise in international travel and the unprecedented movement of plant materials has led to the introduction of devastating new pests and diseases. It is unreasonable to expect poor African smallholders to adapt to these challenges without strong scientific support. On the other hand, the rate of change which African farmers face in so many aspects of their environment and daily circumstances makes it increasingly difficult for them to maintain a sufficiently fast rate of change to advance their levels of productivity to meet the needs of the 21st century. The examples listed below show the very real benefits from strong farmer/science interaction and collaboration.

2. The most rapid growth in Africa's population occurred after 1950, with modern family planning little used before the 1980s. "Until then, the inherited attitudes of an under-populated continent joined with modern medicine to produce the most sudden and rapid population growth the world is ever likely to see" (Iliffe, 1995)

Cassava

Cassava crop-protection successes are an interesting mixture of farmer-led enterprise and focused scientific endeavour. Cassava was introduced to Africa by Portuguese traders to trading stations in the Congo in the mid-1500s. The crop was attractive to farmers due to its drought tolerance, known resistance to locusts, low labour requirements and its capacity to survive in low-fertility soils (Jones, 1957; Gabre-Madhin and Haggeblade, 2001). It spread across Central Africa supplanting yams in some locations and cereals in others (Jones, 1957). Introduced into eastern Africa after 1800, cassava spread west into the interior from Zanzibar and Mozambique. It is now a major African staple food and, in particular, is an important source of household food security for many of the continent's poor (Gabre-Madhin and Haggeblade, 2001).

In the 1920s and 1930s, cassava mosaic virus, spread by a whitefly, threatened this increasingly important food-security crop in Ghana, Nigeria, Cameroon, Central African Republic, Tanganyika and Madagascar (Jones, 1957). Farmers responded immediately by replacing affected plants with cuttings from unaffected varieties. This theme was taken up by colonial agricultural research stations in Tanzania, Kenya, Madagascar and Ghana which introduced cassava breeding into their programmes for the first time (Cours *et al*., 1997; IITA, 1992). The result, after a decade of intensive research, was a series of new resistant varieties which spread rapidly and largely replaced the affected local varieties (Gabre-Madhin and Haggeblade, 2001).

In the early 1970s, two imported pests – the cassava mealy bug in the Democratic Republic of Congo (then Zaire) in 1973, and the cassava green mite in Uganda threatened the crop. Lacking natural predators both spread rapidly across the continent. The mealy bug, the more voracious of the two, caused crop losses of 80% as it ate its way across the continent at over 300 kilometres per year. By the early 1980s, the mealy bug had infested the entire African cassava belt where it threatened the principal food source of over 200 million Africans (Herren and Neuenschwander, 1991). A decade of collaborative work by international and national research institutions led to the identification of a natural predator of the mealy bug. The International Institute for Tropical Agriculture (IITA) mounted a mass rearing and distribution programme in collaboration with African NARS. First released in 1981, by 1988 the predator wasp had, largely controlled the mealy bug threat throughout Africa (Gabre-Madhin and Haggeblade, 2001). A rather more challenging programme to identify a suitable predator for the cassava green mite has also proved successful.

Bananas in the Central Highlands

Bananas in the Central Highlands of Africa owe their importance as a food crop to skilful farmer plant selection over the last 800 years or so. The crop, like cassava, an introduction (but by Arab traders) was well-suited to the climate in what are now Uganda, Rwanda, Burundi and eastern Congo. Farmers liked the crop because of its high calorie yields per hectare and its ability to protect the soil from erosion

(Gabre-Madhin and Haggeblade, 2001). Ugandan farmers now grow some 60 different cultivars, the largest pool of genetic diversity anywhere in the world – and this despite the difficulties of undertaking crop improvement with a vegetatively propagated crop (de Langhe *et al.*, 1996; Reader, 1997).

In recent times, while the banana remains an established staple, it is increasingly threatened by pests and fungal diseases and farmers have not been able to develop varieties quickly enough to meet these new challenges. Tissue culture methods have been introduced to promote rapid and sterile multiplication of pathogen-free planting material. The Kenya Agricultural Research Institute (KARI), in conjunction with a local private biotechnology company, has begun to produce *in vitro* banana plants commercially. These have been shown roughly to double both yield and income under farmer conditions (Qaim, 1999). This farmer/scientist collaboration has supported the development of a highly sustainable food-security crop that currently accounts for over 25% of caloric consumption in such countries as Rwanda and Uganda. A commercial tissue culture laboratory is now established in Uganda and plants produced by tissue culture by a South African company have been used in national trials in Uganda.

African export horticulture

Kenya, with its high-value tourist industry, developed a quality vegetable production capacity for the local market in the 1950s. The rehabilitation of previously ecologically declining areas such as Machakos bears testimony to the positive effects of this industry on smallholders who have access to markets associated with the expanding tourist industry (Tiffen *et al.*, 1994). In 1957, private traders in Kenya began expanding this trade into the export of off-season vegetables and tropical and temperate fruits. After 1970, the trade expanded steadily as a result of growing demand in Europe, improved technologies and marketing systems for fresh vegetable distribution there, and substantial increases in air-freight space from Nairobi to Europe, a by-product of Kenya's booming tourist industry (Gabre-Madhin and Haggeblade, 2001).

The steadily increasing production quality standards, particularly in Europe, have led to a marked expansion in the considered use of pest control methods amongst the 500,000 smallholder vegetable farmers who today supply about 75% of all vegetables and 60% of all fruits under contract to exporters (Jaffee and Gordon, 1993; Noor, 1996). The value of horticultural exports rose from US$13 million in 1970 to US$155 million in 1999. In recent years Uganda, Zimbabwe and Zambia have all entered the same market.

Farmer associations are providing crops for export

Smallholder cotton

In Zimbabwe, before the recent policy turmoil in that country, most of the cotton crop was being grown by smallholders. The number of registered cotton growers increased from a few hundred farmers in the years before 1980 to 300,000 in 1992; by which time they were producing 200,000 t of seed cotton annually. But yields are still compromised by pests causing an estimated 60% loss in yields (Maumbe, 2001). Pest resistance to pesticides has added another dimension to the risks of growing cotton in Zimbabwe.

In 1996, Zimbabwe officially introduced FFSs-based integrated pest and production management (IPPM) training in a number of cotton-growing areas. Creative programmes including on-farm demonstrations and field days, radio programmes and rural agricultural shows have introduced information in participatory environments. Government legislation prevented ratooning cotton plants to restrict the spread of red bollworm and enforced the destruction of cotton stalks by specific dates in the different cotton regions. A Cotton Training Centre (CTC) introduced smallholders to the appropriate management of crop chemicals and fertilisers for cotton production. By 1996, more than 9000 farmers had undergone cotton training at the CTC, mostly in pest management and scouting, and yields had improved (Figure 1). The CTC has played a major role in the transfer of technology in the smallholder cotton sector in Zimbabwe.

CPP has a portfolio of pest management technologies that could be evaluated within an IPM or, preferably, an integrated crop management (ICM) context. Integrated resistance (to insecticides) management has been developed and promoted in India but there is scope for wider adoption, as indicated by experience from India. India accounts for 29% of the world's cotton area but only 15% of the


R Hillocks

Smallholder producers delivering their cotton harvest to a buying post in Tanzania

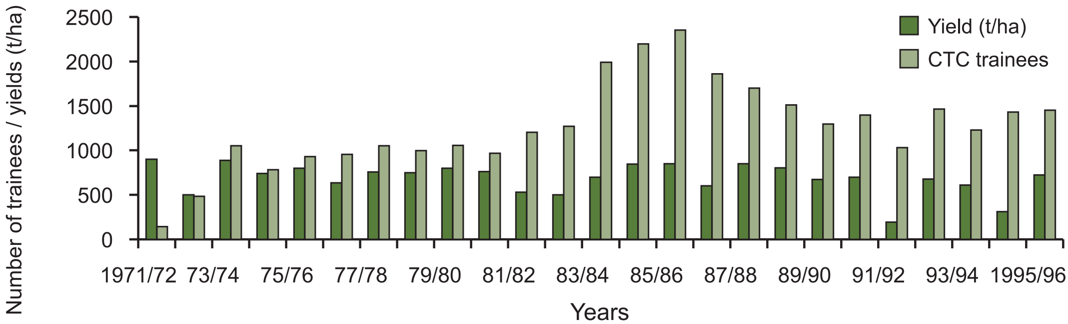

Figure 1. Relationship between cotton farmer training and smallholder yield trends, Zimbabwe 1971–96

total production. Yields per unit area have declined in recent years, in part due to weather but, equally importantly, as the result of a debilitating cotton virus spread by insects that is affecting production in the north, and by outbreaks of the American bollworm (Russell, 1998). Pesticides account for around 25% of crop-production costs. Spraying equipment is badly maintained and inefficiently used. Available pesticides are often poorly formulated by local companies and farmers have only limited advice (usually from the chemical dealer) on what and when to spray. However, the critical new factor is that the insects have become resistant to the pesticides. This has been countered by the development of novel pesticides, which act on the insects in new ways (e.g. by preventing them from moulting) or by growing genetically engineered cotton plants which produce bacterial toxins that kill the caterpillars.

Even more promising has been the introduction of IPM with a resistance focus. This involves working with farmers to 'manage' resistance by combining a range of such control practices as the use of resistant varieties, seed treatments, selective and limited spraying of particular pesticides only when pest numbers are high, and the alternation of chemicals that work in different ways to avoid the build up of resistance. Pilot villages where these practices are in use are showing very encouraging results, with a reduction in chemical useage of at least 40% and yield increases of 20–40% (Russell, 1998). From 1996–99 Researchers at the Natural Resources Institute (NRI) collaborated with farmers and scientists at the Central Institute for Cotton Research (CICR), Tamil Nadu Agricultural University (TNAU) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) to create pest management strategies that are economical, sustainable and safer. These were based on the use of appropriate pest-tolerant varieties, suitable agronomic practices, detailed pest scouting, and the application of chemical insecticides as a final resort only when pest numbers exceed clearly defined thresholds. Such IPM strategies aim to protect the biodiversity of the agricultural scene while maximising the role of natural agents in minimising pest impact.

In three Indian States – Tamil Nadu, Andhra Pradesh and Maharashtra – NRI and Indian researchers and cotton farmers have together developed and tested a set of IPM 'best-bet' practices. Village participatory methods were employed to ensure that the benefits encompassed the whole community. The results of trials by over 1000 farmers in 13 villages in the three states have been dramatic. The use, and thus the cost, of pesticides were reduced by almost half in two states and almost entirely in one. It was also estimated that hazards to health due to pesticide use dropped by between 77 and 98%. And despite the low chemical usage, yield increases rose in all three states

CPP can capitalise on its portfolio of cotton pest management technologies to focus further research on cotton IPM/ICM within a sustainable livelihoods context. Once Zimbabwe returns to normality, that country is an evident candidate for such work because of the satisfactory linkages already developed by CPP-supported researchers. In Uganda, the project for Investment in Developing Export Agriculture (IDEA) is seeking advice and technical support on IPM as part of its mission to demonstrate improved cotton production practices on 6000 farms by the end of 2002. An active effort to build similar linkages in other African cotton-producing countries could have widespread impact.

D Russell

Participatory farmers in India recognise the benefits of improved pest management

Building farmer/scientist partnerships

The preceding examples are not intended as a comprehensive review of achievements in crop protection in Africa. Rather they aim to highlight across a range of very different commodities, from food crops to high-quality export production, the power of linking farmer knowledge and interest with the best of modern science. The challenge is urgent. The income of the richest 1% of the world's population is equivalent to the income of the poorest 57% and the relative income distribution is getting worse. In 1960, average *per capita* incomes in the industrialised nations were nine times those in sub-Saharan Africa; today, they are 18 times higher. Eight hundred million people are food-insecure and 166 million pre-school children suffer from calorie/protein malnutrition. Many more suffer from micronutrient deficiencies. Between 5 and 7 million pre-school children die from nutrition-related illnesses every year (Pinstrup-Anderson, 2002).

Farmer with her vitamin A-enriched sweet potato multiplied for the local community, Uganda

Pro-poor agricultural research must exploit all appropriate scientific tools and methods and provide low-income farmers and consumers with real choices and options. They need to be active participants in setting priorities for research and every effort needs to be made to ensure that promising technological developments do not bypass the poor. The remainder of this report is devoted to the challenge of turning such good intentions into practice.

Diagnosis and cure: methods, analyses and problem solving

Effective problem diagnosis, particularly by outsiders, requires careful information gathering and analysis. In the complex African farming systems outlined earlier, there is a real issue of where to set the boundary around the information task. Reductionist scientific approaches tend to set boundaries narrowly round a perceived problem area and to concentrate the consequent analysis and problem-solving activities within tightly constrained frameworks. This can and has worked successfully. Ideally the problem is clearly evident and the researcher is fully familiar with the context within which various potential solutions must operate.

In the cassava examples mentioned previously, a clear focus on a single, serious problem, combined with strong inputs from the field, led directly to success. The problem was considerable – huge areas of the crop were being devastated. In the pest examples, the only viable option, given the farming circumstances of the typical cassava grower, was the introduction of a natural predator to control the introduced pest. Once a predator was identified and its ability to perform across the cassava belt established, the problem became one of mass rearing and distribution.

But such clear-cut problems are the exception. Ellis (2000) reviews the case of farmers in the Hai district in Tanzania. The conventional wisdom was that coffee had been their main source of cash earnings but had steadily declined due to poor prices, coffee berry disease and ageing trees. At the policy level, liberalisation had been introduced to improve farm-level coffee prices but, in practice, due to the concurrent increases in input costs, the profitability of coffee to the smallholder had not improved. Unsurprisingly in these circumstances, farmers simply did not invest in replacing their trees. In fact, a detailed look at the data showed that the farming system was no longer predominantly based on coffee but was actually dependent on milk production from stall-fed dairy cattle. A programme to address the evident problem of coffee berry disease, while important in the context of coffee, could have been expected to make little impact on farmer incomes or poverty alleviation in such an environment.

The problem then is how to collect high-quality data as the basis for intervention in any farming system. The traditional approach is to undertake a detailed survey. Large-scale field surveys are expensive and all 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 are the real problems 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.

Participatory data collection methods

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 the efforts of Collinson in the 1970s and 1980s (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

Farmers participating in a maize trial

supplemented by secondary data from key sources and informants. Variations on this theme – with a broader, less directly agricultural focus – have been developed by Chambers and others, i.e. rapid rural appraisal (RRA) and participatory rural appraisal (PRA) (Chambers, 1981; Chambers, 1994; McCracken *et al.*, 1988). The aim has been to develop quick, accurate and relatively cheap ways to collect relevant information on a local scale, including information on poverty and social, seasonal, personal and diplomatic dimensions (Chambers, 1994). Methods include group discussions, drawing maps, transect walks, time lines and trend analyses, seasonal calendars and wealth ranking amongst others. The intention is to encourage and facilitate the 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 on 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, thereby empowering them to become more active partners in development.

But such 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 can all methods of data collection, be liable to incorrect interpretation. The use of groups in particular can result in misunderstandings:

- Group 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
- Groups that relate to the purposes of the study (e.g. the poor, 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 of their strengths to acheive 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 simply extract information from the community. Regardless of how expertly this process is conducted, a single directional flow of information is, by its nature, bound to be limited in scope and quality. 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. 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. PRA in its various forms and guises is part of the necessary interactive process with farmers; it is not a substitute for it.

Farmer participatory plant breeding

Because crop varieties are usually developed by researchers who are rarely practising farmers (or, even when they are, operate on a different scale and with different resources from those of 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). By involving farmers directly, the plant breeder:

- Gains a better understanding of farmer preferences
- Is able to select more precisely for individual environments
- Is able to share the work involved in breeding
- Empowers farmers *vis-à-vis* the decision-making process.

Farmer participatory breeding methods and the use of local knowledge for seed development and distribution may be 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, in participatory plant breeding programmes farmers are rarely consulted prior to the genetic fixing of traits in candidate varieties, in contrast to their involvement in priority setting for desirable characteristics (Jones, 1999). Important factors determining the success of farmer participation in such schemes are the willingness and interest of farmers to set aside time for the work and a clear consensus on the needed crop traits among the farmers who are consulted.

Even greater farmer involvement can be achieved through training farmers in plant selection and stationing nurseries in farmers' fields to facilitate the evaluation by farmers of as many lines as possible ahead of the choice of the best candidates.[3] 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 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*).

The significance of this development was that the interspecific rice varieties represented an entirely new plant type with various combinations of traits contributed by each of the two species. The African rice genome contributed vigorous early growth that reduced competition from weeds together with resistance to a number of important pests and diseases. Asian rice characters that 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 that could be presented for release and multiplication through national research programmes.

In Year 1 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 2, 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 (Year 3), WARDA multiplies the varieties 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 that 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 to tap biodiversity and the wide variation that exists within landraces of crops grown in Africa. It is known that resistance genes exist in low, but useful, frequencies in a number of African crops but that are difficult to isolate in order 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, a methodology is gradually emerging to ensure 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 (Kitch *et al.*, 1998; Sperling *et al.*, 1993). Nevertheless, it is important not to ignore the

3. See also earlier work of Maurya in India (Maurya et al., 1988)

complexities in terms of taking timely decisions and maintaining the rhythm and steady progress necessary to get improved lines moved through a programme. Farmer participation and the use of local and farmer knowledge are catalysts, not substitutes, for scientific and focused breeding programmes.

Farmer participation in other research activities

Probably because, as noted earlier, 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. The involvement of farmers in selection of other technologies (e.g. soil fertility or pest management) has proved more problematic, with few successful models (Kanyama-Phiri *et al.*, 1998). The highly variable performance of technologies is one challenge; local adaptation may be necessary to optimise performance in a heterogeneous environment. These technologies also require substantial farmer investment in the form of land, labour or cash which can be a barrier to local experimentation. By contrast, participation in variety trials involves limited risk and it can be relatively easy to involve many stakeholders (Banziger and de Meyer, 2001).

The challenge of conducting participatory research with many clients over an extended geographical area (common in pest and natural resource management research) is considerable. The participatory development process is frequently conducted on a small project scale (Defoer *et al.*, 1998). Working intensely with many partners over a large area could require prohibitive levels of financial and human resource investment.

Benchmark sites (BSs)

The Uganda National Banana Research Programme (UNBRP) instituted an intensive programme of research into bananas in Uganda in the 1990s in response to a major decline in the productivity of this national staple. An important feature of this effort was the establishment of BSs with the aim of accelerating the uptake of promising improved technologies. The problem was considerable, with yields falling to as low as 6 t/ha. The life of a banana plantation had fallen from around 50 years to 5–10 years due to various social, economic and biological factors. Pests and diseases, including wilts, leaf spots (especially Sigatoka), parasitic nematodes and weevils caused many farmers to abandon their crops. As part of its drive to reverse this decline, the UNBRP is actively promoting the use of new, improved cultivars and the principle of planting banana material that is free of pests and diseases on pest-free and disease-free land – termed BSs. For example, in Luwero, 128 farmers have been given ‘clean’ planting material of traditional East African Highland cooking and brewing banana varieties and new hybrid varieties, bred especially for their resistance to diseases. The farmers are also adopting recommended management practices of mulching and manuring.

'Wonder' bananas evaluated through the benchmark sites project in Uganda

The outcome has been a marked enthusiasm among the farmers of Luwero to return to growing bananas. In addition, neighbouring farmers are also becoming interested in adopting the improved practices and re-entering banana production. The UNBRP cannot produce enough of the resistant cultivar FHIA 17 (renamed Kabana 3) even though the new cultivars do not have the same cooking quality or produce such good *matooke* as the true East African Highland cultivars and their bunches do not command the same price in the markets.

Mother and Baby trial design

A recent innovation to counter these constraints has been the 'Mother and Baby'[4] trial design developed by Snapp (1999). 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 the results in Baby trials on a similar theme that are managed by farmers. The design is very flexible – Snapp (1999) reports Mother trials located on-farm at central locations in villages, but they could just 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-replicate' 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 limited field size. It simplifies the design and makes it easier for farmers to evaluate technologies. Having many replicates across sites makes it possible to sample wider variations in farm management and environment (Fielding and Riley, 1998; Mutsaers *et al.*, 1997). 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 the plot was weeded. The farmers provide quantitative feedback

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

on their evaluation of technologies to researchers through surveys, paired matrix ranking and by rating technologies. Qualitative feedback is obtained from meetings between farmers and researchers and comments recorded during field days. The Mother trials are evaluated more informally during discussions held during field days. This makes it possible to integrate the farmers' assessment and improve research priority setting. Meetings are also held with senior stakeholders, conducted as part of an iterative process to maintain support and inform priority setting at every level. This process includes 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 provide a relatively rapid approach to developing 'best-bet' options. The linked trial approach provides researchers with tools for quantifying feedback from farmers and generates new insights, such as the need to widen the research focus beyond soil fertility to include such secondary benefits as weed suppression (Snapp *et al.*, 2002). 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 are 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 systematically involve many farmers and to rapidly elicit evaluation of technologies and varieties.

Farmers testing researcher-designed trials

Scaling up: building partnerships with the wider community

In the vision developed so far, farmers are already partners in the identification and development of improved technologies. Their knowledge and skills are directly incorporated within the options explored and they have the status of real participants in the effort to create change in their circumstances. But farmers, like many scientists, have deep knowledge about their own small area. To create change that will affect many, different and more broad-based partnerships need to be developed and sustained. Actors whose concern is to reach out to thousands (and hundreds of thousands) of farmers need to be brought into the process. In some cases, such as the cassava mealy bug example, researchers have the resources and capacity to take direct responsibility for this scaling up. In others, a thoughtful and careful handing over of responsibility may be the appropriate course of action.

Firstly, it is important to be realistic about the potential benefits to the poor of improved agricultural technologies. Agricultural research is, compared to many of the other options, a very cheap form of intervention. For example, in the context of present famine situation in Malawi, a programme costing US$1.9 m will provide a 'starter pack'[5] of maize and beans for winter gardens. This should produce some 75,000 t of incremental increase in maize over what would be produced without the inputs, with the beans providing an additional benefit. The cost of the programme would only buy about 6500 t of maize at present import parity prices, so even if there is a substantial shortfall below the 75,000 t, the programme remains highly cost-effective as a contribution to the national food supply (Potter, personal communication). Almost any biological technology that is accepted rapidly by a sizeable number of farmers generates sufficient returns to cover not only its own costs, but also many of the costs of programmes which prove ultimately not to be practical, or attractive, to farmers (Walker, 2000). Every research project will not generate a practical output. However, it is reasonable to expect that a mature research programme will produce several significant success stories. It is to the strategy of facilitating this last aim that the remainder of this report is devoted.

Researcher-led dissemination

Snapp *et al.* (2002) report that their aims for soil fertility technologies built as a development of the ongoing Mother and Baby trial exercise that catalysed farmers, researchers and extension advisors into learning together through action research.[6] The exercise was led by University of Malawi staff and students who began by extensively reviewing the literature and selecting a site with high

5. A 'starter pack' is a small, free demonstration pack made available on as wide a scale as feasible in order to move out new technology quickly. The approach was pioneered in Malawi in 1999 using maize seed and fertiliser in a pack of sufficient size to add one extra bag of grain to every farmer's granary

6. 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 was shot during a protest. Modern attempts to work with peoples' ideas and energies in managing watersheds positively are in marked contrast

population density and intensive land use. They chose the Songani watershed, characterised by steep, eroded slopes and with a population density of around 250 inhabitants per square kilometre – typical of many southern Malawi districts.

The researchers organised community meetings to define current resource use, farmer constraints and opportunities. As with the Mother and Baby trials, emphasis was placed on the inclusion of all members of the community, particularly female-headed households and the very poor[7] (Kanyama-Phiri *et al.*, 1998). 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 chose 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 and implementing participatory research trials. This documentation of farmer knowledge was particularly valuable in building up the capacity of researchers to communicate efficiently with farmers (Kamangira, 1997; Kamanga, 1999).

Establishing the collaboration in the watershed-based process involved considerable investment 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.*, 2002). It also served to develop technologies that were applicable to other regions similarly affected by erosion and intensive land use (Kamanga, 1999; Phiri *et al.*, 1998). The Songani watershed has become a platform for learning and action research for researchers from the University of Malawi who have continued to work with communities on defining their problems and developing long-term solutions (Snapp *et al.*, 2002).

Snapp *et al.* 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 the most-promising candidate technologies and to validate these for scaling up and dissemination over wider areas. Farmers often highlighted secondary benefits from, and disadvantages of, the proposed technologies,[8] 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 (Kanyama-Phiri *et al.*, 1998). Promising technologies from both participatory research experiences are being widely promoted in Malawi. By linking the Mother and Baby exercise to the watershed approach, some of the concerns about the cost of implementing a wide-scale participatory technology development and dissemination process can be addressed, although not eliminated.

Hinchcliffe *et al.* (1999) have documented a series of case studies that further elaborate the potential for watershed-based approaches.

7. This, as in the Mother and Baby trials, proved remarkable successful and the data suggest that a representative sample of the community was indeed achieved (Snapp *et al.*, 2002)

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

Regional partnerships across institutions and farming communities

Creating change in potato systems in Bolivia

Despite much evidence to the contrary, there is a widespread perception that too much research is produced on the basis of researcher interest (supply-driven) rather than on farmer needs (demand-driven). In Bolivia, CPP and partner agencies have 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. In Bolivia, the national agricultural research programme is experiencing considerable change. As in many developing countries, (Uganda is the prime African example), the Government of Bolivia is developing a new framework for agricultural research and extension – El Sistema Boliviano de Tecnologia Agro-pecuaria (SIBTA). Within SIBTA, four Foundations (Fundación para el Desarrollo Tecnológico Agropecuario, FDTAs) have been established – one for each of the principal agro-ecological 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.


J Bentley

New projects in Bolivia are actively seeking partnerships with farmers

CPP has been highly active in promoting a collaborative effort on the promotion of improved potato technologies using the new SIBTA framework and engaging potential and existing partners. The aim has been to develop an initiative directed towards achieving impact and maximising the investments made to date by validating and promoting the outputs of past and present work. The FDTA Altiplano, currently the only SIBTA foundation with an interest in potato, has been fully involved in the discussions.

The outcome has been an innovative, imaginative and impressive exercise that links demand with supply for agricultural research, while at the same time taking into account evolving market factors. The FDTA Altiplano strategy is strongly focused around improving the competitivity of the potato sector in the context of trade liberalisation under Mercosur (Mercado Común del Sur, the South American equivalent of the EEC). One of the activities in the plan is to identify demand and to put out a call for research and dissemination activities for potato and other Andean crops. The potato food chain is complex and the FDTA Altiplano requires technical support to identify products and associated chains with commercial potential, and also to identify the demand for technical innovation along those chains.

An interesting distinction was drawn between explicit and implicit demands. Explicit demands were defined as 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). It is important to understand explicit demands, but basing all research funding on this type of demand could be excessively restrictive and will not take into account knowledge and technologies of which poor farmers are unaware. Relying on researchers' assessments of implicit demands is equally dangerous, because researchers have vested interests in maintaining their own research activities.

Many ongoing efforts to assess demand often confuse explicit and implicit demand by letting the researcher evaluate critical productivity constraints or give primacy to explicit demands through PRA or voting methods (Pretty, 1995). The Bolivian exercise was aimed at carefully differentiating between the two kinds of demand. One option being tested is a network of farmer research committees or CIALs (Comité de Investigación Agrícola Local), a platform originally developed by Centro Internacional de Agricultura Tropical (CIAT) in Columbia (Ashby *et al.*, 1995; Braun *et al.*, 2000).

The objective is to develop a range of mechanisms for exchange between researcher and end-users – including meetings and long-term relationships with *municipios* and *sindicatos*, CIALs, FFSs, PRAs and farmer participatory research (FPR) – as well as by researcher-led surveys and research prioritisation exercises. The project addresses both technical constraints (pre- and post-harvest) and institutional constraints (lack of mechanisms for linking demand and supply of technical innovation), and has the following aims:

- Project outputs will assist SIBTA, whose mission is to benefit the poor by commissioning technology innovation and extension. SIBTA are in the process of developing mechanisms for prioritisation of research and transfer based on real evidence of demand and developing effective mechanisms for uptake.
- The project will strengthen mechanisms for improving access by poor producers to pre- and post-harvest technical innovation that is relevant, timely and affordable.
- Institutional mechanisms will be developed to link supply with demand for research and to give producers a voice in setting the agenda for agricultural research and extension.
- Poor producers will have improved market access and, in consequence, possibly increased farm incomes.
- Technology innovation will increase crop yields for poor producers, thus contributing to food security.
- Technology innovation (notably in farm machinery) and improved weed management could reduce drudgery and release labour for other activities.

Low-input maize systems in southern and eastern Africa

CIMMYT have extended the Mother and Baby concept to serve a regional maize improvement effort in southern Africa. This involves some 30+ core collaborators, more than 50 institutions including: international agricultural research centres (IARCs), NARSs, NGOs, extension services and private seed companies, and over 1000 farmers actively involved in the maize variety selection process. The aims have been to develop and deliver maize cultivars which produce 1–2 t/ha more yield and have yield stability under conditions typical for resource-poor farmers, and to establish a simple feed-back process where farmers and their environments start to influence breeding priorities. On-farm stresses are prioritised in consultation with farmers and local experts. Potential germplasm is screened on experiment stations (at the CIMMYT station and with selected NARS) both under high-yielding/optimal conditions and those under stresses. The best performers under both sets of circumstances are selected and the process repeated using germplasm from thousands of different sources.

In Figure 2, two different approaches to problem solving by plant breeders are illustrated. In the first, (a), there is little interaction between the problems as seen by the farmer and by the scientist. In the second, (b), the scientist is working entirely within the problem set as it is perceived by the farmer.

This revised approach (b) makes it easy to link in with other associated activities, to ensure adequate and full verification by farmers in a wide number of circumstances and to build in linkages for future dissemination. There is reliable assessment of new elite maize cultivars by all players and the chances of accidentally missing characteristics important to resource-poor farmers are reduced. There is better and faster targeting of good cultivars since NARS, NGOs, private seed companies and extension services are all actively involved in product development.

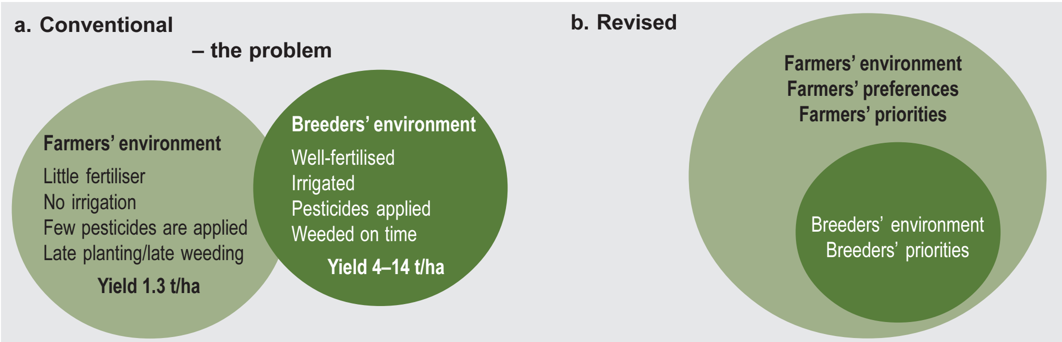

Figure 2. Two approaches to problem solving

'Best-bet' technologies

Farmers, as already noted, are familiar with plant selection and improvement. They recognise the traits they want in improved materials. Seed is often a relatively cheap medium for providing an opportunity to increase productivity at the household level. Yet, seeds with higher-yielding potential take more from the soil and thus the adoption of improved varieties as a single-component technology is, at best, a very temporary solution. Also, as noted earlier, many households lose a substantial part of their potential harvest to pests and diseases. Technologies to address the soil fertility or the pest and disease components of the production problem are particularly challenging. In part, a seed approach may be suitable, e.g. by breeding for nutrient-use efficiency or pest resistance. However, interventions in either of these areas typically tend to be expensive in terms of cash and labour, or both.

The CIMMYT-led Soil Fertility Network has addressed this problem through the adoption of a 'best-bet' approach. The Network sponsors a regular set of field tours during which researchers and farmers review ongoing technologies in the field. The aim is to encourage a rigorous process of peer review, with inputs from scientists and farmers, of research as it moves from a researchable idea towards a potential adoptable technology. The process is very open, consultative and inclusive. It is intended to provide a challenge to the best scientists and a learning process for the younger entrants, as well as a way of bringing farmer voices into the exercise in a continuing, rather than a one-off, manner.

Information from the field tours and the research analyses are used to select potential 'best-bets'. These are technologies deemed to have particular value for identified farming environments or groups. The screening criteria used include:

- The ability to raise profit and productivity in the short term (1–3 years)
- Application across a number of agroecologies
- Modest costs in terms of cash and labour
- Minimal competition for arable land
- More than one end-use for the farmer.

One example is improving the profitability of fertiliser use. Fertiliser is expensive – some 12 kg of maize are needed to pay for 1 kg of nitrogen fertiliser. The agronomic efficiency use of fertiliser is low – as little as 5 kg of grain per kg of fertiliser in some situations. Moisture and soil fertility work both with and against each other. The climate of southern and eastern Africa means that lack of moisture is a frequent constraint on maize yields and yield responses to fertiliser. The efficiency (measured through grain production) of water use and fertiliser use is raised when both are in adequate supply. The high risk of poor response to fertiliser in dry years is a major reason why most farmers in semi-arid areas use little or no fertiliser.

Piha (1993) developed and modified 'response farming' techniques that use early rainfall events to decide on the amounts of fertiliser to apply in any given season. The results were very promising. Over a five-year period, Piha's system gave 25–42% more yield and 21–41% more profit than the existing fertiliser recommendations. The key to the system was its flexibility. In poor years, fertiliser nitrogen use was reduced, but yields would, in any case, have been poor in those years. In good years, the farmers were able to get good yields. Participating farmers' profits were 105% higher than those of the control group of comparably good farmers. Yields were on average 78% higher.[9] Loan repayment was excellent at 90%. An NGO (the Self Help Development Foundation, SHDF) and Piha's group worked together in campaigns in selected project areas to scale up the package through associated savings clubs. In 1999 participating farmers increased their profits by 227% and their yields by 143% over those of farmers following normal practice. In the 1999/2000 season some 500 farmers formed 53 savings clubs to participate in the scheme.

Piha and his team have shown clearly that, with simple but different practices, fertiliser use can be made profitable for poor farmers in Zimbabwe without bringing in whole new groups of advisors and their associated costs.

Partnerships and collaborations

Zimbabwe soya bean promotion taskforce

In Zimbabwe in the 1980s, typical smallholder yields of soya bean were about 10% of their potential. In Zambia, work by Javaheri in the early 1980s had resulted in the release and promotion of the 'promiscuous'[10] varieties Magoye and Hernon 147. These varieties proved easy to grow under smallholder conditions and rapidly become popular, not only in Zambia, but also in adjacent areas of Malawi and Zimbabwe where they were taken up spontaneously by numbers of smallholders.[11]

9. Yield increases ranged from 55–111% and profits were from 25–146% more than those of the comparative controls

10. 'Promiscuous' soya beans, unlike conventional materials, do not need inoculants to form a nitrogen-fixing symbiosis but are able to use indigenous soil flora for this purpose.

11. The Malawi case is particularly interesting. In 1989 a Malawi NGO tried to introduce Magoye to smallholders as part of a food security programme aimed at the poorest rural families but was prevented by the Ministry of Agriculture from promoting the variety. It took nine years for 'official' permission to be given for smallholders to be supplied with Magoye seed. In the interim, thousands of farmers along the Zambia/Malawi border were cheerfully (and successfully) ignoring the Ministry of Agriculture recommendation and growing Magoye soya beans from seed smuggled over the border.

In 1997, after detailed discussions with various actors in the farming sector, Sheunesu Mpepereki, a microbiologist at the University of Zimbabwe, put together a small soya bean promotion taskforce. This included senior farmer representatives, soya processors, scientists, economists and extension staff. The aim was to build on improved scientific understanding of nitrogen dynamics within grain legume-based systems. Modest funding for some of taskforce activities was obtained from donor sources but, just as importantly, local agro-industries were persuaded to provide inputs both in cash and kind to the initiative. This private-sector collaboration facilitated the development of active markets for the crop and the associated inputs it required.

In the first year of the programme, ten different smallholder farming areas were targeted. Some 55 farmers participated in the first phase of the work. Crop packs (containing the necessary inputs to grow 0.1 ha of soya bean) were assembled and sold (not given – thus building a market ethic into the programme from the outset) to participating farmers. The numbers of smallholders growing soya beans grew, in just three years, from the initial 55 participants to some 10,000.[12] The area sown increased to around 4000 ha and sales to about 4000 t (around 30% of the additional production was estimated to be retained as seed). The eventual target for smallholder soya bean production in Zimbabwe is some 200,000 producers.

The soya bean promotion task force achieved its objectives through focusing on the key factors of leadership, networking and the effective delivery of a profitable technology, together with access to input and output markets. The whole exercise was undertaken with a very modest input of donor funding and without employing any additional people or making large investments in vehicles or infrastructure. More recently, networking by the taskforce has been expanded more widely and linkages to village-based banks have also been established.

Malawi ‘starter pack’ programme

Malawi smallholder agriculture is based on maize as the dominant cereal, with small grains and cassava adding diversity. Maize has become increasingly dominant in the farming system as farm households seek to maintain their calorie production under declining soil fertility and as individual land holdings decrease in size with population growth. Household food security is poor, as indicated by widespread and pervasive malnutrition and one of the highest levels of child mortality in the world. In the smallholder sector, neither improved nor unimproved maize showed any clear increase in yields per hectare in the decade from 1985[13].

Malawi needed urgently to implement a strategy for broad-based income growth. A small group of Malawian policy-makers, scientists and academics decided

12. 3000 soya bean ‘packs’ were distributed in the third year of the programme – the remaining growers were those from earlier years together with others who had decided to grow soya beans based on what they had learned from field days and contact with neighbours growing the crop

13. Subsequent years’ data suggest that unimproved maize yields were trending downwards towards around 800 kg/ha, with improved maize yields at around 2,500 kg/ha. The very low figures for 1991/92 are the result of a particularly bad drought in that season. The area sown to new hybrid seed has been declining since 1992/93.

to review the options for themselves. Their conclusion was that the best way to break out of the downward spiral and to restart vigorous economic growth in a non-inflationary environment was to get hybrid seed and fertiliser into the hands of all of Malawi's farmers (Benson *et al.*, 1998). The decision was made to improve the productivity of smallholder maize-based cropping systems by a strategy of:

- Providing **all** smallholders with small 'starter' packs of improved seed and fertiliser for farmers to use (and appropriately modify for their own circumstances) on their own fields, following the new area-specific recommendations from the work of the Maize Productivity Task Force (MPTF)
- Ensuring that supplies of improved seed and fertiliser were readily available for purchase in all rural markets in small bags of 1–3 kg at a price per kilogram comparable to those of existing large bags
- Providing opportunities for able-bodied individuals to increase their purchasing power for seed and fertiliser through a structured fertiliser (and seed) for work programme implemented during the dry season.

'Starter packs' were specially packaged 2.5 kg packets of hybrid seed together with the fertiliser recommended for that quantity of seed. Each pack was sufficient to sow 0.1 ha and the incremental production was estimated as sufficient to feed a household for more than a month in the hungry season.[14] At the national level, 1.8 million households producing 100 kg more maize per household provided, conservatively, incremental national production of 180,000 t. In the event, with the benefit of good weather for two years running (1998/99 and 1999/2000), the incremental maize production due to the starter packs was more than double the conservative estimates of the original proposal.

The programme provided all smallholders the means to test improved maize seed and fertiliser technology for themselves under their own conditions, without the risk inherent in purchasing the necessary inputs. It was a technology-testing and demonstration programme for a small part of each farm, facilitating experimentation by farmers of promising, but yet to be widely adopted technologies. The starter pack was small and thus likely to stimulate, not diminish the incentive to purchase more inputs.[15] Thus the programme would stimulate, not substitute for, market demand.

The basic concept was to give all smallholders (over two million) a small packet of improved inputs for at least five, but preferably ten, years as a central component of a long-term campaign to move the poor towards both sustained higher yields and diversified farming systems. It was to be a transmission belt for continuously moving improved technologies into farmers' hands. Sadly, the original starter pack exercise was changed from its original development objectives into a (reduced) targeted safety-net programme with less-productive inputs. This change was made largely as the result of external pressures. Some major development agencies were strongly opposed to any form of free intervention in a liberalised

14. At 1998 prices, this was the equivalent of more cash income than a poor family would see in a year

15. The package was designed to be of a size that can be carried away easily by an individual on foot and not to contain inputs for more than 0.1 ha. The package needed to be small enough, on a household scale, that it really was a starter pack, but yet adequate, on a national scale, to create a significant production difference when distributed to 1.8 million households.

economy, while others favoured the more limited objectives of a safety-net programme over the ambitious development goals of the starter pack.

The 2001/02 season that brought famine to Malawi, combined with increasing donor support for long-term and higher aid levels for Africa, have revived interest in the starter pack concept. It shows a viable way of taking a potentially profitable technology and extending it quickly and effectively (at reasonable cost) to poor people who have virtually zero purchasing power.

Farmer field schools (FFSs)

The FFSs approach has been widely adopted in Asia as a means of promoting IPM. FFSs not only help participants minimise pesticide use, but also incorporate training on soil management, weather surveillance and on-farm management practices that are designed to grow a healthy crop (Maumbe, 2001). More than two million rice farmers across Asia have been trained in IPM FFSs since 1989. Those farmers who have participated in FFSs have managed to reduce their use of pesticides, improve their use of such inputs as water and fertiliser, realise enhanced yields and experience increased incomes (Maumbe, 2001). FFS alumni are now at the forefront of promoting sustainable agricultural systems in their communities (Maumbe, 2001). The underlying assumption is that farmers already have a wealth of experience and knowledge. The FFSs facilitate farmer-to-farmer knowledge sharing, provide practical hands-on education and are highly participatory and linked to local issues and problems.

FFSs have been used to disseminate IPPM strategies in Zimbabwe's cotton and horticultural production enterprises and are an increasingly important component of the technology dissemination process in Kenya. The initial evidence from implementing FFSs in eastern Africa suggested that the costs of running such schools were high, leading to questions about the sustainability of the approach in the face of complex problems and poor local funding. However, more recently, a new generation of FFSs has developed in eastern Africa under the auspices of various funding sources (e.g. International Fund for Agricultural Development (IFAD), Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (GTZ), and the Netherlands) with a focus on becoming self-financing. Data from the International Service for National Agricultural Research (ISNAR) show a cost:benefit ratio of 2.2 after one year of operation considering savings from agro-chemical use alone. These cost-effective schools offer an important entry point for smallholders attempting to diversify into commercial (especially export) horticulture, an increasingly important option for addressing poverty and reaching the poor.

Agricultural Technology and Information Response Initiative (ATIRI)

ATIRI is a Kenya-based programme that is representative of a change being encouraged amongst the NARS of southern and eastern Africa. The underlying rationale is that the Kenya Agricultural Research Institute (KARI) needs to become a knowledge broker, linking groups of farmers with multiple sources of relevant information that originate from its own sources, from IARCs and NGOs and from appropriate indigenous farmer knowledge. The fundamental assumption is that this approach will provide a faster and more cost-effective route to creating change in poor rural communities than the conventional supply-driven technology transfer model.

Responsibility for the design, management and assessment of trials is passed to farmer research groups (FRGs) or some other form of institutional arrangement to facilitate the expression of farmer demand in the research agenda. KARI staff need to increase their work with both NGOs and the national extension service. Farmers are encouraged to form FRGs within the community to test technologies, which they select from a basket of options.

The aim of such programmes as ATIRI is to substantially strengthen the capacity of NARS to deliver improved technologies. If implemented appropriately and successfully, ATIRI has the potential to widen and strengthen the uptake pathways necessary to transfer improved technologies to farmers. The approach is ambitious but, if implemented according to plan,[16] offers a broad (and explicitly highly flexible) framework in which innovative efforts to improve uptake pathways and research priority setting can be achieved. Success will depend upon the detail. Collaborative arrangements in practice range from those with little more than token interaction to highly participatory exercises. The former is much easier to put in place and implement than the latter. But it is only by **long-term**, effective, strong and well-planned teamwork that progress in solving the tough problems of productivity in smallholder cropping systems in southern and eastern Africa will be achieved.

In this context, it will be essential from the start to have clear and agreed mechanisms for reporting data and assigning responsibilities and credit. None of the potential team members is likely to have core funding and therefore will be dependent on short-term donor resources. KARI, for example, will be sourcing funds through ATIRI. The IARCs, which used to have substantial core resources, rely increasingly on special project funds. NGOs survive almost entirely on short-term (often relief) funds. The same donor could easily be providing support to each team member and might well become increasingly sceptical if each claims successful outcomes without adequate acknowledgement of the contribution of the others. In an increasingly competitive funding environment, such issues can become major obstacles to essential long-term collaboration.

Secondly, all research activities should focus on reaching large numbers of farmers. This requires not only a well-defined characterisation of the target farmers and ecologies, but also an explicit willingness to exploit to the maximum the scientific potential of research sites – especially those on-farm. Joint use of sites between national and international staff is one option, but proper arrangements need to be set in place to cover overhead costs and to ensure clear communication with farmer partners. Agreement will be needed on assigning credit and responsibilities. However, these are modest problems that could be easily sorted

16. Very real and present obstacles to successful implementation are considerable

out within the context of a proper collaboration. The benefits of working together greatly outweigh the disadvantages.

Kenya is widely adopting farmer participatory approaches in its efforts to reach smallholders. Typical projects try such technologies as exotic grasses to encourage soil conservation, experiment with reduced rates of inorganic and organic fertilisers and encourage green manures, legume intercropping and participatory plant breeding. Methodologies adopted include on-farm participatory research, demonstrations, workshops, farmer training, farm visits and tours and farmer research committees. However, the costs in both human and financial terms are high and there remain difficulties in scaling up from successful pilot schemes.

Partnerships with community-based organisations (CBOs) and NGOs

There is a growing interest amongst the donor community in the potential of NGOs as they are perceived (not always correctly), as participatory, systems-focused, low-input and with institutional structures that give them an advantage in responding to the needs of the rural poor. Many NGOs have gone beyond participation in on-farm research to strengthening and even creating local organisations. However, they are often poorly coordinated both among themselves and with the wider development process and are sometimes driven by an excessive preoccupation with quick results.

The range of uptake pathways available through public-sector agencies is expanding through such initiatives as ATIRI and the FFS efforts. These represent a significant shift in conventional thinking, with the objective being to create a greater demand-led component in technology development and extension. These approaches are still in the pilot stage. They depend on very optimistic assumptions about the numbers of farmers that can be reached and on the long-term cost implications. The data indicate that with seed systems, which to date have been the main focus of CBO and NGO technology-transfer schemes, widespread uptake is not common. Most often the effort relies on intensive inputs over a quite small area and attempts to scale up to deal with large numbers of farmers have very mixed records. But, as potential suppliers of technology to smallholders, NGOs are a particularly important group. They often have substantial budgets, but little long-term field experience in agriculture. There is an important liaison job to be done to ensure that the NGO community receives high-quality and appropriate advice in the design and implementation of agricultural projects.

A Kenya-based network, FORMAT, has been established as a platform to stimulate the sharing of ideas and technologies involving more-efficient use of under-utilised organic resources. It has an innovative programme based around open membership and a flexible agenda. It has its own website and aims to: connect members to their mutual advantage, to help devise an organic resource management policy framework, publicise farmer innovations, provide members with small grants (including help with publishing) and to assist in setting up and maintaining group organisation. It awards prizes for excellence in organic resource management, innovation in organic resource management and community service through organic resource management. It also runs various competitions.

An interesting experiment has been the Western Kenya Consortium (WKC), formed in 2001 in a densely populated area where most farmers are food-insecure but where there are a number of development institutions, and technologies for improving soil fertility appear ready for dissemination. Most options are on a pilot scale, dissemination is weak and there are poor linkages between research and extension. The WKC was formed to design a strategy for scaling up technological options to the majority of western Kenya smallholder farmers by building successful partnerships among research, extension and NGOs. This effort was to be combined with a regional strategy to meet germplasm and seed demands with seed-based technologies. The impact of the scaling-up efforts and capacity building were to be carefully monitored. The key working principles were a shared vision, voluntary and neutral membership and active collaboration and networking. A Regional Coordinating Committee assisted by farmer, government and NGO representation and regional sub-committees manages the Consortium.

Partnerships with the private sector

While it is evident from previous discussion in this report, and from the literature in general, that smallholders in Africa are desperate for new and improved agricultural technologies, their ability to express this demand is weak. The consequent market failure means that the private sector usually finds few attractive investment options. But it is also pertinent to realise that, even if markets were more efficient, the capacity of the private sector to adequately address the chronic and increasingly severe problem of African rural poverty is untested and that the expectations placed upon it are unrealistic. What is being sought are new ways to improve access to existing technologies, adapt them to local conditions and deliver them to agricultural enterprises, including those of the poor.

The pure 'market' view is that investment of public money to stimulate agriculture in less-favoured regions is an unproductive use of scarce resources and that those who cannot better themselves *in situ* should migrate to more-favoured regions, or into other sectors. This assumes, rather in the face of the evidence, that there are other sectors and regions with adequate opportunities. Clearly such an approach is part of the solution, but a more imaginative and inclusive effort is required to create widespread change without devastating levels of social disruption. One obvious option is to look towards public–private partnerships of various types.

Rapid growth and consolidation in the private sector agricultural R&D business has resulted in a situation where five integrated multinationals (the 'Big 5') dominate the world market for commercial agricultural technologies,[17] with the balance of expertise held within a residual of small OECD-based biotechnology companies and in publicly funded advanced research institutes and universities. A long-term collaboration between advanced First-World institutions, the Big 5

17. The so-called 'Big 5' are: Bayer, Dow Agro, Du Pont, Monsanto and Syngenta.

and public (or private) agencies in the developing world is an opportunity to be explored. There is willingness on all sides although the essential detail remains undefined. The development of such partnerships from concept to policy will, inevitably, be a tough and tortuous process.

Meanwhile the problems of rural poverty in southern and eastern Africa will continue to mount – so a strategy of 'wait and see' is not a defensible option. The following three initiatives aimed at leveraging substantial additional private-sector resources into developing countries to achieve pro-poor outcomes were recommended by the Scoping Study on Supporting Pro-Poor Private Sector Rural Enterprise Development (RETF, 2002):

- An International Rural Enterprise Technology Company (IRETCO) to support private investment in the delivery and use of existing and new technologies with pro-poor outcomes
- A Rural Enterprise Technical Assistance Facility (RETAF) to support governments in developing and implementing policies for modern agriculture
- A Pro-Poor New Technologies Initiative (PNTI) designed to develop and deliver new, pro-poor agricultural technologies from public – private partnerships.

However, as the Scoping Study notes, even if partnerships **do** provide improved access to existing technologies and the technologies **can** be successfully adapted for local conditions, **the** major challenge for developing countries is achieving uptake and use by local agribusiness and agricultural producers, including resource-poor smallholders. Weaknesses in domestic input and output markets, poor infrastructure, and poor extension and information systems reduce the responsiveness of smallholders to new opportunities. Few developing countries have effective mechanisms to achieve adaptation, demonstration, dissemination and uptake of agricultural technologies. Public-sector extension services in most developing countries, particularly those in Africa, have failed.

Some developing countries are exploring options for involving the private sector in services commonly funded by public funds; often involving the private sector directly in the delivery of services but with at least some funding for these services coming from the public purse. However, few fully operational and tested examples exist and the ability of such private services to reach the poor and excluded is, as yet, unproven. There are numerous NGOs actively supporting poor people in rural areas, but few of them approach their activities from the perspective of developing markets and creating sustainable businesses.

Ahead of all these possible changes, there are opportunities well-suited to imaginative partnerships between scientists, farmers and the market. CPP has already explored several of these and further possibilities exist. Kenya and Zimbabwe have an active private sector with an evident interest in developing a market amongst smallholders. In Kenya, the Safe Use Pilot Project is an exercise largely funded by industry to promote the appropriate use of agricultural chemicals. Working through the national extension service, it has trained 0.5 million 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 good advice to farmers. Its wide outreach has been through careful use of the national extension system, with which it has had excellent cooperation. A continuing audit of programme quality and effectiveness is maintained.

Increasing market access for smallholders

Developed by the Sustainable Community-Oriented Development Project (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 smallholder farmer communities in market places, schools and churches. By purchasing the smallest mini-pack for no more than the cost of a soft drink at a local store, the farmers are encouraged to experiment with recommended seeds and fertilisers and, having learned by doing and succeeded on their own small plots, they 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 smallholder farmers in Siaya District to such an extent that farm input supply quickly became profitable at the village level. In 2001, the Farm Input Promotional Service (FIPS), an NGO, was to scale up the SCODP approach for the benefit of smallholder farmers throughout Kenya. Multinational companies cooperating with FIPS include: Norsk Hydro, Kali and Salz, Du Pont, Pannar, Monsanto and Bayer. Local input suppliers are also active and include: Kelchemicals, Farmchem, Vetagro, Da'kianga distributors and Peron Agencies.

The Investment in Developing Export Agriculture (IDEA) programme is probably the most radical 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 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 model, involves demonstration with fertiliser as an additional input together with appropriate pesticides. This is linked to a concurrent programme – the Agribusiness Training and Input Network (ATAIN) – 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.

Market support is essential to the programme and involves linkages at the regional, 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 price (despite the fall in local currency value by 20% over the period, 1998–2001).

Outputs claimed by the programme include four maize hybrids and ten bean varieties released, together with appropriate fertiliser and herbicide packages. The programme has reached some 200,000 smallholders and cooperating farmers now run half the demonstration plots. ATAIN has assisted in the development of rural associations and claims to have raised rural incomes by US$7 million per year and increased agricultural exports to US$20 million per year. Some 200 additional new rural businesses have been established with earnings of US$1 million per year and there are now three active private seed companies in Uganda.

Future plans include the expansion of national commodity marketing and extension of the input supply system. The technology transfer programme will be broadened to include such other crops as upland rice, groundnuts, sesame, cotton, coffee and bananas.

CARE is one NGO that has taken up the challenge of helping to develop agricultural markets in Zimbabwe. The effort started with the establishment of input distribution systems development in 1995 with private-sector collaboration. There are now over 500 agents in the country linked to suppliers of agricultural inputs. Loan repayment rates have been 100% over the past two years and graduation rates have been over 90% over the last three years. The model is being adopted and adapted by others within and outside Zimbabwe and Africa.

ICRISAT have a strong focus on improving market access in the drier areas of Zimbabwe. Typically, policy for these areas has been a 'residual' from that developed for the better-watered areas of the country. In particular, input markets are very poorly developed. Farm retail stores are rare and often stock little beyond maize seed. Other essential agricultural inputs, e.g. fertilisers, plough parts, or agrochemicals – are not easily found.

The technical recommendations given to farmers are usually out of date and unhelpful; seldom does a farmer meet an extension agent and what recommendations do exist fail to take into account farmer capital and labour constraints. ICRISAT, therefore, is pioneering a programme to facilitate the development of better-resourced rural traders, who stock small packs of essential farm inputs and who are linked to an ongoing process of improved recommendation development. An important component of this effort is exploration of opportunities for income diversification so that farmers can spread their risk over a wider range of options.

ICRISAT has also been active in working with NARS in eastern and southern Africa to develop pigeonpea technologies that are attractive to both farmers and private-sector traders and processors. One of the major pigeonpea production constraints is fusarium wilt where, in severely infected fields, 100% crop loss can occur. Conventional plant breeding was used to develop varieties resistant to the disease. In Malawi, the fusarium wilt-resistant variety ICP 9145 was hurriedly released in 1987 after a severe outbreak of the disease. But the variety was popular with neither traders nor farmers. Traders disliked the low processing yields and farmers found the seed slow to cook. A new more suitable variety, ICEAP 00040 was selected after extensive testing with both farmers and industry. But the active interest of traders in this traditional food crop provided an opening to build a collaboration which dealt with marketing and trade aspects, in addition to the technological components, of the new technologies.

Pigeonpea 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 pigeonpeas 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. The collaboration pioneered by ICRISAT was an effort to develop strategic partnerships with market traders as an integral component of developing a focused pigeonpea development strategy. ICRISAT's technical contribution was to develop pest- and disease-resistant materials while at the same time helping to open up and sustain novel institutional arrangements to improve the attractiveness of the crop to smallholders.

TechnoServe Inc., a US-based, not-for-profit organisation with country offices in Kenya, Mozambique and Tanzania had independently identified pigeonpea as a crop of significant potential. The starting point for collaboration with TechnoServe was a detailed sub-sector analysis within each of the four major pigeonpea-producing countries in eastern and southern Africa. In each country, a locally adapted strategy was developed. In Mozambique, a cotton–pigeonpea rotation was promoted, with improved pigeonpea inputs and marketing arrangements linked skilfully with the cotton system. In Malawi and Tanzania, the focus was on high-quality pigeonpea 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, sending fresh green or frozen pigeonpea to Britain was an attractive option. TechnoServe specialised in enterprise development while ICRISAT and its NARS partners worked closely with farmers to develop the varieties and farming systems that could viably and sustainably serve the identified markets. Smallholder farmers were 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 benefit from higher quality and higher-value markets (Jones *et al.*, 2002).

A strategy for enhancing uptake of CPP research

The challenge to agriculture-led, poverty-reducing growth is greater in today's poor rural areas as they face the combination of increased risk and uncertainty with increased costs and/or lower returns to agricultural investment. Many of these difficulties are the result of existing agro-ecological, locational, demographic and socio-economic conditions in these areas. That such areas have not already enjoyed a process of agricultural transformation is a direct result of these differences. It is unfortunate that an already difficult task has been made harder by broader processes of change (for example, HIV/AIDS and some aspects of globalisation and the biotechnology revolution) (Dorward *et al.*, 2001). Current policies promoting education, health, governance, communications infrastructure and macro-economic stability all have an important part to play and should help to provide necessary, but not sufficient, conditions for pro-poor agricultural growth. In such a context, therefore, it is unlikely that research activities alone will be able to comprehensively address the poverty alleviation agenda. That said, this report has shown that significant impacts have been consequent upon the implementation of high-quality, focused research activities. CPP has been involved, at some level, with several of these efforts and is well-placed to build on this experience for the future benefit of poor communities in southern and eastern Africa.

CPP has already gone some way to incorporating farmer participation into its activities. This needs to be strengthened and explicitly made an important part of the **process** rather than being either marginal or a one-off consultation exercise. To stimulate local ownership (by farmers and researchers) and to encourage innovative explorations and collaborations, CPP should consider either setting up its own African network on the FORMAT model, or linking with an existing one. The FORMAT exercise has shown the value of a well-designed website, interesting competitions and events and other stimuli to facilitate creativeness and new ideas within a team framework. Ongoing peer review, perhaps building in some of the experiences of the CIMMYT Soil Fertility Network, could be invaluable in building up and strengthening institutional memory. A small budget for preparation grants might be set aside to allow promising ideas to be developed into proper proposals. The Rockefeller Foundation, for some of its grant activities, routinely allows simple, one-off preparation grants of around US$6000 to allow potential collaborators to meet and to develop proposals.

There is effective market demand for crops that smallholders either already grow or those which they could quite readily bring into their farming systems. Groundnuts, pigeonpea, chickpea, cowpea, maize and a range of other crops have both local and international markets that are open to skilful exploitation. This report has detailed both traditional and introduced crops which smallholders, once important technical obstacles have been removed, have taken up with enthusiasm. In this context, demand-led initiatives linked to market development or expansion will be more efficient in stimulating the adoption of improved technologies than those that are supply-driven. This should be combined with bringing experience from CPP's work in Asia and Latin America to bear on African problems. For example, fruit flies are estimated to cause annual losses of over US$200 million to fruit and vegetable farmers in Pakistan. The Bait Application Technique (BAT) and the soaked-block Male Annihilation Technique (MAT) are being tested in Pakistan. BAT deploys spots of protein bait mixed with insecticide; adult insects are attracted to these spots, feed from them and are killed. Per unit surface area, BAT may use less than 10% of the insecticide content of cover sprays and thus is cheaper and less polluting. Bees and parasitoids are not attracted to the protein and deposits can be positioned to minimise the exposure of humans and domestic animals. MAT attracts and kills fruit flies using wooden blocks soaked in insecticide and chemical parapheromones which selectively attract males so that flies cannot reproduce. It involves even less expense, insecticide and threat to humans and non-target organisms than BAT. Such technologies have obvious implications for the emerging horticultural industries of southern and eastern Africa.

This does imply the need for detailed market research to identify promising marketing opportunities for smallholder farmers. Strategic partnerships will have to be developed between the private sector and institutions involved in technology development and technology promotion both to focus the research agenda and to stimulate farmer demand for new technologies. This report has shown that there are a number of agencies actively concerned with smallholder market development in the Africa region. CPP needs to be actively seeking out, through its grantees, opportunities for collaboration since importantly for CPP, many of these crops have significant pest and disease problems that provide exciting opportunities for research linked to the improvement of farm livelihoods.

The HIV/AIDS pandemic in southern and eastern Africa will impact heavily on rural families. Labour, which is already critically short during important periods of the cropping season, will become even more so. A focus on such labour-saving technologies as the use of herbicides for weed control, or low-cost, low-labour methods of pest control are obvious priorities. Efforts in the control of S*triga* and cereal stem borers are showing considerable promise, and efforts to validate and scale up the best technologies will be important.

Suggested actions needed to forge linkages, scale up technologies and processes and to enhance impact from CPP research projects are provided. Since its inception in 1995, the CPP has incorporated many of these into its strategy and the project portfolio, particularly stakeholder consultation, capacity building, competitive promotional grants for national institutions, and the use of innovative promotional channels; but the check-list also includes others which require further consideration and consultation with new partners including those in the private and educational sectors.

Actions needed to forge linkages

- Consult stakeholders and clients
- Develop partnerships with training and education institutions to improve the quality and relevance of educational training in relation to farmer/client driven participatory research and development
- Continue to support retraining of researchers and extensionists in farmer-participatory R&D methods
- Identify 'best-bet' technologies and develop toolboxes for appropriate interventions
- Refine dissemination technologies
- Implement pilot projects
- Develop a forum for sharing information and experiences
- Develop a 'who's who' database (directory of institutional and individual capabilities)
- Consider small grants to catalyse and facilitate community involvement.

Actions needed for scaling up

- Strengthen existing consortiums and upgrade networking among all types of participants – researchers, NGOs, extensionists, farmer-innovators and farmers
- Strengthen participatory monitoring and evaluation
- Improve access and affordability of farm inputs, including germplasm
- Solicit and invest in innovative, demand-driven dissemination strategies
- Stakeholder skills training: CBO management, problem diagnosis, farmer experimentation
- Strengthen institutional capacity to work with community groups.


SEG

References

ASHBY, J. and SPERLING, L. (1995) Institutionalizing participatory, client-driven research and technology development in agriculture. *Development and Change* **26**: 753–770.

BANZIGER, M. and DE MEYER J. (2001) *Farmers' voices are heard here*. Centro Internacional de Mejoramiento de Mäiz y Trigo (CIMMYT), Mexico DF.

BENSON, T., BLACKIE, M., CHISVO, M., CONROY, A., GILBERT, R., KANYAMA-PHIRI, G., KUMWENDA, J., MANN, C., MUGHOGHO, S. and PHIRI, A. (1998) *Malawi: soil fertility options and issues* (A paper for Ministry of Finance, Malawi), Soil Fertility Network for Southern Africa, Harare. Centro Internacional de Mejoramiento de Mäiz y Trigo (CIMMYT), Mexico DF.

BLACKIE, M. (1994) Maize productivity for the 21st century: the African challenge. *Outlook on Agriculture* **23(3)**: 189–196.

BRAUN, A., THIELE G. and FERNANDEZ M. (2000) Farmer field schools and local agricultural research committees: complementary platforms for integrated decision-making in sustainable agriculture. *AgREN Network Paper* **105**. Overseas Development Institute (ODI), London, UK.

BUMB, B. and BAANANTE, C. (1996) The role of fertiliser in sustaining food security and protecting the environment to 2020. *Food, Agriculture and the Environment Discussion Paper* **17**. International Food Policy Research Institute (IFPRI), Washington DC, USA.

BUTLER, L., MYERS, J., NCHIMBI-MSOLLA, S, MASAANGYE, E, MDURUMA, Z, MODELL, N and DIMOSA, P. (1995) Farmer evaluation of early generation bean lines in Tanzania: comparisons of farmers' and scientists' trait preferences. In: *Proceedings of the Southern Africa Development Community Regional Bean Workshop*, 2–4 October, Potchefstroom, South Africa. Oil and Protein Seed Centre, Potchefstroom, South Africa.

CHAMBERS, R. (1981) Rapid rural appraisal: rationale and repertoire. *Public Administration and Development* **1:** 4–12.

CHAMBERS, R. (1994) The origins and practice of participatory rural appraisal. *World Development* **22**: 953–969.

CHAMBERS, R. and BLACKBURN, J. (1996) The power of participation: PRA and policy. IDS *Policy Brief* 7. Institute of Development Studies (IDS), University of Sussex, Brighton, UK.

CHAPMAN, J., WHITE, J. and NANKAM, C. (1997) World Visions's experience with seed supply during emergency and resettlement programmes in Mozambique and Angola. In *Enhancing research impact through improved seed quality options for strengthening national and regional seed supply systems* proceedings of a workshop, 10–14 March, Harare, Zimbabwe. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Bulawayo, Zimbabwe.

CONWAY, G. (1997) *The doubly green revolution*. Penguin Books, London, UK.

CROMWELL, E. (1996) *Governments, farmers and seeds in a changing Africa*. CABI, Wallingford, Oxon, UK.

COURS, G., FARGETTE, D., OTIM-NAPE, G. and THRESH, J. (1997) The epidemic of cassava mosaic virus disease in Madagascar in the 1930s–1940s: lessons for the current situation in Uganda. *Tropical Science* **37(4):** 238–248.

DEFOER, T., DE GROOTE, H., HILHORST, T., KANTE, S. and BUDELMAN (1998) Participatory action research and quantitative analysis for nutrient management in southern Mali: a fruitful marriage. *Agriculture, Ecosystems and Environment* **71:** 215–228.

DE LANGHE, E., SWENNEN, R. and VUYSTEKE, D. (1996) Plantain in the early Bantu world. In: Sutton, J. (Ed.). *The Growth of Farming Communities in Africa from the Equator Southwards*. Azania, Nairobi, Kenya.

DEVRIES, J. and TOENNISSEN, G. (2001) *Securing the harvest*. CABI, Wallingford, Oxon, UK.

DORWARD, A., KYDD, J., MORRISON, J. and UREY, I. (2001) A policy agenda for pro-poor agricultural growth, Paper presented at the Agricultural Economics Society Conference, Aberystwyth, 8–10 April 2001 http://www.wye.ac.uk/AgEcon/ADU/publications/index.html.

DOVER M. and TALBOT, L. (1987) *To feed the earth*. World Resources Institute, Washington DC, USA.

EICHER, C. (1990) Africa's food battles. In: Eicher, C. and Staatz, J. (Eds.). *Agricultural Development in the Third World*. Johns Hopkins, Baltimore, USA.

ELLIS, F. (2000) *Rural livelihoods and diversity in developing countries*. Oxford University Press, Oxford, UK.

FAO (FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS) (1999) www.fao.org.

FAO (FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS) (2002) www.fao.org.

FIELDING, W.J. and RILEY, J. (1998) Aspects of design of on-farm fertiliser trials. *Experimental Agriculture* **34**: 219–230.

GABRE-MADHIN, E. and HAGGEBLADE, S. (2001) *Successes in African agriculture: results of an expert survey*. International Food Policy Research Institute (IFPRI), Washington DC, USA.

GERHART, J. (1975) *The diffusion of hybrid maize in western Kenya*. Centro Internacional de Mejoramiento de Mäiz y Trigo (CIMMYT), Mexico DF.

HERDT, R. (1991) Research priorities for rice biotechnology. In: *Rice biotechnology*. Khush, G. and Toenniessen, G. (Eds.). CABI, Wallingford, Oxon, UK.

HERDT, R. and CAPULE, C. (1983) *Adoption, spread and production impact of modern rice varieties in Asia*. International Rice Research Institute (IRRI), Los Baños, Philippines.

HERREN, H. and NEUENSCHWANDER, P. (1991) Biological control of cassava pests in Africa. *Annual Review of Entomology* **36**: 257–283.

HINCHCLIFFE, F., THOMPSON, J., PRETTY, J., GUIJT, I. and SHAH, P. (Eds.) (1999) *Fertile ground: The impacts of participatory watershed management*. IT Publications, London, UK. 385 pp.

HOLDEN, S. and SHANMUGARATHAN, N. (1994) *Structural adjustment, production subsidies and sustainable land use*. *Discussion Paper* D–11/1994U. Department of Economics and Social Science, Agricultural University of Norway, Norway.

IITA (INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE) (1992) *Sustainable food production in sub–Saharan Africa: IITA's contributions*. IITA, Ibadan, Nigeria.

IITA (INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE) (1995) *Annual report*. IITA, Ibadan, Nigeria.

ILIFFE, J. (1995) *Africans: the history of a continent*. Cambridge University Press, Cambridge, UK.

JAFFEE, S. and GORDON, P. (1993) Exporting high-value food commodities: success stories from developing countries. *World Bank Discussion Paper* **198**. World Bank, Washington DC, USA.

JONES, W. (1957) Manioc: an example of innovation in African economies. *Economic Development and Cultural Change* **5(2)**: 97–117.

JONES, A., WELSTEIN, E., SMITH, M., MEITZER, L. and SPERLING, L. (1999) *Technical and insitutional issues in participatory plant breeding*. Consultative Group on International Agricultural Research (CGIAR),Washington DC, USA.

JONES, R., FREEMAN, H. and LO MONACO, G. (2002) Improving the access of small farmers in Eastern and Southern Africa to global pigeonpea markets. *Agricultural Research and Extension Network Paper* **120**. Overseas Development Institute (ODI), London, UK.

KAMANGIRA, J.B. (1997) *Assessment of soil fertility status using conventional and participatory methods*. MSc Thesis. Department of Crop Science, Bunda College of Agriculture, University of Malawi. Blantyre, Malawi. 107 pp.

KAMANGA, B. (1999) *Soil fertility management and socioeconomic components of farmer participatory research in a southern Malawi watershed*. MSc Thesis. Department of Crop Science, Bunda College of Agriculture, University of Malawi. Blantyre, Malawi. 150 pp.

KANYAMA-PHIRI, G., SNAPP, S.S. and MINAE, S. (1998) Partnership with Malawian farmers to develop organic matter technologies. *Outlook on Agriculture* **27**: 167–175.

KITCH, L.W., BOUKAR, O., ENDONDO, C. and MURDOCK, L.L. (1998) Farmer acceptability criteria in breeding cowpea. *Experimental Agriculture* **34**: 475–486.

LELE, U. (1989) Managing Agricultural Development in Africa. In: Eicher, C. and Staatz, J. (Eds.). *Agricultural development in the Third World*. Johns Hopkins University Press, Baltimore, USA.

MAUMBE, B. (2001) Essays on the economics of cotton production in Zimbabwe: implications for technology adoption, farmer health and market liberalization. PhD Dissertation, Michigan State University, Michigan, USA (Unpublished).

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* **24**: 311–320.

MCCRACKEN, J., PRETTY, J. and CHAMBERS, R. (1988) *An introduction to rapid rural appraisal for agricultural development*. International Institute for Economic Development (IIED), London, UK.

MORRONE, V.L. and SNAPP, S.S. (2001) Uptake of a new on-farm trial design that includes the smallholder farmer. *Hortcultural Science* **36**: 477 (Abstract).

MUTSAERS, H.J.W., WEBER, G.K., WALKER, P. and FISHER, N.M. (1997) A field guide for on-farm experimentation. International Institute of Tropical Agriculture (IITA)/Technical Centre for Agricultural and Rural Cooperation (CTA)/International Service for National Agricultural Research (ISNAR), Ibadan, Nigeria. 235 pp.

NOOR, M. (1996) Successful diffusion of improved cash crop technologies. pp 43–57. In: *Proceedings of the Workshop on Developing African Agriculture: Achieving Greater Impact from Research Investment*, 26–30 *September* 1995, *Addis Ababa*, *Ethiopia*. Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), Kampala, Uganda.

NWEKE, F., DIXON, A., ASIEDU, R. and FOLAYAN, S. (1994) Cassava varietal needs of farmers and the potential for production growth in Africa. *Collaborative study of cassava in Africa*, *Working Paper* **10.** International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria.

PIHA, M. (1993) Optimising fertiliser use and practical rainfall capture in a semi-arid environment with variable rainfall. *Experimental Agriculture* **29**: 405–415.

PINSTRUP-ANDERSEN, P. (2002) Towards a sustainable global food system: what will it take? Keynote presentation for the Annual John Pesek Colloquium on Sustainable Agriculture, Iowa State University, 26–27 March 2002. [Source: *Briefing Notes*, International Food Policy Research Institute (IFPRI)].

PRETTY, J. (1995) *Regenerating agriculture: policies and practice for sustainability and self–reliance*. Earthscan Publications, London, UK.

QAIM, M. (1999) A socioeconomic outlook on tissue culture technology in Kenyan banana production. *Biotechnology and Development Monitor* **40**: 18–22.

QUINONES, M., BORLAUG, N. and DOWSWELL, C. (1997) A fertilizer-based Green Revolution for Africa. In: Buresh, R., Sanchez, P. and Calhoun, F. (Eds.). *Replenishing soil fertility in Africa* (*Soil Science Society of America* (SSSA) *Special Publication*) **51**. Madison, Wisconsin, USA.

READER, J. (1997) *Africa: a biography of the continent*. Vintage Books, New York.

RETF (Rural Enterprise Technology Facility) (2002) Supporting pro-poor private-sector rural enterprise development (CNTR 01 2596). Submitted by NM Rothschilds and Sons Ltd., Cambridge Economic Policy Associates Ltd, Overseas Development Institute (ODI) and Natural Resources Institute. Cambridge Economic Policy Associates Ltd website www.cepa.co.uk

RUSSELL, D. (1998) India's bitter harvest (or the human cost of cotton). *Financial Times*, 6 March 1998, London, UK,

RICHARDS, P. (1985) *Indigenous agricultural revolution: ecology and food production in West Africa*. Hutchinson, London, UK.

SANCHEZ, P., SHEPHERD, K., SOULE, M, PLACE, F., BURESH, R. and ISAC, A. (1997) Soil fertility replenishment in Africa: an investment in natural resource capital. pp 81–96 in: Buresh, R., Sanchez, P. and Calhoun, F. (Eds.) *Replenishing Soil Fertility in Africa*. (Soil Science Society of America (SSSA) Special Publication) 51. Madison, Wisconsin, USA.

SMALE, M. and HEISEY, P. (1995) Maize of the ancestors and modern varieties: the microeconomics of high-yielding variety adoption in Malawi, *Economic Development and Cultural Change* **43**: 351–368.

SNAPP, S.S. (1999). Mother and baby trials: a novel trial design being tried out in Malawi. TARGET *Newsletter of the Southern Africa Soil Fertility Network* **17**: 8.

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.

SPERLING, L., LOEVINSOHN, M. and NTABOMVURA, B. (1993) Rethinking the farmer's role in plant breeding: Local bean experts and on-station selection in Rwanda. *Experimental Agriculture* **29**: 509–519.

TIFFEN J., MORTIMORE, M. and GICHUKI, F. (1994) *More people, less erosion*. Oxford University Press, Oxford, UK.

WALKER, T. (2000) Reasonable expectations on the prospects for documenting the impact of agricultural research on poverty in ex–post case studies. *Food Policy* **25**: 515–530.

Appendix: DFID CPP projects February 2003

Full details of these projects can be found on the new CPP website: www.nrinternational.co.uk and www.cpp.uk.com

DFID number	CPP Project Title	PS[1]	Geographic focus
R7267	Principal pod-boring pests of tropical legume crops: economic importance, taxonomy, natural enemies and control	FA1	Eastern and Western Africa (specifically Malawi, Niger), South and Southeast Asia (specifically India), South America (Brazil)
R7492	Promotion of and technical support for methods of controlling whitefly-borne viruses in sweet potato in eastern Africa	FA1	Uganda, Tanzania
R7505	Strategies for the sustainable deployment of cassava mosaic disease resistant cassava in eastern Africa	FA1	Uganda, Tanzania, Kenya, eastern Africa
R7529	Management strategies for banana streak virus; epidemiology, vector studies and control of banana streak virus in Eastern Africa Highland bananas	FA1	Eastern Africa; Uganda. (Outputs are also likely to be applicable to Nigeria, Tanzania, Kenya, Rwanda and Burundi)
R7563	Management of cassava brown streak disease and mosaic disease in eastern and southern Africa	FA1	Tanzania, Mozambique, Malawi
R7565	Participatory breeding of superior mosaic disease resistant cassava	FA1	The broad geographical focus of the project is Africa, more specifically Ghana in West Africa
R7567	Integrated management of banana diseases in Uganda	FA1	Uganda
R7972	Integrated management of the banana weevil in Uganda	FA1	Eastern Africa
R8040	Rapid multiplication and distribution of sweet potato varieties with high yield and 8-carotene content	FA1	Central Uganda
R8167	Promotion of sustainable sweet potato production and post-harvest management through farmer field schools in eastern Africa	FA1	Northeastern Uganda, Soroti and Kumi districts of western Kenya with potential to spread to Lake Zone Tanzania and other locations where sweet potato plays an important livelihood role
R8227	Promotion of control measures for cassava brown streak disease	FA1	Tanzania, Mozambique, Malawi
R8243	Working with farmers to control sweet potato virus disease in eastern Africa	FA1	Eastern Africa
R7326	Control of *Phytophthora megakarya* diseases of cocoa with phosphonic acid	FA2	Ghana
R7942	Integrated pest management (IPM) for smallholder coffee in Malawi	FA2	Malawi

1. PS= Production System and purpose; FA=Forest Agriculture Interface; Hill=Hillsides; HP=High potential; LW=Land – Water Interface; PU=Peri-Urban; SA=Semi-Arid

DFID number	CPP Project Title	PS[1]	Geographic focus
R8188	Epidemiology and variability of *Gibberella xylarioides*, the coffee wilt pathogen	FA2	Uganda, Tanzania and Ethiopia. Some basic work undertaken in France and through related projects will have an impact in Democratic Republic of Congo (DRC), Rwanda, Cameroon and Côte dIvoire
R8204	ICPM for smallholder coffee in Malawi	FA2	Malawi, relevant also to Zimbabwe and Tanzania
R7462	The development of integrated management systems for the control of pests and diseases in the potato systems of the mesothermic valleys of Bolivia	Hill	Bolivia
R7569	Participatory promotion of disease-resistant and farmer-acceptable *Phaseolus* beans in the southern highlands of Tanzania	Hill	Tanzania and ultimately other bean-growing countries of eastern Africa
R7885	Promoting the adoption of improved disease and pest management technologies in chickpea by poor farmers in mid-hills and hillside cropping systems in Nepal	Hill	Nepal, India
R7965	Promotion of IPM strategies of major insect pests of *Phaseolus* beans in hillsides systems in eastern and southern Africa	Hill	Kenya, Uganda, Tanzania, Malawi
R8044	Integrated management of major insect pests of potatoes in hillside systems in the Cochabamba region, Bolivia	Hill	Bolivia. Outputs applicable throughout Andean region in Peru, Ecuador, Colombia and Venezuela
R8182	Strengthening technical innovation systems in potato-based agriculture in Bolivia	Hill	Bolivia
R7566	Management strategies for maize grey spot (*Cercospora zeae-maydis*) in Kenya and Zimbabwe	HP	Zimbabwe, Kenya, Swaziland
R7955	Strategies for feeding smallholder dairy cattle in intensive maize forage production systems and implications for IPM	HP	Kenya
R8212	Integrated pest and soil management to combat *Striga*, stemborers and declining soil fertility in the Lake Victoria basin	HP	Kenya, Uganda, Tanzania (Lake Victoria basin)
R8220	Improving farmers access to and management of disease-resistant maize cultivars in the southern highlands of Tanzania	HP	Tanzania
R8219	Improved access to inputs for maize farmers in Kenya districts	HP	Kenya
R8215	Increasing food security and improving livelihoods through the promotion of integrated pest and soil management in lowland maize systems.	HP	Tanzania, with relevance to lowland maize – producing areas of eastern and southern Africa

DFID number	CPP Project Title	PS[1]	Geographic focus
R8041	Sustainable integrated management of whiteflies as pests and vectors of plant viruses in the tropics: Phase 2 - Network Strengthening, Pest and Disease Dynamics and IPM Component Research	FA1/HP	Uganda, Tanzania, El Salvador, Guatemala, Ecuador, Colombia
R8222	Adaptive evolution within B*emisia tabaci* and associated Begomoviruses: A strategic modelling approach to minimising threats to sustainable production systems in developing countries.	FA1/HP	Colombia, India, Uganda, Latin America
R7876	Investigations onto the epidemiology of Kalimatan wilt of coconuts in Indonesia	LW1	Indonesia
R8187	Development of IPM strategies for coconut mite, *Aceria guerreronis*, with emphasis on fungal pathogens	LW1	Asia region
R7331	Principal pod-boring pests of tropical legume crops: economic importance, taxonomy, natural enemies and control	LW2	Eastern and West Africa (specifically Malawi, Niger), South and Southeast Asia (specifically India), South America (Brazil)
R7377	Development of sustainable weed management systems in direct, seeded, irrigated rice	LW2	India
R7345	Management of weedy rices in Africa	LW2	Ghana, Mali
R7471	Developing weed-management strategies for rice-based cropping systems in Bangladesh	LW2	Bangladesh
R7552	Strategies for development and deployment of durable rice blast resistance in West Africa	LW2	West Africa, Ghana, Côte d' Ivoire
R7570	Determining the nature and function of crop associated biodiversity for sustainable instensification of rice-based production systems	LW2	Vietnam, Cote d'Ivoire, Bangladesh
R7778	Rice sheath blight complex caused by R*hizoctonia* species: pathogen epidemiology and management strategies	LW2	Bangladesh
R7891	Ecology and management of rice hispa (D*icladispa armigera*) in Bangladesh	LW2	Bangladesh
R8026	Commercial adoption of pheromones as a component in the IPM of rice in Bangladesh	LW2	Bangladesh
R8184	Ecologically based rodent management for diversified rice-based cropping systems	LW2	South Asia
R8198	Development and promotion of wild rice management startegies for the lowlands of southern Tanzania	LW2	Tanzania
R8234	Promotion of cost-effective weed-mangement practices for lowland rice in Bangladesh	LW2	Bangladesh
R8233	Integrated weed management in India	LW2	India

DFID number	CPP Project Title	PS[1]	Geographic focus
R7346	Evaluation of the effects of plant diseases on the yield and nutritive value of crop residues used for peri-urban dairy production on the Deccan Plateau in India.	PU	India
R7449	Development of biorational brassica IPM in Kenya	PU	Kenya
R7460	Sustainable management and molecular characterisation of B*emisia tabaci* and tomato leaf curl virus on tomato in India (Phase II)	PU	India
R7472	Integrated management of root-knot nematodes on vegetables in Kenya	PU	Kenya
R7568	Characterisation and epidemiology of root rot diseases caused by F*usarium* and P*ythium* spp. in beans	PU	Africa: Uganda and Great Lakes Region and Democratic Republic of Congo, South Africa
R7571	Management of virus diseases of important vegetable crops in Kenya	PU	Kenya
R7960	Public – private partnerships for development and implementation of entomopathogenic viruses as bioinsecticides for key lepidopteran pests in Ghana and Benin, West Africa	PU	Ghana, Benin
R8089	Management of fruitflies (D*iptera*: T*ephritidae*) in India	PU	India, peripheral studies in Bangladesh, Pakistan, Nepal
R8104	Promoting potato seed-tuber management for increased ware yields in Kapchorwa District, eastern Uganda	PU	Uganda (but relevant to other countries in eastern Africa)
R8106	Promotion of on-farm, small-scale seed-potato production in low-input farming communities in Kabale district, Uganda	PU	Uganda
R8217	Production of Baculovirus to control lepidopteran pests in vegetable crops in peri-urban and rural areas	PU	Kenya
R8218	Production of P*asteuria penetrans* to control root-knot nematodes (M*eliodognye* spp.)	PU	Kenya
R8247	Promotion and impact assessment of tomato leaf curl virus disease-resistant tomatoes	PU	India, Bangladesh, Southeast.Asia regional
R7299	An evaluation of the promotion and uptake of microbial pesticides in developing countries by resource-poor farmers	SA	India, Thailand, Africa and Asia
R7401	Improving production in the Teso farming systems through the development of sustainable draught animal technologies	SA1/2	Uganda

DFID number	CPP Project Title	PS[1]	Geographic focus
R7441	Development of pheromone trapping for monitoring and control of the legume podborer, *Maruca vitrata* (syn. *Testulalis*) by smallholder farmers in West Africa	SA1/2	Based in West Africa (Ghana and Benin), results applicable to other countries in the region covered by the IITA/PEDUNE project (Burkina Faso, Niger, Nigeria, Cameroon, Senegal, Mali, Mozambique).
R7445	Groundnut rosette disease management	SA1/2	Uganda, sub-Saharan Africa
R7452	Characterisation of the causal virus of pigeonpea sterility mosaic disease – a step towards attaining sustainability of pigeonpea production on the Indian subcontinent	SA1/2	India
R7473	Weed management in wetland fields	SA1/2	Zimbabwe, southern Africa
R7518	An investigation into the epidemiology and control of fungal pathogens of sorghum in semi-arid production systems in eastern Africa	SA1/2	Kenya, Tanzania, Uganda
R7564	Integrated management of *Striga* species on cereal crops in eastern Africa	SA1/2	Tanzania, Uganda
R7572	Management of key insect pests of sorghum in southern and eastern Africa: developing IPM approaches with expert panels	SA1/2	Kenya
R7809	Strategies for reducing aflatoxin levels in groundnut-based foods and feeds in India: A step towards improving health of humans and livestock	SA1/2	India
R8105	Farmer-led multiplication of rosette-resistant groundnut varieties for eastern Uganda	SA1/2	Uganda (but relevant to other countries in eastern Africa)
R8030	Finger millet blast in eastern Africa: pathogen diversity and disease-management strategies	SA1/2	Eastern Africa, Uganda, Kenya
R8190	Technology transfer and promotion of ecologically based and sustainable rodent control strategies in South Africa	SA1/2	South Africa, Mozambique, southern Africa
R8194	On-farm verification and promotion of green manure for enhancing upland rice productivity in *Striga*-infested fields in Tanzania	SA1/2	Tanzania
R8205	Characterisation of the causal virus of pigeonpea sterility mosaic disease: a further step towards attaining sustainability of pigeonpea production on the Indian subcontinent	SA1/2	India, Nepal and Myanmar
R7474	Weed management options for cotton-based systems of the Zambezi valley	SA3	Zimbabwe, southern and central Africa
R7813	Sustainable control of the cotton bollworm, *Helicoverpa armigera*, in small-scale cotton production sytems	SA3	India, Pakistan, China
R8197	Development and promotion of appropriate IPM strategies for smallholder cotton in Uganda	SA3	Uganda (outputs relevant to Tanzania)

DFID number	CPP Project Title	PS[1]	Geographic focus
R8191	Promoting improved crop management in cotton- and cereal-based cropping systems in semi-arid areas	SA3	Zimbabwe
R7428	Biology and control of armoured bush crickets in southern Africa	SA4	Botswana
R7779	Forecasting outbreaks of the brown locust in southern Africa	SA4	Angola, Botswana, Lesotho, Mozambique, Namibia, South Africa, Zambia, Zimbabwe
R7818	Development of biologically based control strategies for environmentally sustainable control of red locust in central and southern Africa	SA4	Zambia, Tanzania (and central and southern Africa)
R7890	Establishment of an Information Core for Southern African Migrant Pests+B93 (ICOSAMP)	SA4	Southern Africa: Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia, Zimbabwe.
R7954	Novel technologies for the control of the East African armyworm *Spodoptera exempta* on smallholder cereals in eastern Africa developed, evaluated and promoted	SA4	Eastern Africa, Tanzania
R7966	Identifying the factors causing outbreaks of armyworm as part of improved monitoring and forecasting systems	SA4	Tanzania
R7967	Forecasting movements and breeding of the red-billed quelea bird in southern Africa and improved control strategies	SA4	Southern Africa: Botswana, Mozambique, Namibia, South Africa, Swaziland, Zimbabwe
R8253	Biology and control of armoured bush crickets in southern Africa	SA4	Southern Africa; Botswana: agricultural extension services in armoured bush cricket-affected countries throughout southern Africa

Acronyms

ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa (Uganda)
ATAIN	Agribusiness Training and Input Network (Uganda)
ATIRI	Agricultural Technology and Information Response Initiative (Kenya)
BAT	Bait Application Technique
BS	benchmark site
CBO	community-based organization
CGIAR	Consultative Group on International Agricultural Research
CIAL	Comité de Investigación Agrícola Local (Bolivia)
CIAT	Centro Internacional de Agricultura Tropical (Colombia)
CICR	Central Institute for Cotton Research (India)
CIMMYT	Centro Internacional de Mejoramiento de Mäiz y Trigo (Mexico)
CPP	Crop Protection Programme (DFID)
CTA	Technical Centre for Agricultural and Rural Cooperation (Netherlands)
CTC	Cotton Training Centre (Zimbabwe)
DFID	Department for International Development (UK)
FAO	Food and Agriculture Organization of the United Nations (Italy)
FDTA	Fundación para el Desarrollo Tecnológico Agropecuario (Bolivia)
FFS	farmer field school
FIPS	Farm Input Promotional Service (Kenya)
FORMAT	Forum for Organic Resource Management and Agricultural Technologies (Kenya)
FPR	farmer participatory research
FRG	farmer research group
FSR	farming systems research
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit GmbH
IARC	international agricultural research centre
ICM	integrated crop management
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics (India)
IDEA	Investment in Developing Export Agriculture (Uganda)
IDS	Institute of Development Studies (UK)
IFAD	International Fund for Agricultural Development (Italy)
IFPRI	International Food Policy Research Institute (USA)
IIED	International Institute for Economic Development (UK)
IITA	International Institute of Tropical Agriculture (Nigeria)
IPM	integrated pest management
IPPM	integrated pest and production management

IRETCO	International Rural Enterprise Technology Company
IRRI	International Rice Research Institute (Philippines)
ISNAR	International Service for National Agricultural Research (Netherlands)
KARI	Kenya Agricultural Research Institute
MAT	Male Annihilation Technique (Pakistan)
MPTF	Maize Productivity Task Force (Malawi)
NARS	national agricultural research system
NGO	non-governmental organisation
NRI	Natural Resources Institute (UK)
NR International	Natural Resources International Limited (UK)
ODI	Overseas Development Institute (UK)
OECD	Organization for Economic Community Development (France)
PNTI	Pro-Poor New Technologies Initiative
PRA	participatory rural appraisal
R&D	research and development
RETF	Rural Enterprise Technology Facility
RETAF	Rural Enterprise Technical Assistance Facility
RRA	rapid rural appraisal
SCODP	Sustainable Community-Oriented Development Programme (Kenya)
SHDF	Self Help Development Foundation (Zimbabwe)
SIBTA	El Sistema Boliviano de Tecnologia Agropecuaria
SSSA	Soil Science Society of America
TNAU	Tamil Nadu Agricultural University (India)
UNBRP	Uganda National Banana Research Programme
WARDA	West Africa Rice Development Association (Côte d'Ivoire)
WKC	Western Kenya Consortium

Vernacular terms

matooke	porridge made from cooked bananas
Mercosur	Mercado Común del Sur, the South American equivalent of the EEC
municipos	municipal councils
sindicatos	a system of unionisation set up during agricultural reform in Bolivia 1950. There are geographically organised syndicates for many segments, including farmers.