Systematic review

A systematic review on the impacts of capacity strengthening of agricultural research systems for development and the conditions of success

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Contents

List of acronyms and abbreviations

ACIAR	Australian Centre for International Agricultural Research
AfDB	African Development Bank
AR4D	Agricultural Research for Development
ASTI	Agricultural Science and Technology Indicators
CAADP	Comprehensive Africa Agricultural Development Programme
CGIAR	Consultative Group on International Agricultural Research
CRSP	Collaborative Research Support Programme
CS	Capacity strengthening
DANIDA	Development Agency of the Ministry of Foreign Affairs of Denmark
DFID	Department for International Development (UK)
DGIS	Directorate-General for International Cooperation, The Netherlands
FARA	Forum for Agricultural Research in Africa
ESRC	Economic and Social Research Council (UK)
EU	European Union
GDP	Gross domestic product
GTZ	German Agency for Technical Cooperation
ICT	Information and communication technology
IDRC	International Development Research Centre
IFAD	International Fund for Agricultural Development
IFS	International Foundation for Science
ILRI	International Livestock Research Institute
IRR	Internal rate of return
ISNAR	International Service for National Agricultural Research
M&E	Monitoring and evaluation
NARI	National Agricultural Research Institute
NARO	National Agricultural Research Organisation
NARS	National Agricultural Research Systems
NGO	Non-governmental organisation
NORAD	Norwegian Agency for Development Cooperation
PM&E	Planning, monitoring and evaluation
PPP	Public-private partnerships
PRA	Participatory rapid appraisal
R&D	Research and development
RAILS	Regional Agricultural Information and Learning Systems

RNRRS	Renewable Natural Resources Research Strategy
S&T	Science and technology
SCARDA	Strengthening Capacity for Agricultural Research in Africa
Sida	Swedish International Development Agency
SRO	Sub-regional organisation
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development

Executive summary

This report reviews the evidence of impact of capacity strengthening on agricultural research for development (AR4D) in developing countries. The study was commissioned by DFID as part of the documentation process of the project Strengthening Capacity for Agricultural Research for Development in Africa (SCARDA).

Needs assessments have shown that, although investments in capacity strengthening have increased over the past decade, greater levels of support are needed to counteract decades of underinvestment in AR4D. Investments need to be made in agricultural higher education to strengthen human resource capacity, in particular in the scientific fields that are at the cutting edge: biotechnology, food safety, intellectual property rights, biodiversity, agribusiness and information systems. At the level of National Agricultural Research Systems (NARS), investments need to be made in strengthening relationships between research, extension, higher education, civil society, the private sector and farmer organisations to enhance innovation.

A peer-reviewed protocol for the systematic review was followed to collect and analyse the publications (e.g. journal papers, project reports, evaluations) that provided evidence on impact of capacity strengthening interventions for AR4D. More than 33, 500 references were screened for their relevance; 73 publications were eventually selected for the systematic review based on a predetermined set of selection criteria. For some capacity strengthening programmes, multiple publications were found. Three types of capacity strengthening interventions were distinguished (with several programmes addressing more than one type): strengthening of research capacity in particular scientific disciplines (37 programmes), strengthening of managerial capacity for AR4D (13 programmes) and strengthening of agricultural research and innovation systems (10 programmes).

This systematic review puts more emphasis on the qualitative evidence provided by the studies, as there is a general concern about the availability and robustness of the quantitative evidence. Studies report a lack of robust data obtained through monitoring and evaluation (M&E) or impact assessments which makes it difficult to measure impact and compare objectively different capacity strengthening interventions. Nevertheless, many lessons were reported on the range of factors that influence capacity strengthening outcomes and impact.

All publications reported positive results for the immediate outputs and outcomes: researchers received training and gained new skills and knowledge, new management tools and approaches were introduced, and organisations and other actors in research and innovation systems improved their collaboration. Evidence on the impact on AR4D is less consistent. Only a few studies reported cases where the strengthened capacity was used to address needs or opportunities in the agricultural sector, resulting in considerable economic impact. For example, capacity strengthening of biotechnology research has led to the adoption of new crop varieties in Asia, and a seaweed industry was developed in Tanzania on the back of PhD research.

But few evaluations attempted to estimate the cost-effectiveness of capacity strengthening. The impact pathway was easier to trace in the case of strengthening biotechnological research where new crop varieties or husbandry practices led to higher animal and crop productivity. Five evaluation studies estimated internal rates of return between 11 and 74 percent based on such linear impact pathways, but these high rates of return cannot be taken as representative for all capacity

strengthening interventions. The impact pathway of capacity strengthening of research organisations or systems is typically nonlinear, explaining why most evaluation studies only reported on outputs or outcomes and not on impact, because of the difficulty of determining causality and attribution. The conclusions of most evaluations, however, suggest that capacity strengthening is most successful in improving research capacity when it is long-term and comprehensive, targeting multiple levels (individual researchers, research organisations and NARS). If capacity strengthening is implemented in an appropriate manner, and the researchers and organisations are able to effectively utilise the built capacity, considerable economic or social impact can be achieved, as some studies show.

Key requirements for successful capacity development include:

- A sound and detailed capacity needs assessment in which the beneficiary and its key stakeholder organisations play an active part.
- Strong commitment of senior managers and staff to support the capacity strengthening interventions, often as part of a change process which requires new ways of thinking and behaving and the adoption of new systems or structures.
- Adequate management structures and systems in place to capture the benefits and share good practice.
- M&E systems which document the capacity strengthening process, measure indicators and targets and have a strong focus on learning. The interventions and M&E systems have to be based on clear and justified impact pathways.
- Sustained appropriate support over a long enough period to institutionalise new approaches.
- Fostering collaborations and strengthening relationships with other NARS actors.

1. Introduction

1.1 Background

Agricultural research is thought to hold a vital key to improving food security, reducing poverty and sustaining broad-based economic development (Beye, 2002). Investments in the agriculture sector in sub-Saharan Africa, however, declined substantially during the 1990s. This has led to stagnating agricultural productivity and an increasingly fragile food security situation in many countries (Jones, 2004; Patel and Woomer, 2000). Human and physical capacity in agricultural research organisations in Africa remains weak and their ability to effectively utilise new resources is limited. Strengthening the ability of different types of research and development organisations to work together to contribute to agricultural innovation is critical (Horton *et al.*, 2000).

Although there is a growing consensus that greater support for capacity strengthening at organisation and system levels is required (e.g. Horton *et al.*, 2000), the evidence from sub-Saharan Africa to show that this has had a beneficial impact on research performance is sparse and widely scattered. It has to be noted that agricultural R&D is a slow business (Pardy *et al.*, 2006) and it thus takes time for benefits to be realised. Consequently, there is a need to identify and synthesise current knowledge and evidence on the effectiveness of capacity strengthening strategies and interventions and the extent to which they deliver beneficial outcomes for agricultural and rural development. It is important to understand what has worked and to establish the conditions which have enabled success to be achieved. At the same time, it is necessary to identify where the main capacity gaps lie, so that the most appropriate strategies can be used and investments targeted to address them.

Box 1: Working definition of 'capacity'

Capacity is defined for this purpose as: 'the ability of individuals, organisations and systems to perform and utilise research effectively, efficiently and sustainably in addressing local, national and regional priorities that will contribute to poverty reduction and the achievement of the Millennium Development Goals, and to continuously learn and adapt to new challenges'. In the context of research for development, research capacity involves: the systems, facilities and resources to work with relevant stakeholders to identify and define relevant researchable problem areas; developing and maintaining research partnerships and networks; planning and implementing research tasks; participating in and utilising international research; evaluating, selecting and adapting research findings; and publishing, disseminating and applying research findings.

(Source: Pound and Adolph, 2005)

Berg (1998) defines capacity as 'the ability of individuals, organisations and systems to perform their functions more efficiently, effectively and sustainably, and capacity development includes activities that seek to improve and strengthen such abilities at individual, organisational and systemic levels'.

Almond and Kisauzi (2005) define capacity as 'the ability of individuals, organisations, and the system not only to perform research, but also to transform

research knowledge into successful pro-poor innovation'. Horton *et al.* (2000; pp 14-15) take a similar view:

> The term capacity is defined as the ability of individuals and organizations to perform functions effectively, efficiently, and in a sustainable manner … It includes all those attributes, capabilities, and resources of an organization that enable it to undertake its mission. ... Capacity development in agricultural research can be seen as the process of improving the ability of agricultural research organizations and systems to perform their assigned tasks in an effective, efficient, and sustainable manner. Such capacity development involves strengthening the capabilities of individuals, and organizations and linkages among them.

We define capacity strengthening as any process, initiated internally or externally, that aims to improve the performance of regional and national agricultural research systems. Capacity can be conceived at three different levels: individual capacity and skills; organisational capacity, including management arrangements; and capacity of National Agricultural Research Systems (NARS), including networks and institutions[1] (e.g. Almond and Kisauzi, 2005; Stern *et al.*, 2006). Figure 1 illustrates the various levels at which agricultural research capacity can be strengthened.

Figure 1: Levels of agricultural research

NARS is defined as a system including agricultural research networks and programmes, National Agricultural Research Organisations (NAROs), university faculties of agriculture and other agricultural education institutes, NGOs active in agricultural research for development, the private sector and farmers.

The term capacity strengthening is interchangeably used with the terms capacity building and capacity development in the literature and in development programmes (Almond and Kisauzi, 2005), and in this report no distinction is drawn either.

[1] Organisations are physical bodies (companies, government departments, research institutes, etc.), but institutions provide the framework that structures human behaviour (rules, laws, norms of behaviour, conventions, markets, etc.). The institutions define the pattern of incentives and pressures in a society within which the organisations and individuals play their roles and do their work.

This review on the impact of capacity strengthening of agricultural research systems for development was commissioned by DFID and was linked to a process of documenting outcomes from the project Strengthening Capacity for Agricultural Research for Development in Africa (SCARDA). SCARDA provided support to twelve research and education institutes in ten countries in sub-Saharan Africa to assist them to enhance their performance in carrying out demand-led and high-quality agricultural research.

The objectives of the review are:

- To systematically review studies and reports on capacity strengthening interventions in agricultural research systems in developing countries, to identify the types and extent of their outcomes and impacts on capacity and performance
- To review evidence of capacity strengthening needs at institutional levels in regional and national agricultural research systems in sub-Saharan Africa
- To make recommendations on areas for future investment in, and impact evaluation of capacity strengthening in agricultural research systems.

This report contains the following sections. Section 1.2 gives a brief overview of the capacity needs identified for sub-Saharan Africa. Chapter 2 explains the methodology of the systematic review. Chapter 3 discusses the synthesis of results from the systematic review, and is structured around the research questions. Chapter 4 discusses the conclusions and implications. The appendices contain detailed information on the results of the literature searches and summary tables of the publications included in the systematic review.

1.2 Capacity needs

This section reviews evidence on capacity gaps in African agricultural research systems and the capacity strengthening needs as identified in the literature. It is intended to provide background information relevant to the main topic of this report, the evidence of impact of capacity strengthening in agricultural research systems in developing countries.

The capacity gaps identified in recent literature cover needs within higher education institutes, needs for technical training in specific disciplines within universities and research organisations, research management skills, and organisational development and change within research and extension organisations. They also address the need for capacity development to implement new approaches to agricultural research for development in the changing context of public and private contributions to agricultural research and development (R&D) systems.

1.2.1 Agricultural investment and capacity strengthening

There are a number of sources which discuss the levels of funding allocated for agricultural research, education and training; for example the Agricultural Science and Technology Indicators (ASTI) initiative[2] provides data on institutional developments and investments in agricultural R&D worldwide and analyses and reports on these trends. It is noted that after a period of stagnation in investments in human resource capacity during the 1990s (Beintema and Stads, 2006), the years 2001-2008 saw an average increase of 20 per cent in such investments in public

[2] www.asti.cgiar.org/

agricultural R&D in sub-Saharan Africa (Beintema and Stads, 2011). However this was limited to a small number of countries and was largely aimed at rectifying low salary levels and poor infrastructure. Countries reported prolonged recruitment freezes, limited training opportunities, ageing pools of researchers, loss of senior staff and disproportionate recruitment of junior, BSc-qualified scientists. This analysis is widely supported (Beintema and Di Marcantonio, 2010; Blackie *et al.*, 2010; Mukiibi and Youdeowei, 2006).

Beintema and Stads (2011) identify four key areas to be addressed by governments, donors and other stakeholders: (1) the need for more investment to counteract decades of underinvestment in agricultural R&D; (2) the need for longer-term stable funding aligned with national priorities to avoid excessive volatility in yearly investment levels; (3) the need for government and donor organisations to expand investments in agricultural higher education to meet existing and imminent challenges in human resource capacity; and (4) the need to maximise regional and sub-regional co-operation in agricultural R&D. The emphasis is on African countries and sub-regions building their own capacity for directing and managing agricultural development and for utilising external resources (World Bank, 2008).

Investment is seen as necessary to support the next generation of agricultural education professionals, researchers and extension workers. However, much of the challenge lies in securing political support for such investment. An important initiative is the commitment under the Comprehensive African Agricultural Development Programme (CAADP) to monitor agricultural expenditures, and to set a target of 6 percent annual growth in agricultural gross domestic product in countries where agriculture plays a dominant economic role (Blackie *et al.*, 2010). The Science and Technology Consolidated Plan of Action calls for substantial increases in national R&D budgets, with each country taking concrete measures to allocate at least 1 percent of its GDP to R&D (NEPAD, 2006). However, in 2008, only 8 out of 31 countries had met this target (Beintema and Stads, 2011).

More recently, there have been initiatives to support the role of parliamentarians in influencing agricultural investment, for example the 2011 meeting, 'Regional Parliamentary Dialogue: Enhancing Competitiveness through Increased Investments in Agriculture Value Chains in Africa', organised by the Forum for Agricultural Research in Africa (FARA).

1.2.2 Education and training

The needs in relation to provision of agricultural training, at both undergraduate and postgraduate level, are covered in some detail in the literature. Several sources highlight a decline in the quality of African universities, and the loss of qualified people to other countries or to the private sector, including consultancies (Belay, 2000; Eicher 1999; Mihyo, 2008). There is evidence of considerable loss of senior staff through retirement, and consequently a large proportion of the teaching and supervision is carried out by less qualified and experienced staff (World Learning Inc., 2003). Replacing the expertise of retiring staff is a challenge, and action is needed to avoid a recruitment 'black hole' (Batte and Wanzala, 2009). It is also widely noted that the increase in numbers of graduates in Africa has not been matched by improvements in the quality of their training (FARA, 2005).

Attention is drawn to the challenges of improving the quality of degree programmes and sustaining them in the long term without donor support. Suggestions include a greater emphasis on exchange of information and staff, linkages with universities in the north, tailoring materials to national contexts, developing new curricula responding to demands for new skill sets, and attracting

high-quality students through popularising agricultural careers in secondary schools (Eicher, 1999; Kruijssen, 2009).

Other lessons which inform proposals for future development of agricultural education and training include the importance of recognising that 'one size does not fit all'; that there is need for learning and adapting different models for different contexts. Programme designs should be demand-driven and collaborative, involving the participation of faculties of agriculture. Systems of rewards and incentives need to be considered if expertise is to be retained (Eicher, 1999; World Learning Inc., 2003). Networking and collaborative partnerships among universities within the sub-regions could also help build capacity, and mobilise additional human and financial resources to overcome gaps (Batte and Wanzala, 2009; Koehn and Demment, 2010).

While the capacity to provide such training is seen as being under stress, the demand for agricultural skills is buoyant (Blackie *et al.*, 2010). However, employers of graduates are increasingly looking for a range of practical skills and abilities to engage in wider issues, such as policies for adaptation to and mitigation of climate change (Chakeredza *et al.*, 2009) and the role of biotechnology. Further evidence that the type and range of skills required from agricultural graduates are also shifting is provided by a report on a training and capacity building needs assessment for the university faculties of agriculture in Kenya, Tanzania and Uganda. This identified:

> increasing pressure for faculties to be more relevant, to be more engaged with solving national problems, and to produce graduates that meet the changing needs of agribusiness, demand driven research systems, and privatizing extension services (World Learning Inc., 2003; pp 5)

In addition to scientific capacity, 'soft skills', especially communication and facilitation skills, are increasingly required for the type of collaborative work required in current scenarios of multi-disciplinary, multi-organisation and multi-stakeholder approaches (FARA, 2005).

The practical and problem-solving orientation of agricultural education is weak. High student numbers and lack of facilities and infrastructure limit the scope for 'hands on' practical work (Batte and Wanzala, 2009). Recent evidence from a study of demand for graduates in sub-Saharan Africa observed that most agricultural graduates were weak in terms of problem analysis and solution skills (Blackie *et al.*, 2010). Inadequate opportunities for students to interact through group discussions, tutorials, and seminars are likely to contribute to a lack of critical and analytical skills (Batte and Wanzala, 2009).

There is increasing awareness of the need for technical training in some of the more recent cutting-edge areas of agricultural science, such as biotechnology and food safety, intellectual property rights, agro-biodiversity, environmental management and governance, agribusiness, and information systems (Neely, 2010; Ozor, 2008; Rudebjer *et al.*; 2009).

The potential of new information and communications technology (ICT) in education is well recognised, and could fill the gap in access to information, up-to-date literature and research (CGNET, 2009). However, access to the new technology is inadequate (World Learning Inc., 2003) and it is primarily used for individual communication rather than for teaching, e-learning or collaboration in research (CGNET, 2009). There are particular needs for hardware and faster Internet connectivity speeds. Training in the use of ICTs is needed, particularly for information searches, for sharing information and for use of software for data analysis.

As recognition of the importance of agricultural markets and agri-business has increased, so has the need to include these areas in agricultural education and training (Mabaya *et al.*, 2010). This requires a shift towards more agribusiness-centred education and training to enable graduates to be more competitive and prepared for (self-)employment.

An important issue, widely identified in the literature, is the relatively low number of women entrants to agricultural education (Blackie *et al.*, 2010). On average, 34 percent of the students enrolled in agricultural science in 2007 were female, but there were great differences across countries (Beintema and Di Marcantonio, 2010). Some innovative educational programmes have been devised to address these issues, for example pre-entry programmes and scholarships (Mangheni *et al.*, 2010), as well as programmes to support women's professional career development and management roles in agricultural research and development (e.g. African Women in Agricultural Research and Development: AWARD).[3] The proportion of women students of agricultural sciences is larger than the share of female professional staff employed in agriculture and it is important that appropriate incentives are provided to encourage these students to pursue careers in agricultural research, undertake higher degrees and attain positions of seniority (Beintema and Di Marcantonio, 2010).

1.2.3 Research

A commonly held view is that research agencies in sub-Saharan Africa are under-resourced and lack capacity to undertake research technology transfer (Blackie *et al.*, 2010). Discussions on capacity needs in relation to research cover issues of the availability of qualified research staff as well as the areas of capacity strengthening required.

With respect to the availability of qualified staff, there are challenges relating to the attraction and retention of research staff. In some countries, there is dissatisfaction with conditions of service in comparison to the higher education or private sector. Annual research staff turnover rates vary from high levels in some countries (e.g. South Africa 25 percent per year, Senegal 14 percent) to more stable turnover (3 percent in Kenya and Zambia). A major concern, especially in West and Central Africa, is the skewed age distribution of scientists. In a study of five African NAROs, Sène *et al* (2011) found high percentages of agricultural researchers over the age of 51 (over 50 percent for Burkina Faso, Senegal and Kenya), and with low retirement ages in some countries, this has serious implications for future research capacity.

The ASTI indicators show an increase in the absolute number of full-time researchers in the higher education sector for 32 countries for the period 1991–2008 and note that networks are proving to be a successful method of collaboration and information sharing, particularly for small countries (Moock, 2011). Researcher qualifications varied considerably across countries and by gender; 30 percent of the agricultural researchers employed in these countries in 2008 were qualified to the PhD level, 43 percent to the MSc level and 27 percent to the BSc level. Only 14 countries had more than 80 percent of full-time researchers trained to the PhD or MSc level There was a higher percentage of PhD-qualified staff in the higher education sector (52 percent in 2008) compared to the government or non-profit sectors (24 percent and 29 percent respectively) (Beintema and Stads, 2011). Nevertheless, it appears that a large number of African countries are struggling to

[3] http://awardfellowships.org/home.html

maintain viable agricultural R&D capacities (Beintema and Stads, 2008); in several cases, this is linked to freezes in recruitment (Mukiibi and Youdeowei, 2006).

As is the case with agricultural education, areas of capacity strengthening for research cover both specific discipline-based and specialist skills and broader competencies. In terms of specialist skills, a study in 2006 (Mukiibi and Youdeowei, 2006) identified weaknesses in social sciences, agricultural extension, animal breeding, agricultural engineering, food science and technology, weed science, agroforestry, biotechnology, biometrics, information technology, aquaculture and fisheries.

There has been considerable discussion on the need for strengthening of capacity for researchers in biotechnology and also of the regulatory and legal frameworks under which they operate, dealing with intellectual property and biosafety. It is argued that for Africa to participate in improving agricultural productivity and food security at the required pace, innovations in biotechnology will be important and hence capacity building in biotechnology is needed (Cohen *et al.*, 2004; Kassa, 2010; Wambugu, 1999).

Biotechnology faces some unique challenges and capacity requirements in addition to those common to the agricultural R&D sector (Adekoya and Adisa, 2010; Cohen *et al.*, 2004; Kassa, 2010; Ozor, 2008). Investment is needed in human resource training and development for agricultural biotechnology research and in the equipment and infrastructure to support it (Adekoya and Adisa 2010; Cohen *et al.*, 2004; Ozor, 2008). The main biotechnology capacity needs identified include: understanding of intellectual property rights issues and patents and their management, and how these influence relations with the private sector (Ozor, 2008; Wafula and Clark, 2005; Wambugu, 1999); formulating policy, objectives and priorities for agricultural biotechnology (Clark, 2005; Ozor, 2008); understanding the costs, benefits and risks of biotechnology and the alternatives (Cohen *et al.*, 2004); regulatory and biosafety issues (Adekoya and Adisa 2010; Clark, 2005); and training in risk management and assessment procedures (Ozor, 2008). Arrangements which can assist capacity strengthening in biotechnology are collaboration with advanced research organisations and knowledge and technology transfer partnerships (Bull *et al.*, 2011) and postdoctoral fellowships in advanced laboratories (Ozor, 2008). Finally, researchers require enhanced capacity to contribute to public debate and awareness (Cohen *et al.*, 2004; Ozor, 2008).

Among the broader competencies required in agricultural research, the needs identified include the management of agricultural research for development, covering identification of research needs and the prioritisation of the national research agenda, managing the planning and implementation of research, and evaluating, disseminating and adapting the research findings (Beintema and Stads, 2008). Skills are needed to set meaningful investment targets for agricultural research for development (AR4D) (Beintema and Elliot, 2009). These include the need for basic studies of agricultural potential and research demand expressed by different stakeholders, understanding the sources of knowledge and science and technology to realise this potential, and specialist knowledge and capacity to negotiate partnerships and contracts.

Broader needs also include cross-cutting functions such as ICT, gender, monitoring, evaluation and impact assessment, participatory approaches and awareness of the implications of climate change and environmental impacts.

A study commissioned by FARA in 2004 found that NARS had:

> major gaps and weaknesses in ICT infrastructure including skills and Internet connectivity, capacity to generate digital information content, apply and

> manage use of ICT effectively and provide ICT enabled information services (Maru, 2004; pp i)

The studies recommended strengthening capacity for individuals and user communities in AR4D organisations and sub-regional and regional AR4D networks through training in how to access international technical information, in management of scientific and technical information and in sharing databases and research information relevant to extension, outreach and market information. Also proposed was training for information managers to help create agricultural virtual libraries, information directories and open and distance learning centres. National, sub-regional and regional initiatives by FARA and its sub-regional organisations (SROs) are beginning to address these issues, for example through the RAILS (Regional Agricultural Information and Learning Systems) programme.

The proportion of female agricultural researchers is low (22 percent in 2007), although figures are improving (Beintema and Di Marcantonio, 2010). Women are particularly underrepresented in areas related to engineering, such as irrigation and water management, natural resource management and soil science. Fewer women (27 percent) have advanced degrees compared to their male colleagues (37 percent) and only 14 percent of the management positions are held by women. Hence there is a need for policies and actions to increase women's participation in order to create an expanded agricultural research capacity (Beintema and Elliot, 2009), for example, through special programmes for accelerated training of women scientists (Mukiibi and Youdeowei, 2006).

To encourage young researchers, efforts to promote their career development are needed, including strengthening their participation, ensuring age balance, developing and supporting mentoring and experience enhancement programmes, and involving them in policy debate (Kruijssen, 2009).

However, it is important to recognise that whatever the skills and experience of researchers, without funding for research implementation and outreach, there will be little impact. Therefore, skills to influence decision makers and to lobby for operational funding for research are an essential part of capacity building (Blackie *et al.*, 2010).

An important capacity need among researchers is to improve their publication performance, particularly publications in international refereed journals. In 2006, 39 percent of NARO scientists had not published an article in an international journal in the previous five years and only 4 percent had published five articles or more in the same period (Mukiibi and Youdeowei, 2006). Needs were identified for training in publications management and editing, scientific writing and communication skills.

1.2.4 Institutional development

The third main area of capacity strengthening need is concerned with the institutional landscape of AR4D covering the relationships between different R&D organisations in the public and private sectors, NGO actors and farmers' organisations. The arguments for investment in capacity strengthening in this area revolve around the obstacles to agricultural development which are created by institutional structures and relationships. They advocate for 'innovation systems' approaches to encourage more active partnerships and networking among diverse stakeholders in agricultural development, including educational organisations, research organisations and government ministries, farmers, traders, NGOs and civil society organisations, and agricultural service providers, both public and private (providing information, inputs, agricultural finance, business training, etc.) (Davis *et al.*, 2007).

An early argument in favour of capacity building for institutional change was expressed by Eicher (1999). Analysing the failures of NARS-based on models from other countries, he argued that there was a need for African leaders and agriculturalists to craft national 'agricultural knowledge triangles' (Eyzaguirre, 1996) that include research, extension and agricultural higher education, and link to farmer organisations, the private sector and the regional and global scientific communities. This is an example of the concept of agricultural knowledge systems, which became more prominent in relation to discussions of innovation systems a decade later. However, also noted was the absence of intellectual agreement on how this might be achieved.

Later sources provide some suggestions on how to strengthen linkages between these organisations, for example: by including representation of a wider stakeholder group on their boards and other governance structures; by including issues of managing partnerships in training; by seeking collaboration in research and development projects; and through participating in regional initiatives (Mukiibi and Youdeowei, 2006).

Batte and Wanzala (2009) note the need for universities to see innovation as their core business. Their structure and governance need to be more responsive to the needs of dispersed and poor rural communities and more interactive with stakeholders. Faculties of agriculture are not sufficiently integrated into the national and regional innovation systems.

Drawing on a study of agricultural education and training systems in Ethiopia and Mozambique, Davis *et al.* (2007) stress the importance of attuning educational institutions' mandates and programmes to the needs of different actors in the national innovation systems, including smallholder farmers, rural traders, agro-processors, consumers and extension service providers. They suggest expansion of technical and vocational training institutes (public and private), in-service and on-the-job programmes and distance education.

Building sustainable agricultural organisations is a long-term issue requiring continuity of support (Beintema and Stads, 2011; Eicher, 1999). In the context of the high dependency of agricultural R&D agencies on donor funding, the volatility in this funding compared with other sources has had consequences for staff capacity, organisational stability and long-term outputs (Stads, 2011). Halting this volatility requires a long-term commitment from national governments, donors and development banks, and the private sector.

In addition to the observation that long-term scientific technical assistance is needed to support graduate training programmes and develop African research capacity, the argument is made that there has been unwarranted optimism concerning the time period needed for institutional development and change, rather than recognising the longer trajectories needed for building indigenous NARS through a trial and error and learning-by-doing process. On the positive side, expanding information technology capacities are opening the door for novel institutional partnerships to improve agricultural education and training in Africa (Eicher, 2006). A study from Cameroon on institutional adaptive capacity and climate change is instructive (Brown *et al.*, 2010). It concluded that weak networks had serious implications for the effectiveness of national response to climate change and to international policies on forests. Efforts were needed to involve local communities in the climate change dialogue and to build capacity for collaboration and networking for knowledge exchange.

Sumberg (2005) identifies tension between the centralising tendency of the initiatives toward greater integration and the growing appreciation of the

importance of diversity in effecting development and change in rural Africa. He suggests that a less directive approach to support for agricultural research would allow national characteristics and differences to come to the fore, and give more room for the development of the important demand side.

An important area of capacity strengthening for agricultural scientists relates to their capacity to engage in the science and agricultural policy arenas. This involves both the social, economic, ethical and political debates associated with new technologies (e.g. biotechnology and ICTs, discussed above) and also the changes in institutions and governance structures, both public and private, which manage agricultural research for development (Clark, 2005). This is not a short-term process; shifts in policy and strategy do not bring about change within five-year time spans (Davis *et al.*, 2007). New skills are required for more effective communication and partnerships among different stakeholder groups, including government research, NGOs and civil society, and the private sector and donors (Clark, 2005; Davis *et al.*, 2007). This can be most effectively achieved through short-course training in science policy for research scientists and for high level managers; including science policy modules in degree courses; and training trainers in this area (Clark, 2005).

Emerging from these discussions are the needs to address capacity requirements in a systemic way, including the balanced development of research institutes, universities and upstream and downstream partners. While agricultural research and education networks at the global, regional and sub-regional levels are increasingly linked, they need to strengthen their connections with downstream networks concerned with information and support to farmers and rural enterprises.

2. Methodology

This systematic review addresses the first objective of the overarching review, identifying the types and extent of the outcomes and impacts of capacity strengthening interventions on capacity and performance of NAROs and NARS. The main research question and sub-questions to be answered in this systematic review are:

> *What are the impacts of capacity strengthening interventions on the capacity and performance of regional and national agricultural research systems, and the conditions for success?*
>
> *What are the (positive and negative) impacts of different types of capacity strengthening interventions on the capacity and performance of agricultural research systems?*
>
> *What are the different methods and indicators used to measure the impact of capacity strengthening interventions?*
>
> *How does the impact on capacity and performance of agricultural research systems vary by different approaches to capacity strengthening?*
>
> *What (external and internal) conditions play a role in achieving beneficial impacts through capacity building?*

2.1 Literature search

Criteria for inclusion and exclusion in the review

The criteria used for inclusion and exclusion of studies/publications for the systematic review are:

- Types of studies: studies that evaluate *ex-post* the impact or trace the impact pathway of capacity strengthening initiatives on the capacity and performance of agricultural research systems have been included. Since a wide variety of evaluation methods are used, we have therefore included quantitative and qualitative studies. Studies that describe capacity strengthening programmes but do not report on impact or outcomes have been excluded from the systematic review, but relevant studies have been included for the review on capacity strengthening needs.
- Types of interventions: studies that consider the impact of capacity strengthening interventions such as:
  - At individual level:
    - (post-)graduate training of individuals employed at agricultural research institutes
    - Short courses (skills training) for staff employed at agricultural research institutes or in the private sector
  - At organisational level:
    - Organisational capacity strengthening and change management
    - Research management skills
    - Mentoring schemes
    - Improvement of communication and information systems (including ICT)
    - Technical assistance

- At NARS level:
    - Distance or e-learning programmes
    - Public-private partnerships
    - Research-into-Use programme
    - Action research – research with community-level innovation
    - Farmer field schools
    - Innovation platforms.
- Geographical spread: although the focus is on Africa, studies that consider capacity strengthening initiatives in Asia or Latin America have also been included. Studies from other geographic areas have been excluded.
- Studies since 1990 are included.
- Studies are excluded if:
    - The study does not relate to research and development within the agricultural sector
    - The study applies to high-income countries
    - The study does not report on any type of impact or outcome of the capacity strengthening intervention.

Search strategy

The search for literature was done through the following sources:

- EBSCO Discovery Service of the University of Greenwich searching the following online databases: Academic Search Premier, British Library Document Supply Centre, CAB Abstracts 1990-present, CINAHL, EDS Foundation, ERIC, GreenFILE, Humanities International Complete, Library Information Science and Technology Abstracts.
- Databases of scientific journals: Africana Periodical Literature, AgEcon, African Journals Online (AJOL), Asian Journals Online, British Library for Development Studies (BLDS) Digital Library, International Bibliography of the Social Sciences (IBSS), IDEAS, Ingenta Connect, JSTOR, Latin American Journal Online, Scopus (searching scientific journals of large publishers such as Elsevier, Springer, Wiley-Blackwell, Taylor and Francis), SpringerLINK and Swetswise.
- Web portals: 3IE, AGRIS, ASTI, CGIAR Vlibrary, Eldis, FARA, NEPAD-CAADP, RIU, RUFORUM, Search4Dev.
- International agricultural research institutes and major donors projects such as ACIAR, AfDB, AusAid, DANIDA, DFID, DGIS, FAO, FARA, IDRC, NORAD, SDC, Sida, UNDP, USAID and the World Bank.
- Academics and experts working in the field of capacity strengthening, including FARA and the SROs, were contacted by e-mail with a request to send relevant publications and grey literature (e.g. evaluation reports, working papers) to the review team.

For the larger databases, searches were carried out in full text under four broad categories:

- professional academic training of individuals

- short courses (skills training) of individuals
- organisational capacity strengthening
- strengthening of agricultural research systems.

Complex combinations of search terms were not appropriate or possible for some web portals. In those cases simpler searches were carried out using the terms 'capacity building', 'capacity development' or 'capacity strengthening'. Depending on the scope of the portal, some filters became redundant. For example, the terms 'agric*', research and the geographic location were omitted when searching the CGIAR portal, which contains only publications on agricultural research in developing countries. Searches were carried out in all fields by default, including the full text of documents, so the specific search terms would not be restricted to matches in titles or abstracts only. However, searching in full text was not possible in some databases.

The full search strategies (including search words and Boolean operators) for each electronic database or web portal, the search set numbers and the number of records retrieved are reported in detail in Appendix 2.

The retrieved titles and abstracts were examined against the inclusion/exclusion criteria by the reviewers, and irrelevant studies were removed during a first screening. The abstracts and full text of the remaining studies were independently assessed in detail by two reviewers during a second screening. In case of disagreement, the study was discussed to come to a mutual decision. Appendix 3 lists all selected references that were included in the systematic review.

2.2 Modifications to the review's initial protocol

During the search stage, the scope of the systematic review was slightly refined by focusing in particular on academic research systems. This meant that the literature on capacity strengthening at farmer level (e.g. farmer field schools) was not taken into account, except if it was in the context of strengthening the capacity or effectiveness of NARS.

2.3 Data extraction

The selected studies that passed the inclusion/exclusion criteria were reviewed in detail. Data extraction forms (see Appendix 4) were used to extract all relevant data from the selected studies for further analysis. An evidence database was constructed in Excel. The database contains information on:

- the studies (e.g. study objectives, study locale, year of publication, type of publication, authors)
- the context of the studies (e.g. description of agricultural research systems, level of capacity strengthening intervention, scope or sub-sector within agricultural research systems addressed by the intervention)
- the methods used in study (e.g. data collection methods, evaluation methods, performance indicators)
- descriptions of capacity strengthening activities
- the relevance of the studies (high, medium, low), i.e. the appropriateness of the focus and the use of the study design to address the systematic review's question

- the quality of the studies, i.e. the trustworthiness of the results based on the methods used (considering sample size, evaluation method, data type, etc.) and the type of publication
- the key findings on the types and extent of impacts of capacity strengthening on the capacity and performance of agricultural research systems, with particular reference to gender aspects
- the key findings and lessons learnt on what factors determine the level of impact.

2.4 Analysis and synthesis

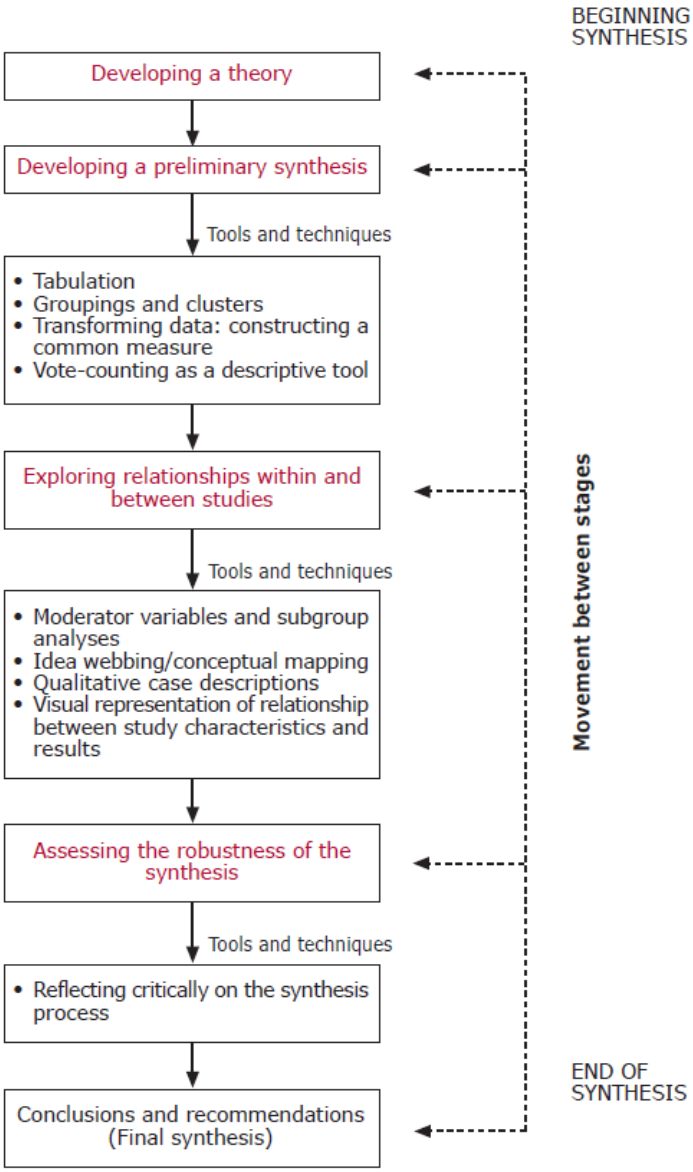
Because of the large variety of interventions and methodologies used by evaluation studies, and a limited number of quantitative impact studies, the results were synthesised using a qualitative narrative approach, following ESRC guidance (Popay *et al.*, 2006). Other synthesis methods that require similarities in context, intervention and evaluation methods, such as vote counting or statistical meta-analysis, were considered inappropriate. The narrative synthesis adopts a textual approach to the process of synthesis rather than a quantitative approach such as statistical meta-analysis. Figure 2 gives an example of the narrative synthesis framework (CRD, 2009). The studies were organised according to the type and level of capacity strengthening (individual, organisation or innovation system). Subsequently, a cross-study synthesis was carried out around specific themes, based on the grounded-theory approach using Atlas.ti software. Grounded theory is a systematic methodology in social sciences where the theory is constructed based on the findings that emerge from data analysis.

2.5 Limitations of the search and selection of the evidence base

The capacity strengthening programmes discussed in this report are not necessarily representative of all capacity strengthening interventions. It is most likely that there is a strong publication bias. Some donors (e.g. CGIAR, Sida, ACIAR) are more committed to publishing evaluation reports than others. Peer-reviewed publications may be more likely to report on programmes that had had substantial impacts or where important lessons were learned than on programmes where no clear impact was identified. Programmes that seek to strengthen agricultural research management or innovation systems are relatively new, and it is difficult to measure impact, and therefore these programmes may be underrepresented in the sample.

It is likely that the search terms have not picked up all studies that report on impacts of capacity strengthening interventions. Nevertheless, because of the extensive search, and the many hits that were screened, it is unlikely that any missing studies will have led to a bias in the selected studies.

Figure 2: Example of applying the narrative synthesis framework (CRD, 2009)

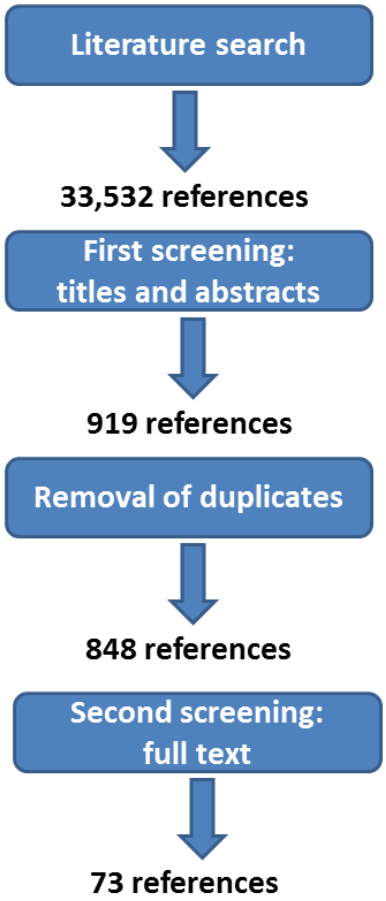


3. Results

3.1 Search results

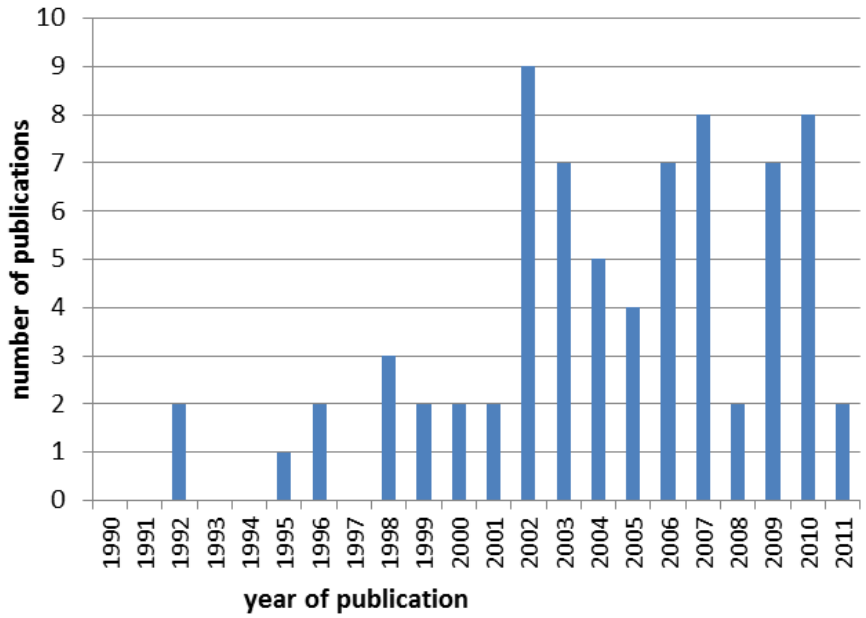
The literature search resulted in over 33,500 references. After screening the titles, abstracts and full text 73 publications on capacity strengthening of NAROs and NARS were left for the systematic review (see Figure 2).

Figure 2: Search results: systematic review



The majority of the publications selected for this review were published after 2000 (see Figure 3). This probably reflects the increasing interest and investment in capacity strengthening for development in the 1990s.

Figure 3: Number of publications on capacity strengthening for AR4D by year



Fifty publications reported on capacity strengthening programmes in Africa, 26 on programmes in Asia and 19 on programmes in Latin America. Various documents covered interventions in more than one continent. The vast majority of interventions were funded by international donors (51 publications), in particular Sida (11 publications), USAID (10 publications), and DFID (6 publications). Other international donors included ACIAR, the African Development Bank, the Asian Development Bank, DANIDA, DGIS, EU, GTZ, IDRC, IFAD, NORAD, UNDP, UNICEF and the World Bank. Several capacity strengthening programmes were funded by multiple donors. The Rockefeller Foundation was the only private donor (2 publications). National governments co-funded capacity programmes in some cases (11 publications).

The publications reported on capacity strengthening programmes that targeted NAROs (51), higher education institutes (27), extension services (8), NGOs (6), the private sector (3) or other actors (8), such as policy makers. Fourteen publications reported on capacity strengthening programmes that targeted innovation systems rather than individual organisations or actors. It should be noted that in many cases, the capacity strengthening was targeted at multiple actors or organisations.

Most publications reported on training of staff (in particular researchers, technicians and managers), either through skills training (53 publications) or postgraduate training (38 publications). Other capacity strengthening activities were also reported upon: organisational development (22 publications), collaborative research (14 publications), technical assistance (10 publications), information systems (9 publications), public-private partnerships (8 publications), innovation systems (8 publications), research networks (8 publications), research grants (7 publications), vocational training (4 publications) and mentoring (4 publications).

Several publications reported on the same capacity strengthening programme. In total, 24 programmes specifically focused on individual capacity strengthening, 11 on organisational capacity strengthening, 4 on capacity strengthening of non-research actors and 19 on capacity strengthening of NARS, summing up to 58 capacity strengthening interventions in total. Two publications (Beye, 2002; Mauldon, 1998) presented meta-evaluations of capacity strengthening

interventions. The main findings and lessons learned from these studies have been included in this review.

3.2 Quality of the evidence base

Assessing the quality of the studies was challenging because of the wide variety of methods used and an often poor description of data and methodology in the reports. Furthermore, the majority of publications were project reviews rather than impact evaluations. As such, it was difficult to compare the studies against each other to assess the quality. In several cases, the authors reported that there was a lack of structured M&E data, the main source of data used in the studies (see also Section 3.5 for a more detailed discussion).

There are two important questions that determine the quality of the evidence: 1) did the methodology fit the objective of the evaluation, and 2) is there any risk of bias in the findings?

Randomised controlled trials are the recommended method to measure the impact of an intervention or treatment. With interventions such as capacity strengthening, this is unethical and impractical. Instead, quasi-experimental approaches can be used, but only three studies applied this robust method to estimate the impact of training of individual researchers. Twenty-five studies applied quantitative methods without a control group, and 63 were based on qualitative methods (see Appendix 5 for more detail on the study objectives and methodologies used). There is thus a lack of quasi-experimental evaluations of capacity strengthening initiatives, and the robustness of the evidence has to be viewed in this context. However, it should be noted that it is practically impossible to apply quasi-experimental approaches to assess the impact of capacity strengthening of NAROs or NARS, because of the lack of appropriate counterfactuals at these levels.

All studies reviewed capacity strengthening interventions in one form or another: 37 studies were external evaluations; 30 were internal evaluations; and for 6 it is unknown whether the evaluation team was internal or external to the intervention. It is difficult to assess whether internal evaluations are more likely to produce biased results than external evaluations. Because most project reviews took place immediately after the interventions, it was too early to establish impact, and most evaluation studies therefore limited themselves to reporting on outputs and outcomes. The absence of control groups for most quantitative studies has most likely introduced a bias into the findings. Another form of bias can be found in so-called tracer studies where graduates of training programmes could not be found or did not respond to surveys. In these cases, any potential bias has not been corrected.

Studies of very low quality, with no information on outcomes or methodology, or dubious findings, were excluded during the screening phase. But many of the included studies can still be criticised for lack of quality in terms of robust impact assessment methods or detailed reporting on methods and potential bias, which seems to be a general problem with this type of intervention and evaluation. The findings of the systematic review are therefore mainly qualitative, as the validity of quantitative findings on impact is limited.

3.3 Capacity strengthening of agricultural research

3.3.1 Capacity strengthening of researchers

Three studies evaluated the impact of postgraduate training for individual researchers in a more systematic way using Kirkpatrick's model (Eley *et al.*, 2003; Jamora *et al.*, 2011; Wanjiku *et al.*, 2010). Kirkpatrick's model distinguishes four

levels of evaluation: reaction (participants' reactions to training), learning (level of achievement of learning objectives), behaviour (job performance or behavioural change), and results (impact, e.g. improved work quality). Wanjiku *et al.* (2010) assessed a World Agroforestry (ICRAF) training programme at these four levels. Nearly all participants thought the training to be relevant, and the majority confirmed that they used the acquired skills in their current work. However, skill utilisation (behaviour) was limited by a lack of funds, labour and equipment. Eley *et al.* (2003) also reported that the vast majority of students were positive about their postgraduate experience at the International Livestock Research Institute (ILRI) and considered it useful. The training in particular contributed to the development of scientific leadership. However, the study also found that many graduates spent little time in their area of specialisation after the training. Jamora *et al.* (2011) used the same model to evaluate the pulse Collaborative Research Support Programme (CRSP) training programme in the USA. Graduates confirmed the relevance of the training and all acquired new knowledge. Although the majority of the graduates were employed in a research setting, only half were still involved in research related to beans and cowpeas (the topic of the training). PhD graduates were more likely to achieve impact in the long run as the proportion of PhD graduates that remained in the same area of research was larger than that of MSc graduates. Moreover, PhD graduates secured academic positions at universities, continuing research collaborations with their supervisors, and serving as multipliers training future generations of students (Jamora *et al.*, 2011). The three studies point out that it is difficult to attribute current job performance and impact to previous training activities, as the latter is only a fraction of the knowledge and skills an adult learner possessed prior to the training (Eley *et al.* 2003). However, impact was considered larger for disciplines within natural sciences than social sciences (Jamora *et al.*, 2011; Wanjiku *et al.*, 2010). This is partly due to the nature of the different disciplines, where researchers within natural sciences are more likely to specialise in a particular research topic than in social sciences.

Six evaluations assessed the number of scientific publications as a measure of strengthened research capacity (Forss, 2002; Freeman *et al.*, 2010; Freudenthal, 2009; Gaillard and Zink, 2003; Patel and Woomer, 2000; Thulstrup *et al.*, 2006). These evaluations all reported on programmes that had a research component, either in the form of research grants or collaborative research, which had a positive impact on research publications, in particular in the natural sciences. Long-term and intensive support to Makerere University has resulted in a 300 percent increase in Institute for Scientific Information (ISI) publications from 1998 to 2008 (Freeman *et al.*, 2010). However, other factors were noted that constrained researchers' productivity in terms of publications, including low national investment in research, lack of access to internet and bibliographic databases, 'scientific isolation' of researchers, and lack of support and incentives for quality research and publication of results in international journals (Gaillard *et al.*, 2002; Gaillard and Zink, 2003; Thulstrup *et al.*, 2006). Researchers were more likely to publish when it was advantageous to their career prospects (Freudenthal, 2009; Gaillard and Zink, 2003).

In addition to an increased set of skills and knowledge and scientific leadership, capacity strengthening of individual researchers often improved North-South research collaborations as graduates kept relationships with their supervisors and peers (e.g. Morris and Louwaars, 2004). Ynalvez and Shrum (2009) showed that the strength of these relationships depended on the organisational culture (e.g. the intensity of interaction with supervisors) at the training institute.

Box 2: Forss (2002; pp 31) on the importance of mutual research interests

'A programme could focus on capacity building or on cooperation. The problem with the former is that it puts the Swedish partners in the role of consultancy firms in technical cooperation; a role they mostly do not have either experience or aptitude to do well in. The problem with the latter is that the conditions for mutual interest may not occur that easily. However, rather than rushing in to a new programme, it is worth waiting for the research interests to develop. It is quite clear that the programmes where capacity building was most successful also had strong elements of mutual research interest. The university institutes do not cope well with pure technology transfer, there is a need for the intellectual excitement of joint research. The cooperation programme must not be too basic, it must be positioned at the front end of research'

The Swedish International Development Agency (Sida) and the International Foundation for Science (IFS) provided competitive research funds to mostly early career researchers in Africa in order to support management of research and capacity building, and to generate knowledge and promote research culture (Eduards *et al.*, 2007; Fones-Sundell and Teklehaimanot, 2007; Gaillard *et al.*, 2002; Gaillard and Zink, 2003; Hydén, 2006; Thulstrup *et al.*, 2006). Hydén (2006) concluded that this type of support was moderately successful as it did result in capacity building but the generation of new knowledge had been marginal. Supported researchers were more successful when their work was related to research programs. Hydén thereforerecommends that research funds were combined with collaborative research programmes to enhance the capacity of NAROs.

Women scientists are still underrepresented in most developing countries. Several publications looked at the gender dimensions of capacity strengthening (e.g. Alberts *et al.*, 2003; Freeman *et al.*, 2010; Gaillard *et al.*, 2002; Gaillard and Zink, 2003; Njuki *et al.*, 2006; NORAD, 2009; Nyirenda and Tostensen, 2009; OSAN, 2009; Robson, 2010; Ynalvez and Shrum, 2009). Activities included scholarships for women, mentoring of women, and observing the gender balance in the recruitment of researchers. In some cases, the programme had a significant positive impact on encouraging women to pursue postgraduate training and develop an academic career (Alberts *et al.*, 2003; Freeman *et al.*, 2010; Gaillard *et al.*, 2002; Njuki *et al.*, 2006; Nyirenda and Tostensen, 2009; NORAD, 2009; OSAN, 2009) but not in other cases (e.g. Gaillard and Zink, 2003; Robson, 2010; Ynalvez and Shrum, 2009). Cultural disincentives seem to play an important role; one problem is that many women hesitate to pursue postgraduate training abroad as this may risk their marital happiness and even status (Alberts *et al.*, 2003). In some cultures (e.g. the Philippines) women are expected to be the main caregivers for children and being assertive is considered indecent, which may make it more difficult for them to engage in (international) collaborative research projects (Ynalvez and Shrum, 2009). It should be noted that lower female participation also reflects the gender composition of secondary school graduates and undergraduate students (NORAD, 2009).

One major concern of strengthening the capacity of individual researchers is the phenomenon called 'brain drain'. Graduates having gained new qualifications and skills may decide to pursue their own careers and apply for better paid positions abroad or at international institutes rather than remain at NAROs. The risk of brain drain increases if trained researchers cannot utilise their new skills due to lack of time, lack of resources or job role (e.g. Babu *et al.*, 2007; Beye, 2002; Njuki *et al.*, 2006; NORAD, 2009; Pray, 2006). Skilled researchers can also be lost due to other

causes, such as (early) retirement (Forss, 2002; Freudenthal, 2009; Longmore *et al.*, 2007; Ryan *et al.*, 2007) or HIV/AIDS (Alberts *et al.*, 2003; Almond and Kisauzi, 2005). However, only a few studies seem to support this brain drain hypothesis (Cooksy and Arellano, 2006; Gaillard *et al.*, 2002; Gaillard and Zink, 2003; Jamora *et al.*, 2011). Most evaluations that considered the phenomenon of international brain drain found that the vast majority of graduates returned to their home countries or indeed home organisations and that the brain drain was minimal (e.g. Alberts *et al.*, 2003; Ayele and Wield, 2005; Berg, 1998; Eduards *et al.*, 2007; Eley *et al.*, 2003; Forss, 2002; Freudenthal, 2009; NORAD, 2009; Nyirenda and Tostensen, 2009). It should be noted though that some of these results may be biased, as the samples of trained researchers typically did not include those graduates whose contact details were out of date. The whereabouts of these 'missing' graduates are thus not known. Some programmes (e.g. Eley *et al.*, 2003; Fisher and Gordon, 2008; Longmore *et al.*, 2007; Mauldon, 1998; Thulstrup *et al.*, 2006) bonded individual researchers to home organisations through contracts that obliged graduates to return to their employers for a minimum number of years in order to transfer their new skills to their colleagues and build the organisational capacity.

In a few cases, it was reported that trained researchers encountered difficulty finding suitable employment because of shallow or saturated labour markets in their home countries. USAID (1995) reported that the labour market in Kenya could not absorb the expanded pool of technical and managerial human resources in the early 1990s. Thulstrup *et al.* (2006) reported that a university in Bolivia sent senior staff members rather than young researchers for postgraduate training for similar reasons, reducing opportunities for young talent. Eley *et al.* (2003), on the other hand, reported that new research and education organisations emerged in Ethiopia and Kenya in the late 1990s, resulting in high demand for research managers and

Box 3: Capacity strengthening and suboptimal outcomes due to inadequate organisational capacity

NORAD funded capacity strengthening programmes at the Sokoine University of Agriculture (SUA) in Tanzania during 1974-2000 (Berg, 1998). However, the concentration of support in certain departments caused discontent and hampered organisational development, as some departments were not enabled to play their expected role nor was the managerial capacity strengthened. According to the author, the skewed focus of the programme was mainly the result of influential Norwegian researchers. Berg (1998; pp 38) concluded that: 'the programme, its objectives and components, have never been formulated as based on a thorough needs assessment. Instead it has been taken for granted that the support to a capacity building process in education and research naturally, and more or less automatically, would assist in the sustainable management of natural resources, and thereby be of benefit to Tanzania's overall agricultural development.'

Freeman *et al.* (2010; pp 7) came to similar conclusions when evaluating the capacity strengthening programme at Makerere University in Uganda: 'less satisfactory outcomes include lack of long-term strategies for building capacity by choice of projects, collaborators, and agendas for research, collaboration across disciplines, and strategies for uptake of results, including links with vital industries. Despite the success of the program until now, there are a number of issues, many of them university-wide, and some program-wide, that need to be resolved for Makerere University to achieve its great potential for further gains in building research capacity. Deficits in university administration, financial management, and program governance plagued implementation of this program, and constitute the greatest barriers to continuing growth in research capacity, as well as to sustainability of gains.'

leaders, and absorbing many of the graduates.

A negative effect of training individual researchers at foreign organisations in the North can be that the academic interests of supervisors differ from the agricultural problems and needs in the trainees' home countries. It is thought, however, that so-called sandwich programmes partly overcome this issue as trainees carry out their research project in their home country, making it more relevant to the national agricultural development strategies (Alberts *et al.*, 2003; Eley, *et al.*, 2003; Eduards *et al.*, 2007; Freudenthal, 2009; Ryan *et al.*, 2007; Thulstrup *et al.*, 2006). Furthermore, Freudenthal (2009) reported that most respondents appreciated the sandwich PhD model because they could keep their positions while pursuing their postgraduate training, and the research had more national relevance while they still had access to more advanced scientific technology and skills. Women also appreciated that this model allowed them to take care of their families as they did not have to be away for long periods. A disadvantage of the sandwich model was that the candidates still had to do office work or teaching at their home organisations, distracting them from their postgraduate studies (Freudenthal, 2009; Thulstrup *et al.*, 2006). In some cases, this could seriously delay the completion of PhD training, lowering its cost-effectiveness (Alberts *et al.*, 2003).

Box 4: Three dimensions of organisational capacity strengthening

Nyirenda and Tostensen (2009) suggest that institution building should comprise three main components:

(a) The external environment. External actors and structures include the policies and structures of government (legislation and other regulations) and those of the donor community, as well as civil society and mass media coverage.

(b) The internal institutional framework. This subsumes, first, in broad terms the organisation's mission and mandate in society; its internal management structures, procedures, rules and regulations, and its established practices. Second, it also comprises the human resources component. With regard to academic staff, their competence level is critical for satisfactory performance, as is that of the administrative and support staff. Third, in order for an institution to know whether or not it is on the right track, a monitoring and evaluation system is indispensable to document activities and outcomes. Fourth, a crucial element in an institution's wellbeing and survival is the maintenance of assets such as buildings, vehicles and other equipment.

(c) The financial foundation. Although strictly speaking part of the above internal institutional framework, the financial underpinnings warrant special attention. The financial foundation includes not only income generation from multiple sources, but also the economic management of that income. For this to be achieved, appropriate systems must be in place for accounting and auditing in order to forestall diversion or misuse of funds.

A negative impact of individual capacity strengthening that is often overlooked is that returned graduates seem to end up with teaching and management duties and thus spend very little time, if any at all, on research in their area of specialisation. Most impact studies do not consider this, although a few seek to identify the number of subsequent research grants as an indicator of impact of capacity strengthening of individual researchers (e.g. Eley *et al.*, 2003). This seems to be a

useful indicator for natural scientists in Asia (e.g. Cooksy and Arellano, 2006; Pray, 2006) but is perhaps less relevant in Africa, where institutes rely more on donor and government funding and researchers therefore have fewer incentives to proactively find external funding for research (Eley *et al.*, 2003). Freudenthal (2009) reported that researchers in Vietnam, after completing PhD training at Swedish universities, claimed that their training was still useful when promoted to other jobs, as they had learnt about new pedagogic methods, research skills and research management. It is therefore recommended by some studies that postgraduate training includes transferable skills such as teaching and research management (Eley *et al.*, 2003; Forss, 2002; Morris and Louwaars, 2004).

Eley *et al.* (2003) pointed out that it is difficult to attribute current job performance to previous training activities, because the job context influences how and what knowledge can be used. Their findings suggested that:

> Much of the 'useful' knowledge was not from contributing to a specific discipline but through wider project and organizational activities, continuing learning opportunities at the workplace such as seminars, and through teaching and working with others (Eley *et al.*, 2003; pp 170)

The authors add that it is important to link individual and organisational needs. Unfortunately, a baseline of information about needs is often not available prior to training, and the absence of this makes the measurement of impact difficult to determine (Eley *et al.*, 2003).

3.3.2 Capacity strengthening of NAROs

Seven programmes explicitly combined strengthening scientific capacity through (postgraduate) training of individual researchers with capacity strengthening at organisational level (Babu *et al.*, 2007; Bennett-Lartey *et al.*, 2003a, b; Freeman *et al.*, 2010; USAID, 1995; Nyirenda and Tostensen, 2005; OSAN, 2009; Robson, 2010). Thirteen programmes focused on organisational capacity strengthening through improving managerial skills (e.g. gender, M&E, administration, change management) and research skills (e.g. participatory approaches). Some NAROs also received support for upgrading their physical structures (e.g. buildings, laboratories, ICT equipment).

Several programmes seem to be built upon the implicit assumption that strengthening the capacity of individual researchers leads to an increased research capacity at the organisational level and subsequently improved research impact for agricultural development (e.g. Oloruntoba, 2002a, b). Some reports indeed seem to confirm this impact pathway (Babu *et al.*, 2007; Cooksy and Arellano, 2006; Freudenthal, 2009). For example, Freudenthal (2009) reported that the home-based research carried out by sandwich PhD candidates brought research activities to the researcher's home organisation, and in some cases equipment and ICT facilities, which could support continued research after the candidate's graduation. Freeman *et al.* (2010) concluded that long-term intensive support to strengthen research capacity at Makerere University through scholarships, research grants and improvement of research infrastructure had propelled the university into the global research community despite deficits in central administrative functions to support research and education. However, other studies reported that this assumption has led to sub-optimal outcomes of capacity strengthening (e.g. Berg, 1998; Freeman *et al.*, 2010; NORAD, 2009). A more holistic approach to capacity strengthening is required. Upgrading resources and equipment, strengthening of management and policy support should complement the training of researchers to achieve capacity strengthening (e.g. Bennett-Lartey *et al.*, 2003a, b; Jamora *et al.*, 2011; Stern *et al.*, 2006). Even if the main focus is

strengthening the scientific capacity of individual researchers, care must be taken that a balance is maintained between individual and organisational support:

> Individual post-graduate support is probably not effective capacity development unless it is linked to a wider organizational or network development strategy consistent with the aims of the research programme (Almond and Kisauzi, 2005; pp 16)
>
> Closer cooperation with NARS is required to ensure that trainees not only come with the necessary pre-requisites prior to training but also have adequate possibilities of putting their training to use afterwards (Stern *et al.*, 2006; pp 3)

Box 5: Horton et al. (2000; pp66-67) on capacity building in planning, monitoring and evaluation:

'The enhanced technical capacity for PM&E is of little value in the absence of a broader capacity for strategic management and managing organizational change. While the project's contributions to individual motivation, capacity, and performance were shown to be strong, significant organization-wide improvements in PM&E were registered in just a few cases. Many of those who participated in project activities became more capable managers. Most changes in PM&E were made at the level of research activities and projects that are managed directly by individuals who were involved in the project. Some, but fewer, changes were made at higher levels, where organization-wide decisions were required for implementation. Most organizational improvement occurred where certain conditions were met:

- The environment was conducive to change (e.g., there were strong external pressures for change).
- Top managers provided leadership for change.
- A critical mass of staff was involved in the change process and committed to it.
- Appropriate institutional innovations were made available or developed.
- Resources were provided for change (e.g., dedicated time of key staff and budgets for training and facilitation).
- There was adequate management of the change process.'

Capacity strengthening at the organisational level becomes particularly important if the intervention seeks to promote attitudinal change in agricultural research (e.g. mainstreaming of participatory approaches, M&E, gender, research management). This affects the organisational culture, and capacity strengthening thus needs to be targeted at all levels within the organisation to be effective (e.g. Hydén, 2006; NORAD, 2009). NORAD (2009) argued that, in addition to integrated capacity strengthening, organisations needed to build up local ownership of facilities, research management and curriculum development. However, the NAROs are only able to take ownership if they have the required capacity to do so (Robson, 2010).

Stern *et al.* (2006) raised another concern that capacity strengthening through short-term project funding might be less relevant to longer term capacity needs.

> In the short term, project funding may help ensure that inputs such as equipment and operational resources are provided to complement the training provided. But over the longer term, the strength of the institutions may suffer because it has become more difficult to form a 'critical mass' of researchers in a given area, or to form multidisciplinary teams who would sustain research and be a force to influence institutional and political change (pp 43). ... Funding arrangements and in particular the growing dependence on project funds can affect relevance. In some CGIAR organisations project funding has been said to increase relevance as researchers are now more committed to training and learning activities that are integrated into collaborative research. However the short-term nature of some project funding can undermine NARS' capacity by reducing the time horizons for planning and investing and by subsidising operational investments that are not sustained once the project ends. Where NARS are weak and under-resourced it is also possible for CGIAR-led project priorities to distort NARS own priorities - pushing them in the direction where funds are available (pp 48) (Stern *et al.*, 2006)

Various authors noted that M&E was a weak point for many organisations and programmes, making it difficult to monitor change at organisational level (e.g. Bennett-Lartey *et al.*, 2003a, b; Berg, 1998; Freeman *et al.*, 2010; OSAN, 2009; USAID, 1995). The lack of M&E data not only makes impact evaluation exercises difficult, but a lack of organised financial, academic and personnel data also limited informed decision making (e.g. Bennett-Lartey *et al.*, 2003a, b; Freeman *et*

Box 6: The SCARDA approach – strengthening AR4D capacity (Robson, 2010)

The SCARDA approach is a shift from viewing capacity strengthening as a service provided to seeing it as a facilitated and supported process of change for whole organisational and institutional strengthening through the provision of tailor-made capacity strengthening packages based on processes of:

- well-grounded institutional analysis, to understand gaps, internal and external factors
- targeting to meet specific needs
- wide stakeholder involvement at regional, sub-regional and national levels, including actors of the agricultural innovation system
- a 'do, learn, reflect and improve' process
- doing things in a different manner
- the application of new knowledge for greater impact
- provision of tools and approaches which empower the partner organisations to apply their particular needs.
- the particular features of the SCARDA approach that received the greatest plaudits include:
- the institutional analyses that informed the design of the project and provided a starting point for the design of the change management action plans. the inclusive and participative approach helped build understanding and established a sense of ownership in mapping out the way forward
- the combination of training with organisational development; the introduction to change management issues and techniques
- the mentoring and the use of team based approaches to solving problems and moving forward
- the lesson learning, through the learning platforms, and the 'space' for reflection. The more open and frequent communication across the project.

al., 2010; OSAN, 2009; Robson, 2010; Vernooy *et al.*, 2009).

The International Service for National Agricultural Research (ISNAR) sought to mainstream planning, monitoring and evaluation (PM&E) in NAROs in Latin America (Horton, 1999; Horton *et al.*, 2000; Mackay and Horton, 2002). Their experiences indeed show that capacity strengthening of individual researchers does not automatically lead to strengthened organisational capacity if an ability to manage organisational change is absent. Rather, the evaluators concluded that, to enable organisational change, a critical mass of individuals (movers and shakers) was required as well as a shift in the organisation's focus.

Box 7: Building institutional capacity under the RNRRS programme (Almond and Kisauzi, 2005)

'Institutional capacity relates to the ways in which individuals and organisations work with each other within the national system, through formal or informal means. Appropriate levels of individual and organizational capacity are necessary, but not sufficient, conditions for the development of "institutional capacity". As well as requiring specific competencies from researchers and research institutes, other parts of the "system" may need to be developed – for example, government departments may need to adapt in order to relate directly to farmers or farmer groups – and this may require changes to culture, policies, and incentives as well as the acquisition of new skills.' (pp 11)

'Many programmes came to recognise, often implicitly in their approach to project implementation, that adaptive research and a requirement for immediate impact meant engaging with a wider set of stakeholders beyond their traditional research institute partners. More than just widening the range of organizations, it meant understanding the linkages and interactions between them, and the relationship to infrastructural constraints and the 'enabling environment' more widely.' (pp 12-13)

Only one report evaluated the impact of using long-term technical assistance to strengthen organisational capacity. Low *et al.* (2001) reviewed the impact of technical assistants employed at the Directorate of Planning at the Ministry of Agriculture in Namibia. The joint working, technical backup and mentoring role of the technical assistants were considered as the main strengths of this type of capacity strengthening. The authors concluded that it went important that resident technical assistance goes beyond skills transfer and focused on supporting learning as opposed to providing training:

> A major strength of resident technical assistance in capacity building is that it can introduce systematic activities to support and foster a learning culture in situations where pressures on an experienced and capable few to get the job done allow little time for reflection and learning-by-doing. (…) The presence of the TAs enabled local staff to have the confidence to embark on new areas of work and learn from the experiences (Low *et al.*, 2001; pp 283)

But Low *et al.* (2001) warned that thorough institutional analysis was critical to deciding on the most appropriate form and length of technical assistance for capacity building. Donors needed to consider carefully the purpose of the support to be provided. Snelder (2010) evaluated the impact of short-term technical assistance and financial support to farmer organisations and concluded that:

> The combination of financial support, expert advice and peer-to-peer discussions about the organization and its strategic direction is an effective way of supporting capacity development (Snelder, 2010; pp vii)

If technical assistants are used for capacity strengthening, it is important that they are seen as peers who come alongside their counterparts, rather than replacing existing local capacity.

Percy (2002) reviewed a capacity building programme that sought to mainstream gender-sensitive agricultural extension planning at the Ministry of Agriculture in Ethiopia. Through a cyclical process of training and implementation, staff gained skills in gender analysis and participatory approaches, and gender awareness was raised. A couple of key staff members adopted and replicated the techniques as best practice, resulting in widespread capacity building in gender-sensitive participatory approaches in one region after the programme had ended.

A negative side-effect of external support for organisational capacity strengthening is that national governments may become dependent on international donors for the strengthening of research and higher education institutes. Indeed, NORAD's long-term support to Sokoine University of Agriculture (SUA), Tanzania, seems to have created such expectancy. NORAD's financial support to SUA equalled nearly half of the university's total budget for the year 1996/97, similar to the government contribution to recurrent costs of the University:

> The very high level of contributions from Norway over a very long period of time makes it unlikely that the capacity building efforts will ever become sustainable. The Government is withholding funds in expectation that donors might step in and compensate for shortcomings, which they actually seem to have done (Berg, 1998; pp i-ii)

Sustainability of capacity strengthening projects is thus an issue. Freeman *et al.* (2010) noted that the activities of the capacity strengthening programme at Makerere University, Uganda, where the university had committed funds, were thought to be the most sustainable.

Mackay *et al.* (1998) and Robson (2010) identified another challenge, in that strengthening individual NAROs does not automatically lead to strengthened NARS:

> The component organisations comprising NARS sometimes exhibit relationships so loosely knit as to defy the minimum conditions necessary to constitute an integrated system. ... 'A second constraint relates to the nature of the NARS as systems. The entities that carry out agricultural research in a country seldom perceive themselves as belonging to a system (Mackay *et al.*, 1998; pp 24-25)

3.3.3 Capacity strengthening of innovation systems and NARS

Fourteen programmes specifically sought to strengthen the national and international agricultural research and innovation systems by creating research networks or strengthening systems through partnerships.

Regional disciplinary research networks are established to strengthen regional research capacity, curriculum development and in some cases advocacy. The networks ANAFE (Fones-Sundell and Teklehaimanot, 2007) and SEANAFE (Tengnäs *et al.*, 2005) promote research and education in agroforestry, and are co-ordinated by ICRAF (World Agroforestry). Bio-EARN is a regional network for biotechnology that facilitates capacity building and influences policy on biotechnology (Morris and Louwaars, 2004). The evaluations report more noticeable outcomes in capacity building and linking up research than co-ordinating education or influencing policy.

Box 8: Capacity strengthening of innovation systems (Hartwich *et al.*, 2007; pp 19-20)

'Seen in an innovation systems context, capacity strengthening to build partnerships can target three different levels: the partners, their relationships, or the overall network or system.

1. At the *partner level*, capacity strengthening can focus on motivating and providing incentives, fostering leadership, improving relevant skill levels, and enhancing the ability of partners to maintain relationships, collaborate, and learn from each other.
2. At the *relational level*, the linkages, partnerships, and networks that enable innovating agents to operate efficiently and effectively can be enhanced through capacity building focusing on communication, negotiation, conflict resolution, and the development of social capital and trust.
3. At the *system level*, the capacity of decision- and policymakers can be developed as a foundation for improving the macro institutions, structures, policies, and rules that support the actions and interactions of innovating agents.'

Carlsson and Wohlgemut (1996) reviewed nine regional research collaborations. They found that the networks were successful in terms of realising their objectives: people had been trained and high-quality research was produced. However, the authors suggested that many networks had been less effective in terms of distributing their results and achieving impact because they worked too much in isolation from other organisations and the surrounding society:

> It seems that the networks become entities in their own rights, rather than just modes of transferring support to institutions for higher education and learning. For many researchers, the networks open possibilities to do research which defunct national institutions cannot offer. The networks seem to be dominated by a small number of people who have made the networks part of their career. For the aid agency, a network can be a very convenient way of bypassing weak and inefficient national institutions, but it runs contrary to the objective of national institution building (Carlsson and Wohlgemut, 1996; pp 33)

Good management of networks is crucial to their success (Forss, 2002; Tengnäs *et al*. 2005). But network structures often fall outside the authority of any one of the participating organisations and management then becomes the responsibility of the donor (Forss, 2002).

Box 9: The importance of the enabling environment (Babu et al., 2007; pp 8)

'Sustainable capacity development depends on, among other things, stability of the state, effective functioning of public and private sector organizations, and a civil society that is able to participate in the decision making processes of the government …. It is not enough to develop capacity through training and skill building. Equally important are the policies and programs and the enabling environment that can nurture and retain such capacity. Furthermore, capacity development needs to be recognized as a long-term effort which requires adequate resources and strengthening of local institutions. It is increasingly recognized that provision of capacity through skill-building activities alone cannot solve problems of capacity at a country level. Creating enabling environments, through major reforms of organizations, if necessary, are needed to effectively use the existing capacity.'

Public-private partnerships (PPPs) are thought to strengthen AR4D by overcoming institutional failures that inhibit the development and dissemination of technologies targeted specifically to small-scale, resource-poor farmers in developing countries (Spielman *et al.*, 2007a, b). Spielman *et al.* (2007a, b, 2010) reviewed 75 PPP projects between CGIAR institutes and the private sector. The authors found that PPPs were changing the way NAROs managed their research agendas, but few partnerships led to joint innovation processes with the private sector. The majority of the PPPs in the CGIAR were exclusive collaborations; only a quarter of the projects included NAROs in the partnerships. The PPPs were concentrated in two main areas: (1) accessing resources, information, and technology from the private sector, and (2) commercialising technologies developed through research to improve crop productivity and post-harvest value addition:

> PPPs operate through three different impact pathways. First, they operate through household-level impacts that result from PPPs focusing on research and dissemination of crops, traits, and technologies that are directly relevant to the incomes and nutrition of small-scale producers, agricultural labourers, or food-insecure consumers. Included in this are the vast majority of PPPs designed to commercialize CGIAR research. Second, PPPs operate through sectoral impacts that result from PPPs that focus on research that benefits other agents in agriculture and agricultural research by enhancing competitiveness in specific value chains, creating employment opportunities, and generating public revenues through the taxation of private-sector activities. (…) Third, PPPs operate through intergenerational impacts that result from PPPs that are designed to preserve and unlock genetic diversity and natural resources for future generations (Spielman *et al.*, 2010; pp 272-273)

Spielman *et al.* (2010) concluded that, although PPPs were generally designed to overcome market and institutional constraints, often they were not addressing the wider systemic constraints associated with innovation; instead, partnerships were often limited to explicit technology and knowledge exchange.

Eight programmes sought to strengthen local or national innovation systems through participatory action research and experiential learning, involving communities, service providers or value chain actors (Almond and Kisauzi, 2005; Ayele and Wield, 2005; Clark *et al.*, 2003; Dijkman, 2010; Hagmann *et al.*, 2002; Horton *et al.*, 2010; Madzudzo, 2011; Ortiz *et al.*, 2008; Ugbe, 2010). Often, technological solutions are not enough to promote agricultural development as institutional assumptions of technology uptake are inappropriate; the problems and needs are often much more complex. Immature innovation systems display inward-looking atomistic behaviour among stakeholders (Madzudzo, 2011). Dijkman (2010) evaluated the Research Into Use programme and found that research did not drive innovation, even though it is an integral part of innovation. If research organisations are disconnected from other stakeholders, research becomes peripheral to technological needs and developments. This observation suggests that investment in research capacity alone will do little to enhance innovation and agricultural development. Ugbe (2010) also concluded that skill development did not equate to capacity development, as wider system issues determined the extent to which these skills could be used for their intended purposes. Capacity strengthening thus has to be conceived in a systems sense. Dijkman (2010) therefore suggested that research organisations should increase their capacity for flexibility that allows research to respond to immediate needs and engage with other actors in the agricultural sector. Building innovation capacity furthermore requires strengthening the ties within the system, for example by establishing rural

development brokering agencies if public and private sectors are weak. Coalitions of private, public and civil society sector actors are important for developing, accessing and using knowledge and technology for agricultural and rural system innovation (Dijkman, 2010). Collaboration, social learning processes and a conducive social environment are required to build effective synergistic institutional arrangements for innovation and extension (Ayele and Wield, 2005; Hagmann *et al.*, 2002; Ortiz *et al.*, 2008).

Well-connected actors have a greater innovation capacity as they can combine skills and knowledge from different sources to address problems and opportunities (Ayele and Wield, 2005; Dijkman, 2010; Hagmann *et al.*, 2002; Hartwich *et al.*, 2007; Madzudzo, 2011; Ortiz *et al.*, 2008). The programmes that used an innovation systems perspective reported successful outcomes in the form of new practices or technologies, such as improvements in packaging and labelling resulting in improved sales, community-based natural resource management, Integrated Pest Management (IPM), and dissemination of new fodder varieties. These results were achieved through collaboration and applied practical research, with researchers taking up the role of independent facilitators (Clark *et al.*, 2003; Dijkman, 2010; Hagmann *et al.*, 2002; Horton *et al.*, 2010; Ugbe, 2010).

Ayele and Wield (2005) evaluated two cases of partnership-based capacity strengthening in biotechnology research in Mali and Egypt. They found significant impacts on research capacity, but dissemination and exploitation of new knowledge and products were rather limited. This could be explained by the weak private sector, as well as lack of consideration of the research projects. The investigated partnerships were stronger in developing scientific and technological research capacity but less successful in developing the innovative capacities that integrate user perspectives at an early stage and deliver products. Ayele and Wield (2005) therefore concluded that a detailed understanding of partnerships and the institutional context within which they operate was important. For successful innovation, capacity building efforts were best conceived across a system of innovation, from the identification of needs and research priorities to delivering products and handling the risks and benefits of biotechnology products, with the participation of farmers, donors and public and private sector agencies in the promotion and regulation of new products and processes.

Almond and Kisauzi (2005) found that when capacity strengthening focused on innovation systems, there was a risk that the capacity strengthening of individuals became limited to ad hoc short-term training for specific scientific techniques, resulting in fragmented capacity strengthening. Little attention was given to capacity strengthening at organisational level, as this was outside the remit of short-term research projects. Organisational and individual capacities, however, remained an important element of strengthening NARS and should therefore receive proper attention. The authors thus recognised that taking an innovation systems paradigm has implications for capacity strengthening:

> The field of engagement will be much wider, with more emphasis on multi-stakeholder, interdisciplinary and client-driven research agendas, and key capacities will relate more to the improved flow and utilisation of existing knowledge than to the generation of new research knowledge. In a system-wide approach, the non-research partners may be in the majority. For example, traditionally the job of passing on the results of agricultural research was given to the state extension services. Not only are these greatly reduced (most particularly in SSA [sub-Saharan Africa]) but there are also questions about the appropriateness of the traditional extension services model, with more market-oriented mechanisms now arising. In these emerging models,

Box 10: Examples of qualitative statements on cost-effectiveness

Berg (1998; pp i): 'The long lasting collaboration between SUA and AUN, funded by NORAD, has been an expensive, but rather successful capacity building effort.'

Anderson *et al.* (2004; pp 7): 'ISNAR's products are very different in character to those traditionally produced by the CGIAR system, and the team found it difficult to discern quantifiable cost effectiveness (on either a regional or global basis), especially for intermediate products whose full impact may not be apparent for some time. However, the team formed the impression that ISNAR has been quite effective in sponsoring and supporting institutional innovations that are widely used in different regions and cultures, and in stimulating systemic policy reforms. There have also been noticeable positive changes in attitudes to, and perceptions of, agricultural research and development that many associate with ISNAR. Although many of these are relatively localized (or intermediate) products and activities, the impression of the team is that they have achieved growing regional and global impact. However, because of the difficulty involved in quantifying cost effectiveness, considerable scope remains for the further investigation of ISNAR's diverse activities.'

Nyirenda and Tostensen (2005): 'It is our considered view that considerable achievements have been made in a cost effective manner.' (pp 28) …

Nyirenda and Tostensen (2009): 'We find it not feasible to give a thorough evidence-based quantitative assessment of efficiency, i.e. the appropriate ratio of resource use to outputs and outcomes. … many features of institution building defy quantification, e.g. the functionality of an institution is not easily captured by a set of quantitative indicators. The best we can do is to offer more or less plausible qualitative arguments to buttress our general assessment of efficiency' (pp 9-10).

increased partnerships in the private sector and with community-based organizations and other NGOs is demanded (Almond and Kisauzi, 2004; pp 4)

3.3.4 Types of capacity strengthening interventions and impact

Another classification of capacity strengthening of AR4D is by the main objective of the intervention rather than the targeted level of intervention. Generally speaking, the following types of capacity strengthening can be distinguished:

Capacity strengthening in academic disciplines and research. Thirty seven programmes strengthened scientific research capacity by improving scientific knowledge and upgrading academic human resource capacity. This type of capacity strengthening is mainly provided through postgraduate training and skills training of individual researchers, collaborative research programmes, research funding and research networks. The positive impacts of this type of capacity strengthening that are reported include: increase in research and teaching capacities through staff development; strengthened collaborations between research organisations in the North and South; and development of new agricultural technologies. Regional or global research networks are used to strengthen research systems through knowledge exchange, collaboration, curriculum development and advocacy. All programmes reported successful outcomes in terms of capacity strengthening of

individual researchers through training. Success is typically measured in terms of completed postgraduate degrees. Eight programmes reported that the vast majority of beneficiaries confirmed the relevance of the training received and related an increase in knowledge and skills. Negative impacts of this type of capacity strengthening can include the risk of 'brain drain', and a mismatch between academic interests and farmers' needs (Alberts *et al.*, 2003; Almond and Kisauzi, 2005; Ayele and Wield, 2005; Badu-Apraku *et al.*, 2004a, b; Bennett-Lartey *et al.*, 2003a, b; Berg, 1998; Brennan and Quade, 2004, 2006; Carlsson and Wohlgemut, 1996; Cooksy and Arellano, 2006; Eduards *et al.*, 2007; Eley *et al.*, 2002; Eley *et al.*, 2003; Fisher and Gordon, 2008; Fones-Sundell and Teklehaimanot, 2007; Forss, 2002; Freeman *et al.*, 2010; Freudenthal, 2009; Gaillard *et al.*, 2002; Gaillard and Zink, 2003; Howes, 1992; Hydén, 2006; Jamora *et al.*, 2011; Longmore *et al.*, 2007; Mauldon, 1998; Morris and Louwaars, 2004; NORAD, 2009; Njuki *et al.*, 2006; Nyirenda and Tostensen, 2005, 2009; OSAN, 2009; Patel and Woomer, 2000; Pray, 2006; Ryan, 1999; Ryan *et al.*, 2007; Stern *et al.*, 2006; Tengnäs *et al.*, 2005; Thulstrup *et al.*, 2006; USAID, 1995; Wanjiku *et al.*, 2010; Ynalvez and Shrum, 2009).

Capacity strengthening in AR4D management. Thirteen programmes aimed to improve the performance of research organisations in order to increase the effectiveness of agricultural research. In addition, seven programmes combined capacity strengthening in scientific research with managerial capacity strengthening. It is recognised that increasing human resource capacity can be ineffective if there is no change in management at the organisational level. Strengthening management capacity was provided through training in research management (including mentoring), development and mainstreaming of management tools (e.g. M&E and gender awareness) and information systems, mainstreaming participatory research, technical assistance, and improvement of physical research infrastructure and facilities. Examples of impacts or outcomes of these capacity strengthening interventions include: awareness raising and attitudinal change among staff (e.g. towards participatory research or gender), proactive management of change, use of monitoring systems for strategic decision making, empowerment of individuals and organisations, and an expanded pool of managerial human resources. Commitment from top management and a critical mass within the organisation are necessary to create a conducive environment for change in research management. External pressure (e.g. a government demanding more transparency in management and decision making) can also trigger change in some of these areas. Evaluation and impact assessment of this type of capacity strengthening is often weak because of the difficulty of measuring indicators that properly reflect impact and change. Two studies reported influence on national policies, but generally impact was either not evaluated or was described in terms of attitudinal or organisational change. Organisational capacity strengthening is more likely to improve the environment that facilitates the utilisation of built research capacity, and is thus a means to an end (i.e. improve impact of agricultural research for development) rather than an end in itself. Intensive capacity strengthening programmes in research management appear to be more successful than less-intensive approaches (Anderson *et al.*, 2004; Babu *et al.*, 2007; Baur and Kradi, 2001; Bennett-Lartey *et al.*, 2003a, b; Campilan *et al.*, 2009; Freeman *et al.*, 2010; Gaillard *et al.*, 2002; Gaillard and Zink, 2003; Horton *et al.*, 2000; Low *et al.*, 2001; Mackay *et al.*, 1998; Mackay and Horton, 2002; Nyirenda and Tostensen, 2005, 2009; Oloruntoba, 2002a, b; OSAN, 2009; Patel and Woomer, 2000; Paul *et al.*, 1996; Percy, 2002; Rao and Abeywickrema, 1992; Robson, 2010; Snelder, 2010; USAID, 1995; Vandergeest *et al.*, 2003; Vernooy *et al.*, 2009).

Box 11: Cost-benefit analysis of capacity strengthening in pig breeding

Fisher and Gordon (2008) estimated that the training of individual researchers in pig breeding in Vietnam made a significant economic contribution to the increased productivity of pigs equivalent to AUS$424m, a cost benefit ratio of 256:1, or internal rate of return of 24.5% over a 40-year period since the initial programme. This estimate was based on the assumption that 20% of the pig population in Vietnam would be of superior genetic quality following the initial capacity strengthening programme, which can only be achieved by follow-up research and dissemination activities. The authors pointed out that the benefits attributable to capacity building depended on the counterfactual scenario: what would have happened in the absence of the capacity-building components of the project. This is often difficult to determine with accuracy.

Capacity strengthening of innovation systems. Ten programmes sought to strengthen innovation systems in order to overcome institutional failures (e.g. market failures or weaknesses in the innovation systems) and to reduce the high transactions costs of knowledge exchange between different actors by promoting collaboration between organisations to enhance innovation. This collaboration can be formal through public-private partnership as well as informal through innovation platforms or action research. Some programmes also seek to encourage joint learning in order to improve the effectiveness of collaboration and joint innovation. These collaborations have typically resulted in knowledge sharing and learning, identifying and overcoming constraints in innovation systems or value chains, and the development and/or commercialisation of pro-poor agricultural technologies. In some cases, the focus has been on the process of collaboration based on participatory action research and joint learning rather than outputs (e.g. Vernooy *et al.*, 2009), making it difficult to predict and plan for outcomes. Public-private partnerships tend to facilitate exchange of existing scientific knowledge and commercialise new agricultural technologies rather than development of new knowledge and joint innovation. (Almond and Kisauzi, 2005; Ayele and Wield, 2005; Clark *et al.*, 2003; Dijkman, 2010; Hagmann *et al.*, 2002; Hartwich *et al.*, 2007; Horton *et al.*, 2010; Madzudzo, 2011; Ortiz *et al.*, 2008; Spielman *et al.*, 2007a, b, 2010; Ugbe, 2010).

Reported outcomes and impacts of these different types of capacity strengthening interventions vary widely (see Appendix 6). Capacity strengthening in academic disciplines is relatively easy to manage and monitor. Many evaluations report on the number of postgraduate students and outcomes of research projects. Stern *et al.* (2006) tried to determine whether any particular type of training was more efficient than others, but found no evidence. A mixture of training activities was thus recommended, fitting them closely to the needs of trainees and NAROs to increase efficiency. Freudenthal (2009) found that the sandwich PhD model had the additional benefits of taking research activities to the trainee's home institute, and in some cases equipment and ICT facilities, supporting continued research at NAROs after the researcher's graduation.

Only a few publications attempt to give a rough (qualitative or quantitative) estimate of cost-effectiveness of capacity strengthening (e.g. Berg, 1998; Brennan and Quade, 2004; Fisher and Gordon, 2008; Freeman *et al.*, 2010; Longmore *et al.*, 2007; OSAN, 2009), but nearly all publications pointed out that capacity strengthening was costly and time-consuming. This lack of assessment of impacts and cost-effectiveness is a weak point of capacity strengthening as there is generally no counterfactual available to measure impact. As Anderson *et al.* (2004) and Nyirenda and Tostensen (2009) noted, measuring impact and cost-effectiveness

was relatively straight forward if the outcome was an end product in itself (e.g. strengthening biotechnology research resulting in improved crop varieties), but was complicated in the case of strengthening organisations (e.g. research management or changing organisational performance, which are intermediate products) and its effects depended on many other factors (see Section 3.4).

Few evaluations traced the impact of capacity strengthening to the farmer level. Most evaluations limit themselves to reporting on the immediate outcomes at the level of NAROs. It is sometimes assumed that impact at farmer level will automatically follow without providing evidence, as the examples below show:

> The summary conclusions of the evaluation team are that programme capacity building objectives have been fully met, research objectives have been met almost fully, and that MEKARN thus has improved the livelihood of poor farmers and has contributed to poverty alleviation (Eduards *et al.*, 2007; pp 29)

> Questions are sometimes asked regarding the impacts of ISNAR on producers. The position taken by the authors of this study is that producers are the clients and partners of NAROs and other entities responsible for agricultural research in a given country; seeking and reporting impacts on producers, therefore, is regarded as the domain of the country, not of ISNAR. It is beyond the scope of this study to attempt to measure achievements in the chain beyond NAROs, although there is an implicit assumption that downstream impacts will affect the broader national goals of food security, poverty reduction, and environmental sustainability (Mackay *et al.*, 1998; pp 19)

USAID (1995) was the only evaluation that concluded that there was no relationship between the number of agricultural graduates and agricultural productivity growth in Kenya in the 1980s and 1990s. However, it was also noted that there were very few employment opportunities for young graduates during that period and the pool of highly trained people was thus not being used.

Three evaluations (Badu-Apraku *et al.*, 2004a, b; Fisher and Gordon, 2008; Longmore *et al.*, 2007) applied cost-benefit analysis to estimate the cost-effectiveness of the programme; their results were positive with estimated internal rates of return (IRR) between 23 and 74 percent. However, in all cases, only a few researchers received postgraduate training and the measured impact was the result of new agricultural technologies (e.g. new crop varieties or improved animal breeding) that were developed during research activities. It is not clear to what extent these results could be attributed to the capacity strengthening activities.

OSAN (2009) reported that following the restructuring of agricultural research in Cameroon, the increased synergy with agricultural extension helped to improve the productivity of the supported plant and animal production by 20 to 30 percent, and to increase farmers' incomes by 20 percent. These achievements generated an economic IRR of 11.5 percent.

Only Brennan and Quade (2004) tried to estimate a direct relationship between change in human capacity and agricultural productivity. The authors estimated the economic effect of postgraduate training using a case study of Indian wheat pathologists who were trained in Australia. Following the training of three plant pathologists in wheat rust resistance, the annual gains in wheat productivity were valued between A$1.8 and $4.5 million per year, resulting in an IRR of 33 percent.

Two studies reported cases where research carried out by postgraduate students or early-career researchers resulted in direct economic benefits. Pioneering research on seaweed in Tanzania led to commercial development of the seaweed industry,

generating export earnings of over US$10 million annually and offering employment to more than 40,000 persons (Gaillard *et al.*, 2002). PhD research in Vietnam resulted in the development of affordable biogas systems that were implemented by 80,000 households providing an estimated economic benefit of US$18 million (Forss, 2002; Freudenthal, 2009). Direct economic impacts such as these, however, seem to be the exception rather than the rule.

Various studies suggested that capacity strengthening programmes acted as catalysts; impact was mainly achieved through subsequent research projects or external pressure for change that utilises the strengthened capacity (Berg, 1998; Brennan and Quade, 2004; Fisher and Gordon, 2008; Freeman *et al.*, 2010; Longmore *et al.*, 2007; Mackay and Horton, 2002; Percy, 2002; Pray, 2006; Robson, 2010). This implies that capacity strengthening is essential for AR4D, but it is difficult to determine the causality and attribution of capacity strengthening on research impact.

3.3.5 Impact pathways

The programmes that attempted an economic assessment were typically those that sought to strengthen capacity in a discipline within the natural sciences, particularly biotechnology. It seems that the impact pathway in this discipline is relatively straightforward: scientists are trained in new biotechnology techniques and in some cases gain access to germplasm. The trained scientists develop, often through collaborative research, new crop varieties that are, for example, drought or disease resistant. Dissemination of these improved crop varieties results in economic impact by increasing agricultural productivity. For other disciplines, however, the impact pathway from individual capacity strengthening to agricultural development is less clear-cut. This process is often nonlinear, and various components are strongly interrelated, making it difficult to attribute impact to capacity strengthening (Campilan *et al.*, 2009). The majority of the evaluations thus reported a more qualitative assessment of impact and cost-effectiveness. Thulstrup *et al.* (2006) stated that the most common contribution of research was its support of economic development that was a necessary condition for a more equitable income distribution.

Two main frameworks of impact pathways can be distinguished in the evaluation literature on capacity strengthening:

- Technology transfer framework: this assumes a linear impact pathway of strengthening of research capacity (through postgraduate training and collaborative research), technology development, technology transfer and impact. This framework is in particular present in plant and animal sciences where new crop varieties or improved animal breeds are developed. These sciences are based on a positivist paradigm and are sometimes referred to as 'hard' science or research.
- Innovation systems framework: this assumes a complex impact pathway involving many stakeholders and nonlinear innovation processes. Improvement of performance through learning and enhancing relationships among stakeholders (from policy, research, extension, NGO and private sectors) is thought to achieve impact. This framework is mainly used in natural resource management and social sciences, which are based on the constructivist paradigm, and are referred to as 'soft' science or research.

Based on their evaluation of the RNRRS programme, Almond and Kisauzi (2005) concluded that impact was limited for research based on the linear impact pathway if no attention was given to the 'uptake system'. But as Hagmann *et al.* (2002) and Dijkman (2010) pointed out, both types of research are needed: soft participatory

action research on processes and conventional hard research on technological (and social) issues. Capacity strengthening thus should focus on the totality of actors, organisations and institutions involved in innovation as well as on research (Dijkman, 2010).

3.4 Factors influencing outcomes and impact of capacity strengthening

The ultimate aim of strengthening the AR4D capacity is to achieve positive impacts for farmers. However, various factors along the impact pathway may hinder impact at farmer level; these factors can be related to the programme, the participants, the organisations, the science or the dissemination strategy. All evaluations discussed internal and external factors that constrained the impact of capacity strengthening, and their findings are categorised and summarised below.

3.4.1 Programme management of capacity strengthening interventions

Aspects of programme management that influenced the outcome of capacity strengthening positively or negatively are summarised below.

Positive project management factors:

- Project duration – capacity strengthening takes considerable time (Almond and Kisauzi, 2005; Baur and Kradi, 2001; Bennett-Lartey *et al.*, 2003a, b; Berg, 1998; Beye, 2002; Forss, 2002; Horton *et al.*, 2000; Hydén, 2006; Jamora *et al.*, 2011; Longmore *et al.*, 2007; Mackay *et al.*, 1998; Njuki *et al.*, 2006; Nyirenda and Tostensen, 2005, 2009; Paul *et al.*, 1996; Percy, 2002; Pray, 2006; Rao and Abeywickrema, 1992; Robson, 2010; Ryan, 1999; Stern *et al.*, 2006; Tengnäs *et al.*, 2005; USAID, 1995; Vernooy *et al.*, 2009). Pray (2006) noted that the short funding period and the need to obtain quick results to justify a follow-up phase could guide the choice of activities rather than long-term impact. Time horizons of 5-10 years (e.g. Mackay *et al.*, 1998) or even 10-15 years (e.g. Forss, 2002) have been suggested for effective capacity strengthening.
- Opportune timing: for example, capacity strengthening in research management is more effective when there is an urgent need for improving research structures and equipment or changing management structures (Mackay *et al.*, 1998; OSAN, 2009; Rao and Abeywickrema, 1992)
- Generic versus tailor-made training (Anderson *et al.*, 2004; Horton, 1999; OSAN, 2009; Robson, 2010; Stern *et al.*, 2006); capacity strengthening is most effective when linked with a specific need.
- Good management of change processes is necessary for strengthening research management (Baur and Kradi, 2001; Horton, 1999; Paul *et al.*, 1996; Vandergeest *et al.*, 2003).
- Opportunities for joint learning and knowledge exchange between beneficiaries and other staff members or actors can be useful tools to strengthen capacity (Almond and Kisauzi, 2005; Ayele and Wield, 2005; Hartwich *et al.*, 2007; Horton, 1999; Njuki *et al.*, 2006; Pray, 2006; Rao and Abeywickrema, 1992; Robson, 2010; Vernooy *et al.*, 2009).
- The use of the experiential learning cycle, alternating training, implementation and learning, is recommended (Percy, 2002).
- Competence of service providers and programme co-ordinators, including good interpersonal skills (communication, networking, negotiation), commitment, right attitudes and good personal chemistry in addition to research competencies (Badu-Apraku *et al.*, 2004a, b; Cooksy and Arellano,

2006; Eduards *et al.*, 2007; Forss, 2002; Hartwich *et al.*, 2007; Morris and Louwaars, 2004; Paul *et al.*, 1996; Pray, 2006; Rao and Abeywickrema, 1992; Ryan, 1999; Snelder, 2010; USAID, 1995). Sometimes the service provider does not have the best expertise to do capacity strengthening, and other organisations or individuals may be better placed to do the job (Forss, 2002; Paul *et al.*, 1996; Ryan, 1999).

- Relationship between service providers and beneficiaries (Berg, 1998; Cooksy and Arellano, 2006; Forss, 2002; Horton *et al.*, 2000; Pray, 2006; Ryan, 1999; Snelder, 2010). A relationship that is stable and based on trust is essential (Paul *et al.*, 1998; Snelder, 2010). Similarly, the intensity of interaction between service provider and beneficiary is important (Mackay and Horton, 2002; Pray, 2006; Rao and Abeywickrema, 1992; Ryan, 1999).
- Flexibility to adjust when circumstances or needs change (Dijkman, 2010; Horton *et al.*, 2010; Njuki *et al.*, 2006; Nyirenda and Tostensen, 2005; Pray, 2006; Robson, 2010; Vandergeest *et al.*, 2003).
- Quality management and control of project management and research improves implementation and outcomes (Forss, 2002; Mackay *et al.*, 1998; Mauldon, 1998; Stern *et al.*, 2006).
- Transparent and fair decision making procedures (Forss, 2002).

Negative project management factors:

- Delays in implementation due to late completion of memoranda, lack of familiarity with procedures, ineffective financial systems, late transfer of funds, change of key personnel, or clearance for research equipment or materials (Alberts *et al.*, 2003; Forss, 2002; Mauldon, 1998; NORAD, 2009; Nyirenda and Tostensen, 2005; OSAN, 2009; Robson, 2010; USAID, 1995; Vernooy *et al.*, 2009).
- Unpredictable funding behaviour of donors or 'changing of goalposts' (e.g. reduction in duration and funding of a project) causing uncertainty (Beye, 2002; Nyirenda and Tostensen, 2005; Tengnäs *et al.*, 2005).
- Project bias due to the preferences and interests of the donor or service providers results in sub-optimal outcomes (Berg, 1998; Beye, 2002). Capacity strengthening activities (in particular postgraduate training and collaborative research) are often more 'supply-driven' than demand-driven (Babu *et al.*, 2007; Bennett-Lartey *et al.*, 2003a, b; Berg, 1998; Beye, 2002; Morris and Louwaars, 2004; Stern *et al.*, 2006). A needs assessment in consultation with beneficiaries is recommended to ensure the relevance and effectiveness of capacity strengthening (Ayele and Wield, 2005; Babu *et al.*, 2007; Bennett-Lartey *et al.*, 2003; Berg, 1998; Mackay and Horton, 2002; OSAN, 2009; Rao and Abeywickrema, 1992; Robson, 2010; Stern *et al.*, 2006; Tengnäs *et al.*, 2005).
- Biased selection of postgraduate candidates (e.g. senior researchers who are selected as a reward for past services), so training may not be relevant to the individuals' abilities and interests or their career stage (Cooksy and Arellano, 2006; Forss, 2002; Patel and Woomer, 2000; Stern *et al.*, 2006). Recruitment should be more transparent and competitive and the selected candidates should meet predefined requirements as well as the needs of universities to optimise the impact of capacity strengthening (Freudenthal, 2009; Morris and Louwaars, 2004; Stern *et al.*, 2006). Targeting of beneficiaries, i.e. strategy or criteria for the selection of postgraduate

candidates is thus recommended (Cooksy and Arellano, 2006; Forss, 2002; Horton *et al.*, 2000; Howes, 1992; Stern *et al.*, 2006; Vernooy *et al.*, 2009).

- Unrealistic expectations and overly ambitious project design and targets can limit impact (Mauldon, 1998; Morris and Louwaars, 2004; Rao and Abeywickrema, 1992; Robson, 2010; Vandergeest *et al.*, 2003). However, lack of clearly stated objectives and strategies, a clear impact pathway or theory of action have a similar effect (Bennett-Lartey *et al.*, 2003a, b; Berg, 1998; Carlsson and Wohlgemuth, 1996; Mackay *et al.*, 1998; Morris and Louwaars, 2004; Rao and Abeywickrema, 1992; Robson, 2010; Spielman *et al.*, 2007a, b; Tengnäs *et al.*, 2005; Vernooy *et al.*, 2009).
- Lack of monitoring ('informational chaos'), hampering informed decision making and strategic planning (Bennett-Lartey *et al.*, 2003a, b; Campilan *et al.*, 2009; Forss, 2002; Freeman *et al.*, 2010; Hydén, 2006; Mackay *et al.*, 1998; Nyirenda and Tostensen, 2005; OSAN, 2009; Robson, 2010; Tengnäs *et al.*, 2005; USAID, 1995).
- Lack of (financial) sustainability in the long term (Berg, 1998; Beye, 2002; Nyirenda and Tostensen, 2005, 2009; Robson, 2010). Exit strategies for phasing out the programme are recommended (Forss, 2002). If the programme is not relevant for capacity strengthening needs in the long term, it is less likely to be sustainable (Horton *et al.*, 2000; Stern *et al.*, 2006).
- A limited budget and staff level constrains impact (Mackay *et al.*, 1998; Nyirenda and Tostensen, 2005).

Box 12: Nine lessons on management of a capacity strengthening programme on project management (Horton 1999)

1. Project design is much more than a technical process; it is essentially one of negotiation.
2. In capacity-building projects, design activities cannot end when implementation begins.
3. Capacity-building efforts should prepare managers to deal with complexity, uncertainty and change.
4. In capacity-building efforts, it is essential to collaborate rather than patronise.
5. Organisational assessment is a complex social process, intertwined with organisational politics.
6. In designing capacity-building projects, it is essential to involve managers and staff members in assessing needs and opportunities.
7. Action-learning strategies offer great potential for capacity building.
8. In the context of strategic management and organisational learning, PM&E take on new meanings.
9. Training is most effective when it is designed to serve a purpose within an organisational change process.

Horton (1999; pp 152) concludes that capacity strengthening is 'more a process of social experimentation than of social engineering. Management systems cannot be imported, but need to be developed within organizations. Development agencies should play catalytic, facilitating roles, rather than take responsibility for organizational change. To support genuine capacity development, donors and funding agencies need to ensure that their planning and accountability procedures foster flexibility, innovation, and learning.'

- The funding and reporting cycle of research grants can be out of tune with the academic cycle, making it difficult for researchers to make best use of funds (Hydén, 2006).

3.4.2 Internal factors at organisational level

Internal factors related to the organisation that benefits from capacity strengthening can constrain impact. These factors can either prevent trained researchers from utilising their new skills or insights, or obstruct managerial changes.

Positive organisational factors:

- 'Strength of the organisation'; several evaluators found that more impact was achieved at organisations with higher existing levels of capacity compared to their weaker peers (Almond and Kisauzi, 2005; Ayele and Wield, 2005; Gaillard *et al.*, 2002; Pray, 2006; Rao and Abeywickrema, 1992; Stern *et al.*, 2006; Vandergeest *et al.*, 2003). Although training strengthens capacity, it is less effective if the organisation is weak (NORAD, 2009; Stern *et al.*, 2006).
- The personal characteristics and attitudes of staff, e.g. willingness to change or collaborate (Bennett-Lartey *et al.*, 2003; Mackay *et al.*, 1998; Oloruntoba, 2002a, b; Pray, 2006). This is linked with the reality and the organisation's image of its performance (Rao and Abeywickrema, 1992) as this informs people's perception on the need for change. Various authors found that a critical mass of staff involved in and committed to the change or capacity strengthening process greatly enhanced impact (Gaillard *et al.* 2002; Horton *et al.*, 2000; Njuki *et al.* 2006; Rao and Abeywickrema, 1992; Stern *et al.*, 2006). Change agents are also mentioned as facilitating change and impact (Hartwich *et al.*, 2007; Vernooy *et al.*, 2009).
- The commitment of leadership (on a continuous basis) to change and/or invest resources in the areas of strengthened capacity are important for impact (Baur and Kradi, 2001; Beye, 2002; Hartwich *et al.*, 2007; Horton *et al.*, 2000; Mackay and Horton, 2002; Mackay *et al.*, 1998; Morris and Louwaars, 2004; Rao and Abeywickrema, 1992; Robson, 2010; Spielman *et al.*, 2007a, b). Good management of a change process is necessary (Baur and Kradi, 2001) but requires commitment. The availability of appropriate tools and innovations is a great help (Horton *et al.*, 2000; Mackay *et al.*, 1998). Ownership of the change process is essential (Forss, 2002). Morris and Louwaars (2004) point out that ownership may also be required at higher levels (organisational, national or regional), depending on the objectives of the programme.
- M&E capability and ability to use M&E data for strategic decision making increases the impact of capacity strengthening in research management (Mackay *et al.*, 1998; Nyirenda and Tostensen, 2005).
- Financial sustainability or organisational capacity to mobilise internal and external resources to maintain the capacity strengthening investments after the programme finishes (Mackay *et al.*, 1998; OSAN, 2009; Thulstrup *et al.*, 2006).

Negative organisational factors:

- Lack of incentives or insufficient reward system at the home organisation, such as inadequate salaries or working conditions (Alberts *et al.*, 2003; Anderson *et al.*, 2004; Bennett-Lartey *et al*,. 2003a, b; Berg 1992; Beye,

2002; Freeman *et al.*, 2010; Freudenthal, 2009; Gaillard *et al.*, 2002; Gaillard and Zink, 2003; Jamora *et al.*, 2011; Njuki *et al.*, 2006; Thulstrup *et al.*, 2006). Because of inadequate salaries, researchers and academics look for additional income opportunities (e.g. farming, business, consultancies), preventing them from doing research (Alberts *et al.*, 2003; Gaillard *et al.*, 2002; Gaillard and Zink, 2003; Hydén, 2006; Njuki *et al.*, 2006).

- Lack of time to use new skills for research because of teaching or management duties, as returned graduates face high teaching loads or get promoted to management positions (Alberts *et al.*, 2003; Anderson *et al.*, 2004; Eley *et al.*, 2003; Freeman *et al.*, 2010; Gaillard *et al.*, 2002; Gaillard and Zink, 2003; Hydén, 2006; Njuki *et al.*, 2006; Ryan *et al.*, 2007; Vandergeest *et al.*, 2003).
- Organisational constraints or inefficient support services (e.g. excessive bureaucratic procedures, inadequate administrative and financial management) have also been reported to prevent the utilization of new skills (Alberts *et al.*, 2003; Brennan and Quade, 2004; Freeman *et al.*, 2010; Gaillard *et al.*, 2002; Gaillard and Zink, 2003; Horton *et al.*, 2000; Longmore *et al.*, 2007; Oloruntoba, 2002a, b; Patel and Woomer, 2000; Rao and Abeywickrema, 1992; Ryan *et al.*, 2007; Tengnäs *et al.*, 2005; Thulstrup *et al.*, 2006; Vandergeest *et al.*, 2003).
- Lack of resources and research facilities such as libraries, equipment, infrastructure, laboratories prevent beneficiaries from utilizing their new research skills that require certain scientific technologies (Alberts *et al.*, 2003; Freeman *et al.*, 2010; Gaillard *et al.*, 2002; Gaillard and Zink, 2003; NORAD, 2009; Patel and Woomer, 2000; Ryan *et al.*, 2007; Stern *et al.*, 2006; Wanjiku *et al.*, 2010).
- Change of key personnel at the organisation can create serious setbacks for capacity strengthening (Mauldon, 1998; Rao and Abeywickrema, 1992; Ryan *et al.*, 2007; USAID, 1995).
- The organisational culture and scientific paradigms on R&D (Ayele and Wield, 2005; Baur and Kradi, 2001; Bennett-Lartey *et al*,. 2003a, b; Cooksy and Arellano, 2006; Mackay *et al.*, 1998; Njuki *et al*. 2006; Thulstrup *et al.*, 2006). If the organisational culture of the beneficiaries clashes with the philosophy of the capacity strengthening programme, it is likely to be more difficult, or slower, to achieve impact.
- Transaction costs of implementing (management) change or partnering with other actors may hinder impact (Mackay *et al.*, 1998; Rao and Abeywickrema, 1992; Spielman *et al.*, 2007a, b).
- Lack of vision or long-term strategies for capacity strengthening, defining the choice of projects, collaborators, agendas for research, collaboration across disciplines and strategies for the uptake of results - can be at the donor level as well as the organisation level (Bennett-Lartey *et al.*, 2003a, b; Beye, 2002; Freeman *et al.*, 2010; Jamora *et al.*, 2011; Mackay *et al.*, 1998; Ryan, 1999; Ryan *et al.*, 2007; Stern *et al.*, 2006).

3.4.3 External factors at institutional level

Factors at institutional level that (positively or negatively) influence the impact of strengthening research systems include the following:

- Adverse socio-political and economic factors have been noted by many studies on the impact of capacity strengthening at all levels (Brennan and Quade, 2004; Fones-Sundell and Teklehaimanot, 2007; Gaillard and Zink, 2003; Mackay *et al.*, 1998; Oloruntoba, 2002a, b; Ryan *et al.*, 2007; Snelder, 2010; Spielman *et al.*, 2010), and can sometimes be linked to low (inter)national priority given to agricultural research (Mackay *et al.*, 1998). Hydén (2006) suggests that African governments and universities tend to prioritise teaching over research, and quantity over quality, as governments are more interested in spending money on education than on research. External pressure for change (e.g. demands for accountability) on the other hand can enhance impact, in particular when this is met by internal support for change within the organisation (Baur and Kradi, 2001; Horton *et al.*, 2000; Mackay *et al.*, 1998; Rao and Abeywickrema, 1992; Ugbe, 2010).
- Diverse organisational cultures (Baur and Kradi, 2001; Ryan *et al.*, 2007; Spielman *et al.*, 2010). Priorities and working culture at research institutes are different from those of other actors in the public and private sectors, which can hamper collaboration and impact. Partnerships however can change the way research institutes do business as they gain insights into private sector perspectives (Spielman *et al.*, 2010).
- The level of stakeholder involvement and linkages or collaboration with other organisations enhances the impact of capacity strengthening (Almond and Kisauzi, 2005; Bennett-Lartey *et al*,. 2003a, b; Dijkman, 2010; Forss, 2002; Mackay *et al.*, 1998; Morris and Louwaars, 2004; Njuki *et al*. 2006; Rao and Abeywickrema, 1992; Robson, 2010; Ryan *et al.*, 2007; Stern *et al.*, 2006; Thulstrup *et al.*, 2006; Tengnäs *et al.*, 2005; Ugbe, 2010). Synergy with agricultural extension or collaboration with farmers facilitates agricultural development and enhances impact at farmer level (Bennett-Lartey *et al*,. 2003a, b; OSAN, 2009).
- System structures and policies based on colonial inheritance, where rural areas are seen as sources of raw materials supported by a commodity extension and research model, have resulted in a weak innovation system with limited connection and interaction between actors in the agricultural sector, hampering knowledge sharing and learning. Inward-looking culture of institutes and actors in agricultural research systems are developed by a traditional focus on technology transfer and a desire for clear division of labour (Madzudzo, 2011).
- Transaction costs of partnerships may be high in terms of searching for appropriate partners, maintaining partner commitment and resolving conflicts (Hartwich *et al.*, 2007; Spielman *et al.*, 2007a, b). These high transaction costs may offset the cost reductions obtained through the partnerships.
- Partnerships require an external catalysing agent (or change agents) to bring partners together. Hartwich *et al.* (2007) found that private-sector leadership was weak, whereas the public sector faced lack of funding, capacity, motivation and human resources.

3.4.4 Research and dissemination

Even if capacity strengthening has been successful, this is not a guarantee of agricultural development. There are factors related to the research and dissemination that may severely hinder impact.

Factors related to research:

- There is a degree of mismatch between academic interests and farmers' needs. Researchers benefit more from basic research (e.g. publications, career progression) than from applied and farmer-oriented research and are therefore sometimes reluctant to engage in applied and on-farm research (Thulstrup *et al.*, 2006; Vernooy *et al.*, 2009).
- Scientific or technical difficulties can hamper research outcomes (Longmore *et al.*, 2007).
- There is a time lag between obtaining results from basic research and achieving impact at farmers' level, in particular in the case of new crop varieties (Forss, 2002; Longmore *et al.*, 2007; Mauldon, 1998). Forss (2002) found that it takes a long time to produce research results, but even longer to the application of results on a scale where an impact may be felt. The process often involves new actors; issues of patent rights, agreement on distribution of profits, pricing of benefits, etc. are difficult and take time to resolve.
- Research agendas in developing countries are often driven by donor interests and foreign aid, which is not necessarily in the best interest of smallholder farmers (Vernooy *et al.*, 2009).
- The time horizons of research activities are generally too short to assess a complex system like agriculture in a meaningful way; long-term trials are required to assess changes and impacts in farm practices over time (Ryan *et al.*, 2007).
- A lack of common understanding of concepts and theories between different organisations hampers impact (Tengnäs *et al.*, 2005).

Factors related to dissemination of research findings:

- A common problem seems to be a lack of, or inadequate engagement between researchers and technology users (i.e. farmers, service providers), causing insufficient research impact (Ayele and Wield, 2005; Baur and Kradi, 2001; Dijkman, 2010; Eduards *et al.*, 2007; OSAN, 2009; Ryan *et al.*, 2007). Participatory approaches, if correctly used, can help to improve this communication between researchers and users and develop local R&D programmes that meet local needs and capacity (Baur and Kradi, 2001). Research programmes in synergy with agricultural extension services, or alternative channels such as farmer unions, also help to improve impact (Eduards *et al.*, 2007; OSAN, 2009). Embedding R&D within an innovation system improves the relevance and thus uptake of research.
- Dissemination of new crop varieties can have many challenges, such as exclusive licensing, lack of commercial interest and underdeveloped seed industries (Ayele and Wield, 2005; Badu-Apraku *et al.*, 2004a, b; Pray, 2006; Spielman *et al.*, 2007a, b). Crops such as sorghum and millet are important for resource-poor farmers, but have little commercial application, and private seed companies show little interest (Ayele and Wield, 2005). The private sector is orientated towards commercial farmers, high-value crops and hybrid cultivars. Public breeders who develop cultivars with traits that are targeted to resource-poor farmers either have to disseminate their improved varieties through government channels or persuade private seed companies to incorporate traits into their hybrids (Pray, 2006). Creating community seed production projects may help to overcome this barrier (Badu-Apraku *et al.*, 2004a, b).

- Research outcomes are often disseminated through outputs such as journal papers and reports. However, these publications are not always easily accessible (both in relation to access and readability) for policy makers or practitioners (Freudenthal, 2009; Ryan, 1999). The costs of purchasing or distributing publications can be a constraint to mass distribution (Tengnäs *et al.*, 2005). In some regions (e.g. Latin America) researchers receive little encouragement to publish their findings, and there is no discrimination between types of publications or journals (Thulstrup *et al.*, 2006). Dissemination of research findings through publications as well as through other channels needs to be encouraged.

3.5 Monitoring and evaluation of capacity strengthening

Capacity strengthening is notoriously difficult to evaluate for several reasons: lack of operationally useful definitions of key concepts (e.g. institutional capacity), the complex and dynamic nature of capacity strengthening, the problem of attribution as multiple factors and programmes influence impact (Carlsson and Wohlgemut, 1996; Vernooy *et al.*, 2009). Most evaluations reported on outcomes (e.g. number of staff trained), and in some cases the research outputs, but were rather descriptive in presenting the impacts. The majority of the evaluations limited themselves to project reviews rather than impact assessments. Evaluation methods that were used in the evaluation studies include:

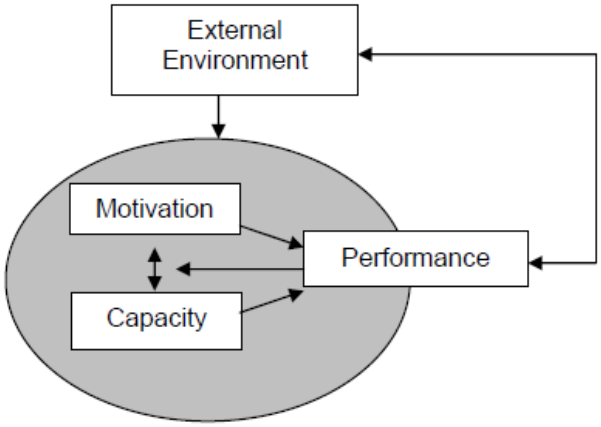
- Project review methods (Ayele and Wield, 2005; Baur and Kradi, 2001; Bennett-Lartey *et al.*, 2003a, b; Berg, 1998; Cooksy and Arellano, 2006; Dijkman, 2010; Eley *et al.*, 2003; Freeman *et al.*, 2010; Freudenthal, 2009; Gaillard *et al.*, 2002; Gaillard and Zink, 2003; Mackay *et al.*, 1998; Robson, 2010; Stern *et al.*, 2006; Ugbe, 2010; Vandergeest *et al.*, 2003; Wanjiku *et al.*, 2010):
  - Monitoring logframe indicators
  - Process monitoring
  - Personal history of the project director
  - Evaluation exercises with beneficiaries
  - Semi-structured interviews with key stakeholders
  - Reviews of project documents
  - Case studies
  - Tracer study of beneficiaries
- Impact assessment methods (Brennan and Quade, 2004; Cooksy and Arellano, 2006; Eley *et al.*, 2002; Fisher and Gordon, 2008; Longmore *et al.*, 2007; Mackay *et al.*, 1998; OSAN, 2009; Stern *et al.*, 2006; Ynalvez and Shrum, 2009):
  - Cost-benefit analysis
  - Quasi-experimental approaches - only for impact on individuals; this is difficult to do for organisations because of the lack of a counterfactual
  - Non-experimental approaches with beneficiaries
  - Economic modelling
- Participatory M&E methods (Campilan *et al.*, 2009; Robson, 2010; Vernooy *et al.*, 2009):

- Joint learning
- Story telling
- Most significant change
- Network mapping
- Community book

Few studies used conceptual frameworks to guide their impact assessment:

- The Kirkpatrick framework was used by several studies to assess the impact of training individual researchers (Eley *et al.*, 2003; Jamora *et al.*, 2011; Patel and Woomer, 2000; Wanjiku *et al.*, 2010). The framework evaluates training at four different levels: reaction (trainee's assessment of his/her training), learning (what the trainee learned), performance (how the trainee applied what he/she learned), and results (impacts on the institute/society).
- Bennett-Lartey *et al.* (2003) and Mackay and Horton (2002) used the IDRC model (Lusthaus *et al.*, 1995), which defines organisational performance as the achievements of the organisation in relation to its objectives. The organisational assessment framework posits that an organisation's performance is za function of its operational environment, its motivation, and its capacity (Figure 5):
  - The operational environment refers to the legal, social, and economic context in which the organisation operates. It includes the administrative and legal systems and the political, economic, social and technological environments in which the organisation operates.
  - Organisational motivation pertains to the internal factors that influence the direction in which the organisation is headed and the energy displayed in its activities. These, in turn, are influenced by such variables as organisational culture, incentives, leadership and management style.
  - Organisational capacity refers to the capabilities of the staff, financial resources, strategic leadership and management systems, and linkages with other organisations.
  - Organisational performance is gauged in terms of effectiveness, efficiency, and sustainability. Effectiveness refers to the degree to which the organisation achieves its goals. Efficiency is the degree to which unit costs are minimised. Sustainability is the extent to which the organisation maintains its relevance to its stakeholders and thereby secures the financial and other resources it needs.

Figure 4: Organisational performance framework (Bennett-Lartey *et al.*, 2003b)



Box 13: Indicators to measure the impact of capacity strengthening on research capacity (Freeman et al., 2010)

- Numbers of PhD teaching staff, supervisors, academic promotions and appointments to leadership roles (academic and professional)
- Representation of women in research groups
- Gains in highly used elements of research infrastructure (ICT, library, laboratories, equipment) and in aspects of institutional culture (eagerness to pursue research opportunities and make more time for research and for collaboration, including writing funding proposals, designing studies and carrying them out, analysing results, drafting manuscripts, and strategising)
- Rates of international publications in various disciplines
- Level of international collaboration, including attracting international funds from more sources
- Evidence of esteem; e.g. recognition in the form of research awards for 'best paper'
- Growing teamwork and increasingly viable research groups able to incorporate masters-level students, and work more collectively on all aspects of agendas for sustainable research
- Strategies for and implementation of the results to assure dissemination to community users
- Connections to industry for commercialisation of innovations
- Attention to long-term strategies for building capacity by the choice of projects, collaborators and agendas for research

- Snelder (2010) applied an 'open systems approach', which stresses the fact that any organisation will influence and be influenced by a number of internal and external factors that determine capacity development. Organisations are thus viewed as open systems with permeable borders. The approach has four pillars: (1) adopt an open systems view on organisations; (2) use a results-oriented method; (3) give context full consideration; (4) exploit both the functional-relational and the political economy aspects of

organisations and change. Capacity strengthening is not seen as a simple cause-effect relationship that takes place in a vacuum. Instead, it is considered as an endogenous nonlinear process, strongly influenced by a range of internal and external factors, of which donor support is merely one.

- Vernooy *et al.* (2009) found that evaluative learning frameworks contribute to understanding and enhancing capacity development strategies, including scaling up, sustainability and institutionalisation, in particular when shared by all actors in the learning process. These frameworks consisted of five 'Cs': context, content, capacity, the capacitated and capacity development.

Various studies (e.g. Berg, 1998; Eley *et al.*, 2003; Freeman *et al.*, 2010; Mauldon, 1998; OSAN, 2009; Robson, 2010; Stern *et al.*, 2006) pointed out that M&E systems of programmes and organisations were ineffective in tracking progress and change, and baseline studies were lacking. It is recommended that outcomes and impact are measured against a set of indicators. However, it is also recognised that this can be difficult if capacity strengthening programmes do not have clear targets and impact pathways from the start. Ayele and Wield (2005) observed that capacity strengthening activities such as training and research facilities were not always related to clear objectives. Bennett-Lartey *et al.* (2003a, b) therefore suggested that a theory of action (or impact pathway) that links short-term objectives and long-term goals should be defined, against which progress can be measured.

Because there is a long and complex series of causal linkages between capacity strengthening and research impact, in particular in organisational and institutional capacity strengthening, Mackay *et al.* (1998) warned that reliability and predictability diminishes with each successive link beyond the intervention. They therefore advised a focus on the 'primary impacts': the outcomes and observed results. Bennett-Lartey *et al.* (2003a, b) suggested that organisational performance should be measured against the organisation's own mission, strategy and action plans. The effectiveness of capacity strengthening should be measured in terms of its contribution to the organisation's performance against its own vision and priority areas.

In the case of NARS, it is useful to think not only in terms of changing capacities, but also of changing relationships — among individuals, organisations, and networks. This needs to be recognised in evaluation planning because the capacity to work together with diverse stakeholders, who often have divergent goals, is crucial (Vernooy *et al.*, 2009).

Hagmann *et al.* (2002) stressed the importance of monitoring a 'plausible impact strategy', recognising that it is impossible to assess the effects of certain activities beyond a given level, as innovation is a social process involving many actors. Too many factors beyond the control of the programme dilute the attribution, causing an 'attribution gap'. Programmes can be assessed for their performance, outputs and outcomes, but not broad impact, but the programme strategy has to be informed by a clear impact pathway to compensate for the attribution gap.

4. Conclusions and implications

4.1 Main findings from the systematic review

4.1.1 Impacts of capacity strengthening on the performance of AR4D

Most evaluations reported benefits at the initial stages of the impact pathway. For example, postgraduate training resulted in improved knowledge and skills among researchers, leading to improved performances. However, the evidence on how this capacity building of researchers translates into the performance of NARS and agricultural development is unclear. Two impact pathways are distinguished: a linear impact pathway based on R&D and technology transfer, and a nonlinear impact pathway based on the innovation systems framework. For both pathways, internal and external factors have an increasing influence on the impact further along the impact pathway. But most reports concurred that capacity strengthening, when done in an appropriate manner, led to agricultural development. This review has identified some examples where capacity strengthening has led to improved performance of NARS and increased agricultural productivity. Only one evaluation found no link between capacity building and agricultural productivity, but it was pointed out that this was because graduates had difficulty finding jobs at research and higher education institutes at that specific time (early 1990s). This emphasises the importance of the wider context; capacity strengthening is only effective if organisational and institutional environments are conducive for the built capacity to be utilised.

The most common type of capacity strengthening is building scientific research capacity through interventions such as skills training, collaborative research projects, competitive research funding and regional research networks.

Box 14: Integrated capacity strengthening (Bennett-Lartey et al., 2003b; pp xi)

'Capacity development should be defined broadly to include much more than technical training. Technical training remains a priority as does equipment and basic infrastructure, but it appears that management and strategic planning, fund raising, public awareness and policy are becoming increasingly important and should be considered as high priority for future capacity development. Capacity development should also include a balanced approach to capacity delivery mechanisms to include publications, training and workshops, personalized technical assistance, equipment and facilitated collaborative research.'

Postgraduate training of researchers tends to be a common element of most capacity strengthening initiatives. Unfortunately, the selection procedures for postgraduate candidates sometimes lacked transparency. Nevertheless, this type of capacity strengthening generally resulted in increased research and teaching capacities within NARS, and strengthened research collaborations with partners in the North. Loss of capacity through the phenomenon 'brain drain' was thought to be minimal. Some evaluations reported a mismatch between academic interests in basic research and farmers' needs, and pleaded for more applied and on-farm research. However, basic research can result in large-scale impact in agricultural development, as some capacity strengthening programmes on plant breeding and animal husbandry in Asia have shown. The findings seem to suggest that building research capacity is more effective in the stronger NARS.

There is an increasing focus on strengthening organisational capacity, in particular the managerial capacity, to improve AR4D. There is little evidence of economic

impact for this type of capacity strengthening. Commitment from top management, a critical mass among the staff, competence of the service providers, and intensive interventions, are key requirements for success. Despite the lack of specific evidence, it is widely acknowledged that well-functioning organisations and research systems are necessary to enable the utilisation of research capacity and improve the performance of NARS.

In the last decade, there has been increasing attention on the strengthening of innovation systems. However, there is still little literature on the impact of interventions that take the innovation systems perspective. There was a wide variety of objectives and approaches among the publications identified for this systematic review. Some programmes focused on specific parts of value chains, some supported formal partnerships between the public and private sectors, and other programmes sought to strengthen the agricultural research systems. The strengthened collaborations among different actors resulted in new agricultural technologies in many cases. The scale of impact, however, is often unknown.

Because of the limitations in the evidence, it is not possible to make an objective comparison between different types of capacity strengthening in terms of impact and cost-effectiveness. But, in general, individual tools for capacity strengthening are suited to particular purposes and are often complementary. Indeed, many programmes that concentrated on one particular type of capacity strengthening reported that impact was constrained because of limited capacity at other levels (e.g. organisational, institutional) or parts of the agricultural research system. It is thus important to view capacity strengthening in a holistic and integrated manner and to design interventions which reflect the needs of the entire research system. The SCARDA programme (Robson, 2010), is an example of best practice in that respect.

Box 15: Considering constraining factors (Babu et al., 2007; pp 6-7)

'Challenges in strengthening staff and institutional capacity differ depending on the political, economic, and cultural context. Institutional and policy frameworks under which public organizations function are important. Developing effective strategies to strengthen and effectively use local capacity will require, as a first step, addressing several fundamental but related questions. What prevents the effective use of capacity in places where some capacity already exists? Who benefits from different types of training activities? How are new knowledge and skills gained from training activities used in public organizations? Does the trained staff use the knowledge and skills acquired to seek employment elsewhere? What incentives are in place to help trained professionals stay on the job? Do strategies to effectively develop capacity at national, regional and district levels differ?'

4.1.2 Influencing factors for capacity strengthening impact

There are many factors that influence the impact of capacity strengthening at a range of levels: project, researcher, organisational, institutional, philosophical, and research and dissemination. Some constraining factors can be addressed by more holistic capacity strengthening approaches, others cannot.

A strong conclusion from most evaluations is that capacity strengthening interventions are more effective when there is a long-term commitment of the donor as well as the beneficiaries. Furthermore, the interventions are more effective when based on a comprehensive needs assessment so capacity strengthening can be targeted to specific needs. Programmes with a clear impact

pathway and good M&E system were also thought to be more effective; flexibility to make adjustments in the implementation if necessary is also beneficial. The competence of the service providers strongly influences the results of capacity strengthening.

Sustained support over a long enough period to institutionalise new approaches is recommended. But, as the Sokoine example (Berg, 1998) shows, (1) it is not sufficient (or even sometimes desirable) to focus support on selected programmes or departments within an organisation, and (2) the provision of too high a proportion of resources by external donors may create an unhealthy dependency culture and a lack of ownership at the national level. It is thus recommended that national governments, and perhaps even organisations themselves, contribute to the capacity strengthening programme, in order to create more ownership and make sure it is relevant.

Capacity strengthening achieves greater impact if the organisation can effectively use the built capacity. This requires incentives and opportunities for researchers to use their skills, well-functioning administrative departments with limited bureaucracy, research facilities, and commitment from top management to improve performance and make changes where necessary. The performance of organisations is furthermore improved when they have a vision and long-term strategies, and M&E systems are used for strategic decision making. Although capacity strengthening is less effective if the targeted NARO or NARS is weak, this should not be a reason to withdraw support if there is commitment to change and improve its performance.

External factors at institutional level also influence the impact of capacity strengthening. Weak public and private sectors and lack of collaboration between different actors hamper the development and dissemination of new agricultural technologies. Adverse socio-political and economic factors, such as political instability or lack of investment in the public sector, can also thwart innovation. Despite the high transaction costs of collaboration, many evaluations suggest that stakeholder involvement and collaboration strongly enhance impact. However, often a catalyst or independent facilitator is required to establish and foster these relationships.

4.1.3 Measuring impact of capacity strengthening

The majority of the evaluations reviewed the capacity strengthening programmes in terms of assessing the inputs, activities and immediate outcomes. Few evaluations tried to estimate the economic impact and cost-effectiveness of capacity strengthening interventions. This lack of evidence on economic impact is a weak point in capacity strengthening evaluation. The reasons for the limited number of evaluations which attempted to assess impact on agricultural development include: the methodological difficulties in assessing impact at this level (e.g. lack of counterfactuals, attribution gap); the long time horizon over which capacity strengthening generally translates into observed outcomes and impact; the short timescales over which capacity strengthening interventions sometimes operate; and the limited attention given to and resources provided for M&E and impact assessment. Several authors made suggestions on how to improve the assessment of capacity strengthening, but putting more emphasis on (and making more resources available for) M&E was most often recommended. Using frameworks such as Kirkpatrick's model or the organisational assessment framework could improve impact assessments and allow comparison between programme evaluations.

4.2 Capacity needs

There is a broad consensus that more investment from governments and donors in agricultural R&D, over long periods, is needed to stimulate recovery and build capacity to address new challenges. The capacity needs identified span the need for support in agricultural higher education, for technical training in specific disciplines within universities and research institutes, and for skills in research management, organisational development and institutional change within the agricultural R&D sector.

There is considerable optimism about the potential of new information and communication technologies to facilitate open and distance learning, which have huge potential for extending the scale and reach of involvement. Biotechnology is also seen as an area where capacity strengthening could have an important impact. Other topics identified where capacities are in need of strengthening include learning associated with adaptation to climate change and conservation of agro-biodiversity, and monitoring, evaluation and impact assessment.

The challenge to involve more women in agricultural education and agricultural research has been recognised and some innovative programmes are being implemented. These address issues associated with the recruitment and selection, management and promotion of female students and staff within research and education organisations. There is, however, a continuing need for the mainstreaming of gender considerations within the day-to-day work of research and education institutions, informing the way that research is planned and implemented, for example, the identification of research demands, the content of training programmes and the criteria for technology assessment.

There are also important needs for capacity development to implement new approaches to agricultural research for development which facilitate closer interaction between different types of stakeholders and encourage the private sector and civil society to contribute more directly to shaping the research agenda and to influencing the curricula at universities. These have to be tailored for specific country situations.

While the link between agricultural education and training and agricultural research is relatively well articulated in discussions about capacity needs, the link with agricultural extension (in the broad sense of public and private information and advisory services and agricultural input supply systems) has been less emphasised. Building on successes in capacity strengthening in AR4D and education, there is a need for more holistic approaches to strengthening capacity in specific contexts of agricultural research, agricultural education and agricultural extension and service delivery.

4.3 Implications

There is no blueprint for capacity strengthening; the findings of the systematic review provide pointers for best practices and principles, but each intervention needs to be targeted to the specific needs and weaknesses of the NARO or NARS that it is trying to address.

Long-term, comprehensive programmes are considered more effective because of opportunities for synergies and holistic capacity strengthening. Long-term interventions also facilitate the institutionalisation of new approaches to management and research.

Although attribution of capacity strengthening to AR4D can be problematic, a clear impact pathway and M&E methodology has to be formulated from the start, and

M&E tools have to be used to monitor progress and inform strategic decision making. Flexibility in programme management, however, is equally important so that adjustments can be made to changing circumstances if necessary. More and better M&E of programmes is also necessary to gather more evidence on the impact of capacity strengthening. The results of evaluations should be made available more widely to share experiences on best practice and lessons learned.

Capacity strengthening has to become more demand driven; NAROs or NARS should be targeted where there is a clear need that requires capacity strengthening and a willingness to change and utilise the capacity. Capacity strengthening therefore has to be based on a thorough needs assessment and a participatory process with a wide group of stakeholders to ensure relevance, identify impact pathways and promote local ownership. The ability to utilise the developed capacities also needs to be considered. This includes favourable organisational and institutional environments and long-term sustainability of capacity strengthening initiatives.

Support for individual researchers through scholarships, internships, exchanges, etc. should be linked to the priorities and programmes of the research organisations for which they work and, if possible, the national research agenda. The selection of postgraduate students needs to be more transparent. It was found that in some cases senior staff members received training as a reward and they retired soon after graduation. There needs to be clear justification for the reasons a particular candidate is selected and specification of the way they will use the new skills in their future career. Scholarships and mentoring for women had a positive impact on the gender balance among research staff and should therefore be continued.

NAROs still tend to operate in isolation. Capacity is used more effectively in a system that encourages knowledge exchange and joint innovation. Such collaboration has to go beyond the research actors. Collaboration with service providers, the public sector, NGOs and the private sector appears to be much more effective in achieving short-term impacts addressing farmers' immediate problems or weaknesses in value chains. NAROs thus need to become more flexible and dynamic to become more responsive to the changing needs in the agricultural sector. However, there is still a place for scientific basic research (and capacity strengthening thereof), such as biotechnology, to achieve long-term large-scale impacts in terms of agricultural productivity growth.

Regional research networks facilitate knowledge exchange, research collaboration and curriculum development. Good management and commitment from the research organisations is required to make the networks more effective. Also, more could be done to increase their effectiveness in engaging with other sectors and to influence national research agendas.

Box 16: Short-term versus long-term planning in capacity strengthening (Almond and Kisauzi, 2005)

'If successful innovation is the goal, rather than simply the creation of good research knowledge, then experience tells us that attention has got to be given as much to the demand side – where capacities are generally weak – as to the supply side.' (pp 15)

'Good research and good capacity development both take time. The thorough pursuit of a research agenda, especially when it needs to be validated by adaptive work demonstrating its potential to impact poverty, needs the ten-year horizon rather than the confines of a two or three year project. So the concept of building capacity for research as part of active research programmes argues for the retention of (at least) the ten year perspective. There are good arguments for the two to three year project however, and they include considerations of accountability, realistic planning and budgeting time frames, the ability to be responsive and to integrate 'new' knowledge and new partnerships as the project evolves. These are not mutually incompatible considerations. It is possible to conceive of long-term research priorities being pursued resolutely over an extended time scale, with appropriate levels of capacity development being factored in, but explored through a succession of shorter-term, focussed projects or project phases that benefit from disciplined project management approaches. It is this combination of long-term programme strategy and short term effective project management that distinguishes the most successful of the research programmes, and those which demonstrate the best evidence of having created a durable change to systems and capacities in-country.' (pp 17)

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Appendices

Appendix 1.1: Authorship of this review

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Appendix 2: Results of the literature search

In the literature search, full-text documents were screened for the pre-defined search terms. All results are presented in the tables below. The search methodology had to be adjusted for each database, as described below. Extra filters of search terms were added if the number of returned hits was excessively high. Studies published before 1990 were not taken into account. The term duplicates refers to duplicate hits already found in previous searches within the same database.

Online search engines

Africana Periodical Literature

The Africana Periodical Literature bibliographic database indexes articles from over 500 journals and periodicals that specialise in African studies. Only three publications out of 159 (excluding duplicates) were selected.

Table A-1: Search results: Africana Periodical Literature database

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
10 Jan 2012	capacity development	8	1	0	0
10 Jan 2012	capacity building AND [Agriculture, Natural Resources and Environment]	7	0	0	0
10 Jan 2012	capacity strengthening	3	1	0	0
10 Jan 2012	technical assistance AND [Agriculture, Natural Resources and Environment]	11	0	0	0
10 Jan 2012	Mentoring	5	0	0	0
10 Jan 2012	institutional development AND [Agriculture, Natural Resources and Environment]	3	0	0	0
10 Jan 2012	secondment	4	0	0	0
10 Jan 2012	attachment AND [Agriculture, Natural Resources and Environment]	7	0	0	0
10 Jan 2012	change management	11	0	0	0
10 Jan 2012	experiential learning	4	0	0	0
10 Jan 2012	information system AND [Agriculture, Natural Resources and Environment]	17	0	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
10 Jan 2012	innovation system	1	0	0	0
10 Jan 2012	research into use	0	0	0	0
10 Jan 2012	innovation platform	0	0	0	0
10 Jan 2012	farmer field school	4	0	2	0
10 Jan 2012	public private partnership	1	0	0	0
10 Jan 2012	action research AND [Agriculture, Natural Resources and Environment]	2	0	0	0
10 Jan 2012	national agricultural research system	5	1	0	1
10 Jan 2012	network AND [Agriculture, Natural Resources and Environment]	69	0	0	0
10 Jan 2012	postgraduate training	2	0	0	0
10 Jan 2012	graduate training	8	0	0	0
10 Jan 2012	distance learning	15	1	0	1
10 Jan 2012	higher education qualification	2	0	0	0
Total		189	3	2	1

AgEcon

AgEcon is a collection of working papers, conference papers and journal articles in agricultural and applied economics. Nineteen publications out of 239 references (excluding duplicates) were selected (Table A-2).

Table A-2: Search results: AgEcon database

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
03 Jan 2012	'capacity development' AND agric*	9	1	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
03 Jan 2012	'capacity building' AND agric*	34	0	0	5
03 Jan 2012	'capacity strengthening' AND agric*	5	0	0	1
03 Jan 2012	'technical assistance' AND agric* AND capacity	8	2	0	0
03 Jan 2012	mentoring AND agric*	6	1	0	0
03 Jan 2012	institutional development AND agric*	32	0	0	0
03 Jan 2012	secondment AND agric* AND capacity	38	2	0	1
03 Jan 2012	attachment AND agric* AND capacity	2	1	0	0
03 Jan 2012	change management AND agric*	8	0	0	0
03 Jan 2012	experiential learning AND agric*	1	0	0	0
03 Jan 2012	'information system' AND agric* AND capacity	7	4	0	0
03 Jan 2012	'innovation system' AND agric*	27	2	0	3
03 Jan 2012	'research into use' AND agric* AND capacity	1	0	0	0
03 Jan 2012	'innovation platform' AND agric*	2	0	0	0
03 Jan 2012	'farmer field school' AND agric*	7	0	0	3
03 Jan 2012	'public private partnership' AND agric*	22	1	0	3
03 Jan 2012	'action research' AND agric*	12	1	0	1
03 Jan 2012	national agricultural research system	12	3	0	1
03 Jan 2012	network AND agric* AND capacity	22	12	0	0
03 Jan 2012	'postgraduate training' AND agric*	1	1	0	0
03 Jan 2012	'graduate training' AND agric*	16	3	0	1

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
03 Jan 2012	'distance learning' AND agric*	1	0	0	0
03 Jan 2012	'higher education qualification' AND agric*	0	0	0	0
Total		273	34	0	19

AJOL

The African Journals OnLine (AJOL; www.ajol.info) is the world's largest collection of peer-reviewed, African-published scholarly journals. The AJOL database was searched using simple search terms as the database does not allow complicated search combinations. Only one publication out of 47 references (excluding duplicates) was selected (Table A-3).

Table A-3: Search results: AJOL database

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
10 Dec 2011	capacity development AND agric*	0	0	0	0
10 Dec 2011	capacity building AND agric*	1	0	0	0
10 Dec 2011	capacity strengthening AND agric*	0	0	0	0
10 Dec 2011	technical assistance AND agric*	0	0	0	0
10 Dec 2011	mentoring AND agric*	0	0	0	0
10 Dec 2011	institutional development AND agric*	1	0	0	0
10 Dec 2011	secondment AND agric*	0	0	0	0
10 Dec 2011	attachment AND agric* AND capacity	1	0	0	0
10 Dec 2011	change management AND agric*	0	0	0	0
10 Dec 2011	experiential learning AND agric*	0	0	0	0
10 Dec 2011	information systems AND agric*	1	0	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
10 Dec 2011	innovation system AND agric*	11	2	0	0
10 Dec 2011	research into use AND agric*	24	0	0	0
10 Dec 2011	innovation platform AND agric*	0	0	0	0
10 Dec 2011	farmer field school AND agric*	3	1	0	1
10 Dec 2011	public private partnership AND agric*	0	0	0	0
10 Dec 2011	action research AND agric*	0	0	0	0
10 Dec 2011	national agricultural research system	2	0	0	0
10 Dec 2011	network AND agric*	6	0	0	0
10 Dec 2011	postgraduate training AND agric*	0	0	0	0
10 Dec 2011	graduate training AND agric*	0	0	0	0
10 Dec 2011	distance learning AND agric*	0	0	0	0
10 Dec 2011	higher education qualification AND agric*	0	0	0	0
Total		50	3	0	1

AsiaJOL

Asian Journals Online is a portal to scholarly journals published in Bangladesh, Nepal, The Philippines, Vietnam, Sri Lanka, and Indonesia. No publications out of 503 references (excluding duplicates) were selected (Table A-4). Various search terms resulted in identical lists of 500 references.

Table A-4: Search results: AsiaJOL database

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
09 Jan 2012	'capacity development' AND agric*	500	0	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
09 Jan 2012	'capacity building' AND agric*	0	0	0	0
09 Jan 2012	'capacity strengthening' AND agric*	500	500	0	0
09 Jan 2012	'technical assistance' AND agric*	0	0	0	0
09 Jan 2012	mentoring AND agric*	0	0	0	0
09 Jan 2012	'institutional development' AND agric*	500	500	0	0
09 Jan 2012	secondment AND agric*	500	500	0	0
09 Jan 2012	attachment AND agric*	0	0	0	0
09 Jan 2012	'change management' AND agric*	0	0	0	0
09 Jan 2012	'experiential learning' AND agric*	0	0	0	0
09 Jan 2012	'information system' AND agric*	3	0	0	0
09 Jan 2012	'innovation system' AND agric*	0	0	0	0
09 Jan 2012	'research into use' AND agric*	88	88	0	0
09 Jan 2012	'innovation platform' AND agric*	500	500	0	0
09 Jan 2012	'farmer field school' AND agric*	500	500	0	0
09 Jan 2012	'public private partnership' AND agric*	0	0	0	0
09 Jan 2012	'action research' AND agric*	0	0	0	0
09 Jan 2012	'national agricultural research system' AND agric*	1	1	0	0
09 Jan 2012	network AND agric*	3	3	0	0
09 Jan 2012	'postgraduate training' AND agric*	0	0	0	0
09 Jan 2012	'graduate training' AND agric*	500	500	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
09 Jan 2012	'distance learning' AND agric*	2	2	0	0
09 Jan 2012	'higher education qualification' AND agric*	500	500	0	0
Total		4,097	3,594	0	0

BLDS Digital Library

The British Library for Development Studies (BLDS) Digital Library contains full-text copies of the BLDS research collection on economic and social change. No publications out of 406 references (excluding duplicates) were selected (Table A-5). The majority of the references were published before 1990.

Table A-5: Search results: BLDS Digital Library

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
10 Jan 2012	'capacity development' AND agric*	12	2	0	0
10 Jan 2012	'capacity building' AND agric*	7	0	0	0
10 Jan 2012	'capacity strengthening' AND agric*	1	1	0	0
10 Jan 2012	'technical assistance' AND agric*	71	57	0	0
10 Jan 2012	mentoring AND agric*	2	1	0	0
10 Jan 2012	'institutional development' AND agric* AND capacity	386	24	0	0
10 Jan 2012	secondment AND agric* AND capacity	357	354	0	0
10 Jan 2012	attachment AND agric* AND capacity	112	112	0	0
10 Jan 2012	'change management' AND agric*	3	3	0	0
10 Jan 2012	'experiential learning' AND agric*	0	0	0	0
10 Jan 2012	'information system' AND agric*	21	18	0	0
10 Jan	'innovation system' AND agric*	1	1	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
2012					
10 Jan 2012	'research into use' AND agric*	10	5	0	0
10 Jan 2012	'innovation platform' AND agric*	0	0	0	0
10 Jan 2012	'farmer field school' AND agric*	0	0	0	0
10 Jan 2012	'public private partnership' AND agric*	1	1	0	0
10 Jan 2012	'action research' AND agric*	5	5	0	0
10 Jan 2012	'national agricultural research system' AND agric*	1	1	0	0
10 Jan 2012	network AND agric* AND capacity	156	156	0	0
10 Jan 2012	'postgraduate training' AND agric*	3	3	0	0
10 Jan 2012	'graduate training' AND agric*	4	3	0	0
10 Jan 2012	'distance learning' AND agric*	1	1	0	0
10 Jan 2012	'higher education qualification' AND agric*	4	4	0	0
Total		1,158	752	0	0

EBSCO

EBSCO*host* is an online reference system that offers a variety of proprietary full-text databases and popular databases from leading information providers. The literature search was carried out in earth/environment databases (Academic Search Premier, CAB Abstracts, GreenFILE), psychology/sociology databases (PsycINFO, Psychology and Behavioural Sciences Collection, CINAHL), education databases (Education Research Complete, Humanities International Complete, Teacher Reference Centre) and literature databases (Library, Information Science and Technology Abstracts). The results are shown in Table A-6.

The EBSCO database was the first database to be searched, and therefore multiple searches with different combinations of search terms were initially used to get a feel for the search terms and associated results. Extra searches were done at a later stage with the terms 'capacity development', 'capacity strengthening' and 'capacity building', plus additional filters. A total of 267 full-text publications were selected out of 6,771 references (excluding duplicates). An additional 192 references were found with available abstracts only. (Table A-6).

Table A-6: Search results: EBSCO databases

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
21 Jul 2011	'graduate training' AND Africa* AND agric*	2	0	0	1
21 Jul 2011	'post-graduate training' AND Africa* AND agric*	67	4	3	9
21 Jul 2011	'higher education qualification' AND Africa* AND agric*	19	1	1	1
21 Jul 2011	'distance learning' AND Africa* AND agric*	9	1	3	3
21 Jul 2011	'graduate training' AND 'developing countries' AND agric*	150	0	6	1
21 Jul 2011	'post-graduate training' AND 'developing countries' AND agric*	2	2	0	0
21 Jul 2011	'higher education qualification' AND 'developing countries' AND agric*	44	18	0	0
21 Jul 2011	'distance learning' AND 'developing countries' AND agric*	17	6	0	0
21 Jul 2011	'graduate training' AND Asia* AND agric* AND research	30	25	0	0
21 Jul 2011	'post-graduate training' AND Asia* AND agric* AND research	1	1	0	0
21 Jul 2011	'higher education qualification' AND Asia* AND agric* AND research	4	4	0	0
21 Jul 2011	'distance learning' AND Asia* AND agric* AND research	8	6	1	0
21 Jul 2011	'graduate training' AND Latin America* AND agric* AND research	1	1	0	0
21 Jul 2011	'post-graduate training' AND Latin America*AND agric* AND research	18	5	0	0
21 Jul 2011	'higher education qualification' AND Latin America*AND agric* AND research	1	0	0	0
21 Jul 2011	'distance learning' AND Latin America* AND agric* AND research	2	1	0	0
Total professional academic training		*375*	*75*	*14*	*15*
28 Jul 2011	(training OR course) AND Africa* AND agric* AND ('capacity	64	4	5	18

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
	building' OR 'capacity development')				
28 Jul 2011	(training OR course) AND Africa* AND agric* AND (skills OR know-how)	218	19	18	25
28 Jul 2011	(training OR course) AND Africa* AND agric* AND management AND (outcome OR impact OR effect OR evaluat*) AND research	279	33	24	19
28 Jul 2011	(training OR course) AND ('developing countries' OR Asia* OR Latin America*) AND agric* AND ('capacity building' OR 'capacity development') AND (outcome OR impact OR effect OR evaluat*)	62	17	3	8
28 Jul 2011	(training OR course) AND ('developing countries' OR Asia* OR Latin America*) AND agric* AND (skills OR know-how) AND (outcome OR impact OR effect OR evaluat*)	206	68	31	27
28 Jul 2011	(training OR course) AND ('developing countries' OR Asia* OR Latin America*) AND agric* AND management AND (outcome OR impact OR effect OR evaluat*) AND research	787	293	36	36
Total skills training		*1,616*	*434*	*117*	*133*
03/08/2011	('technical assistance' OR mentoring OR 'institutional development' OR secondment OR attachment OR 'change management' OR 'experiential learning' OR 'information systems') AND (Africa* OR 'developing countries' OR Asia* OR Latin America*) AND agric*AND (outcome OR impact OR effect OR evaluat*)	1,994	27	13	25
Total organisational capacity strengthening		*1,994*	*27*	*13*	*25*
12/08/2011	(innovation system* OR 'research into use' OR 'innovation platform*' OR 'farmer field schools' OR 'public-private	3,253	257	41	83

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
	partnerships' OR 'action research' OR 'national agricultural research system*' OR networks) AND (capacity OR performance OR research OR development) AND (Africa* OR 'developing countries' OR Asia* OR Latin America*) AND agric* AND (outcome OR impact OR effect OR evaluat*)				
Total strengthening of agricultural research systems		*3,253*	*257*	*41*	*83*
04 Nov 2011	'capacity development' AND agric*	86	11	7	4
19 Dec 2011	'capacity strengthening' AND agric*	19	6	0	0
19 Dec 2011	'capacity building' AND agric* AND Africa* OR 'developing countries' OR Asia* OR Latin America*) AND research	341	103	0	7
Total capacity development		446	120	7	11
Total		7,684	913	192	267

IBSS

The International Bibliography of Social Sciences covers publications from four disciplines: anthropology, economics, political science and sociology. Twenty publications out of 258 references (excluding duplicates) were selected (Table A-7).

Table A-7: Search results: IBSS database

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
06 Jan 2012	'capacity development' AND agric*	8	1	0	0
06 Jan 2012	'capacity building' AND agric*	50	0	1	4
06 Jan 2012	'capacity strengthening' AND agric*	1	0	1	0
06 Jan	'technical assistance' AND agric*	6	0	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
2012	AND capacity				
06 Jan 2012	mentoring AND agric*	8	1	0	1
06 Jan 2012	institutional development AND agric*	21	0	0	1
06 Jan 2012	secondment AND agric*	1	1	0	0
06 Jan 2012	attachment AND agric* AND capacity	2	0	0	0
06 Jan 2012	change management AND agric*	3	0	0	0
06 Jan 2012	experiential learning AND agric*	12	1	0	2
06 Jan 2012	'information system' AND agric* AND capacity	3	1	0	0
06 Jan 2012	'innovation system' AND agric*	20	2	0	0
06 Jan 2012	'research into use' AND agric*	1	0	0	1
06 Jan 2012	'innovation platform' AND agric*	0	0	0	0
06 Jan 2012	'farmer field school' AND agric*	13	2	0	7
06 Jan 2012	'public private partnership' AND agric*	30	2	0	2
06 Jan 2012	'action research' AND agric*	36	0	0	0
06 Jan 2012	national agricultural research system AND agric*	2	0	0	0
06 Jan 2012	network AND agric* AND capacity	53	3	0	0
06 Jan 2012	'postgraduate training' AND agric*	1	1	0	0
06 Jan 2012	'graduate training' AND agric*	3	1	0	0
06 Jan 2012	'distance learning' AND agric*	0	0	0	0
06 Jan 2012	'higher education qualification' AND agric*	0	0	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
Total		274	16	2	18

IDEAS
IDEAS is the largest bibliographic database of working papers and published research in economics. Thirteen publications out of 199 references (excluding duplicates) were selected (Table A-8).

Table A-8: Search results: IDEAS database

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
05 Jan 2012	'capacity development' AND agriculture	5	1	0	0
05 Jan 2012	'capacity building' AND agriculture	39	1	0	3
05 Jan 2012	'capacity strengthening' AND agriculture	13	5	0	2
05 Jan 2012	'technical assistance' AND agriculture AND capacity	8	2	0	0
05 Jan 2012	mentoring AND agriculture	2	0	0	0
05 Jan 2012	institutional development AND agriculture	26	1	0	1
05 Jan 2012	secondment AND agriculture	1	0	0	0
05 Jan 2012	attachment AND agriculture	7	3	0	0
05 Jan 2012	change management AND agriculture	1	0	0	0
05 Jan 2012	experiential learning AND agriculture	0	0	0	0
05 Jan 2012	'information system' AND agriculture AND capacity	5	1	0	0
05 Jan 2012	'innovation system' AND agriculture	30	6	0	3
05 Jan 2012	'research into use' AND agriculture	16	2	0	0
05 Jan 2012	'innovation platform' AND agriculture	1	0	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
05 Jan 2012	'farmer field school' AND agriculture	6	0	0	1
05 Jan 2012	'public private partnership' AND agriculture	25	2	0	2
05 Jan 2012	'action research' AND agriculture	10	1	0	0
05 Jan 2012	national agricultural research system	13	2	0	1
05 Jan 2012	network AND agriculture AND capacity	19	4	0	0
05 Jan 2012	'postgraduate training' AND agric*	1	1	0	0
05 Jan 2012	'graduate training' AND agric*	2	0	0	0
05 Jan 2012	'distance learning' AND agric*	1	0	0	0
05 Jan 2012	'higher education qualification' AND agric*	0	0	0	0
Total		231	32	0	13

Ingenta Connect

Ingenta Connect offers a comprehensive collection of academic and professional research articles of more than 250 publishers online. The Ingenta Connect database was searched using simple search terms as the database does not allow complicated search combinations; Ingenta Connect only returned results when searching titles, keywords and abstract. Fourteen publications out of 333 references (excluding duplicates) were selected; only abstracts were available for five of the 14 references (Table A-9).

Table A-9: Search results: Ingenta Connect database

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
09 Dec 2011	'capacity development' AND agric*	7	0	0	0
09 Dec 2011	capacity building AND agric*	48	0	1	2
09 Dec 2011	capacity strengthening AND agric*	1	0	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
09 Dec 2011	'technical assistance' AND agric*	54	3	0	0
09 Dec 2011	mentoring AND agric*	10	0	0	0
09 Dec 2011	institutional development AND agric*	23	1	1	1
09 Dec 2011	secondment AND agric*	0[a]	0	0	0
09 Dec 2011	attachment AND agric* AND capacity	4	0	0	0
09 Dec 2011	change management AND agric*	9	1	1	0
09 Dec 2011	experiential learning AND agric*	10	1	1	0
09 Dec 2011	'information systems' AND agric* AND capacity	20	0	0	0
09 Dec 2011	innovation system AND agric*	55	6	0	3
09 Dec 2011	'research into use' AND agric*	1	0	0	0
09 Dec 2011	'innovation platform' AND agric*	0	0	0	0
09 Dec 2011	'farmer field school' AND agric*	12	1	0	3
09 Dec 2011	'public private partnership' AND agric*	12	0	0	0
09 Dec 2011	'action research' AND agric* AND capacity	16	6	1	0
09 Dec 2011	national agricultural research system	15	0	0	0
09 Dec 2011	network AND agric* AND capacity	54	2	0	0
09 Dec 2011	'postgraduate training' AND agric*	2	2	0	0
09 Dec 2011	'graduate training' AND agric*	1	0	0	0
09 Dec 2011	'distance learning' AND agric*	2	0	0	0
09 Dec 2011	'higher education qualification' AND agric*	0	0	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
Total		356	23	5	9

[a] The search returned 1,768 hits, but based on the term 'second'; there were no references with the term 'secondment'.

JSTOR

JSTOR provides access to archival and current issues of more than 1,400 scholarly journals across more than 50 academic disciplines within the humanities, social sciences, and sciences. Out of 1,472 references (excluding duplicates) only eight publications were selected (Table A-10).

Table A-10: Search results: JSTOR database

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
16 Sept 2011	('graduate training' OR 'post graduate training' OR 'higher education qualification' OR 'distance learning) AND (Africa* OR 'developing countries' OR Asia* OR Latin America*) AND agric* AND ('capacity development' OR 'capacity building' OR 'research capacity' OR 'agricultural knowledge')	2	0	0	1
16 Sept 2011	(training OR course) AND ('capacity development' OR 'capacity building' OR skills OR know-how OR management) AND (Africa* OR 'developing countries' OR Asia* OR Latin America*) AND agric*	900	6	0	7
31 Aug 2011	('technical assistance' OR mentoring OR 'institutional development' OR secondment OR attachment OR 'change management' OR 'experiential learning' OR 'information systems') AND (Africa* OR 'developing countries' OR Asia* OR Latin America*) AND agric*AND (outcome OR impact OR effect OR evaluat*)	256	163	0	0
16 Sept 2011	(innovation system* OR 'research into use' OR 'innovation platform*' OR 'farmer field	1,044	561	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
	schools' OR 'public-private partnerships' OR 'action research' OR 'national agricultural research system*' OR networks) AND (capacity OR performance OR research OR development) AND (Africa* OR 'developing countries' OR Asia* OR Latin America*) AND agric* AND (outcome OR impact OR effect OR evaluat*)				
Total		2,202	730	0	8

LAMJOL

Latin American Journals Online is a new database that hosts (mainly Spanish) journals from Nicaragua and Honduras. No publications out of 65 references were selected (Table A-11). None of the (English) search terms resulted in any hits, as the database contains mainly Spanish publications, except the search term 'agric*'.

Table A-11: Search results: LAMJOL database

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
09 Jan 2012	'capacity development' AND agric*	0	0	0	0
09 Jan 2012	'capacity building' AND agric*	0	0	0	0
09 Jan 2012	'capacity strengthening' AND agric*	0	0	0	0
09 Jan 2012	'technical assistance' AND agric*	0	0	0	0
09 Jan 2012	mentoring AND agric*	0	0	0	0
09 Jan 2012	'institutional development' AND agric*	0	0	0	0
09 Jan 2012	secondment AND agric*	0	0	0	0
09 Jan 2012	attachment AND agric*	0	0	0	0
09 Jan 2012	'change management' AND agric*	0	0	0	0
09 Jan	'experiential learning' AND agric*	0	0	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
2012					
09 Jan 2012	'information system' AND agric*	0	0	0	0
09 Jan 2012	'innovation system' AND agric*	0	0	0	0
09 Jan 2012	'research into use' AND agric*	0	0	0	0
09 Jan 2012	'innovation platform' AND agric*	0	0	0	0
09 Jan 2012	'farmer field school' AND agric*	0	0	0	0
09 Jan 2012	'public private partnership' AND agric*	0	0	0	0
09 Jan 2012	'action research' AND agric*	0	0	0	0
09 Jan 2012	'national agricultural research system' AND agric*	0	0	0	0
09 Jan 2012	network AND agric*	0	0	0	0
09 Jan 2012	'postgraduate training' AND agric*	0	0	0	0
09 Jan 2012	'graduate training' AND agric*	0	0	0	0
09 Jan 2012	'distance learning' AND agric*	0	0	0	0
09 Jan 2012	'higher education qualification' AND agric*	0	0	0	0
09 Jan 2012	agric*	65	0	0	0
Total		65	0	0	0

SciVerse SCOPUS

Scopus is the largest abstract and citation database of peer-reviewed literature. It includes scientific journals from (among others) the following publishers: Elsevier, Springer, Wiley-Blackwell, Taylor and Francis Informa, Sage, Wolters Kluwer, IEEE, Oxford University Press and Cambridge University Press. Searches were carried out in title, keywords and abstracts only, and in full text. Out of 5,133 references (excluding duplicates), 106 publications were selected; only abstracts were available for 28 references (Table A-12).

Table A-12: Search results: SCOPUS database

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
31 Aug 2011	All fields: ('graduate training' OR 'post graduate training' OR 'higher education qualification' OR 'distance learning') AND (Africa* OR 'developing countries' OR Asia* OR Latin America*) AND agric* AND ('capacity development' OR 'capacity building' OR 'research capacity' OR 'agricultural knowledge')	0	0	0	0
31 Aug 2011	Title/Abstract/Keywords: (training OR course) AND ('capacity development' OR 'capacity building' OR skills OR know-how OR management) AND (Africa* OR 'developing countries' OR Asia* OR Latin America*) AND agric*	7	0	0	1
31 Aug 2011	All fields: (training OR course) AND ('capacity development' OR 'capacity building' OR skills OR know-how OR management) AND (Africa* OR 'developing countries' OR Asia* OR Latin America*) AND agric*	1,027	1	9	41
31 Aug 2011	Title/Abstract/Keywords: ('technical assistance' OR mentoring OR 'institutional development' OR secondment OR attachment OR 'change management' OR 'experiential learning' OR 'information systems') AND (Africa* OR 'developing countries' OR Asia* OR Latin America*) AND agric*AND (outcome OR impact OR effect OR evaluat*)	31	0	1	0
31 Aug 2011	Full text: ('technical assistance' OR mentoring OR 'institutional development' OR secondment OR attachment OR 'change management' OR 'experiential learning' OR 'information systems') AND (Africa* OR 'developing countries' OR Asia* OR Latin America*) AND agric*AND (outcome OR impact OR effect OR	2,000[a]	36	8	12

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
	evaluat*)				
31 Aug 2011	Title/Abstract/Keywords: (innovation system* OR 'research into use' OR 'innovation platform*' OR 'farmer field schools' OR 'public-private partnerships' OR 'action research' OR 'national agricultural research system*' OR networks) AND (capacity OR performance OR research OR development) AND (Africa* OR 'developing countries' OR Asia* OR Latin America*) AND agric*	33	13	0	0
31 Aug 2011	Full text: (innovation system* OR 'research into use' OR 'innovation platform*' OR 'farmer field schools' OR 'public-private partnerships' OR 'action research' OR 'national agricultural research system*' OR networks) AND (capacity OR performance OR research OR development) AND (Africa* OR 'developing countries' OR Asia* OR Latin America*) AND agric* AND (outcome OR impact OR effect OR evaluat*)	2,000[b]	192	9	43
10 Jan 2012	Title/Abstract/Keywords: 'capacity development' AND agric*	28	7	0	0
10 Jan 2012	Title/Abstract/Keywords: 'capacity strengthening' AND agric*	5	1	0	0
10 Jan 2012	Title/Abstract/Keywords: 'capacity building' AND agric*	277	25	1	9
Total		5,408	275	28	106

[a] The search returned 5,880 hits, but only the first 2,000 most relevant references could be accessed

[b] The search returned 14,360 hits, but only the first 2,000 most relevant references could be accessed

SpringerLINK

SpringerLINK provides citations and full-text access to journals published by Springer. It did not have the option for complex combinations of search terms, which made the searches cumbersome. Sixteen publications were selected out of 2,233 references (excluding duplicates); only abstracts were available for five references (Table A-13).

Table A-13: Search results: SpringerLINK database

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
15 Sept 2011	(All fields: 'graduate training' OR 'higher education qualification' OR 'distance learning' AND agric*) AND [Earth and Environmental Sciences]	36	0	0	0
15 Sept 2011	(All fields: 'graduate training' OR 'higher education qualification' OR 'distance learning' AND agric*) AND [Humanities, Social Sciences and Law]	466	0	0	2
Total professional academic training		*502*	*0*	*0*	*2*
15 Sept 2011	All fields: 'agric* AND research AND training AND capacity AND skills	303	11	4	7
Total skills training		*303*	*11*	*4*	*7*
16 Sept 2011	All fields: 'technical assistance' AND agric* AND impact AND [Earth and Environmental Sciences]	193	0	0	0
16 Sept 2011	All fields: 'technical assistance' AND agric* AND impact AND [Humanities, Social Sciences and Law]	21	1	0	0
16 Sept 2011	All fields: mentoring AND agric* AND impact	20	1	0	0
16 Sept 2011	All fields: 'institutional development' AND agric* AND impact	25	1	0	0
16 Sept 2011	All fields: secondment AND agric* AND impact	0	0	0	0
16 Sept 2011	All fields: attachment AND agric* AND impact AND [Earth and Environmental Sciences]	32	0	0	0
16 Sept 2011	All fields: attachment AND agric* AND impact AND [Humanities, Social Sciences and Law]	83	0	0	0
16 Sept 2011	All fields: 'change management' AND agric* AND impact	30	0	0	0
16 Sept 2011	All fields: 'experiential learning' AND agric* AND impact	21	3	0	0
16 Sept 2011	All fields: 'information systems' AND agric* AND impact AND	235	1	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
	[Earth and Environmental Sciences]				
16 Sept 2011	All fields: 'information systems' AND agric* AND impact AND [Humanities, Social Sciences and Law]	14	1	0	0
Total organisational capacity strengthening		*674*	*8*	*0*	*0*
16 Sept 2011	All fields: 'innovation system*' AND agric*	14	2	1	2
16 Sept 2011	All fields: 'research into use' AND agric*	1	0	0	0
16 Sept 2011	All fields: 'innovation platform' AND agric*	4	0	0	0
16 Sept 2011	All fields: 'farmer field school' AND agric*	26	1	0	1
16 Sept 2011	All fields: 'public private partnership' AND agric*	27	1	0	1
16 Sept 2011	All fields: 'action research' AND agric*	102	8	0	2
16 Sept 2011	All fields: 'national agricultural research system*' AND agric*	9	2	0	0
16 Sept 2011	All fields: 'networks' AND agric* AND capacity AND research AND impact AND Africa* AND [Earth and Environmental Sciences]	251	2	0	0
16 Sept 2011	All fields: 'networks' AND agric* AND capacity AND research AND impact AND Africa* AND [Humanities, Social Sciences and Law]	44	5	0	0
16 Sept 2011	All fields: 'networks' AND agric* AND capacity AND research AND impact AND Asia* AND [Earth and Environmental Sciences]	198	0	0	0
16 Sept 2011	All fields: 'networks' AND agric* AND capacity AND research AND impact AND Asia* AND [Humanities, Social Sciences and Law]	27	3	0	1
16 Sept 2011	All fields: 'networks' AND agric* AND capacity AND research AND impact AND Latin America* AND	71	0	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
	[Earth and Environmental Sciences]				
16 Sept 2011	All fields: 'networks' AND agric* AND capacity AND research AND impact AND Latin America* AND [Humanities, Social Sciences and Law]	26	3	0	0
Total strengthening of agricultural research systems		*800*	*27*	*1*	*7*
Total		2,279	46	5	16

SwetsWise

SwetsWise is a gateway facility that includes all of the University of Greenwich Library Service's electronic journal resources. The SwetsWise database was searched using simple search terms, as the database does not allow complicated search combinations. SwetsWise only searches titles, keywords and abstracts. Out of 462 references (excluding duplicates), 31 publications were selected; only the abstract was available for one reference (Table A-14).

Table A-14: Search results: SwetsWise database

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
06 Dec 2011	'capacity development' AND agric*	16	1	0	0
06 Dec 2011	capacity building AND agric*	188	14	0	11
06 Dec 2011	capacity strengthening AND agric*	28	11	0	1
07 Dec 2011	'technical assistance' AND agric*	70	10	0	1
07 Dec 2011	mentoring AND agric*	1	0	0	1
07 Dec 2011	institutional development AND agric*	30	6	0	1
07 Dec 2011	secondment AND agric*	0	0	0	0
07 Dec 2011	attachment AND agric* AND capacity	3	1	0	0
07 Dec	change management AND agric*	40	5	0	1

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
2011					
07 Dec 2011	experiential learning AND agric*	34	7	0	3
07 Dec 2011	'information systems' AND agric* AND capacity	11	3	0	0
07 Dec 2011	innovation system AND agric*	11	5	0	0
07 Dec 2011	'research into use' AND agric*	19	0	0	0
07 Dec 2011	'innovation platform' AND agric*	11	2	0	1
07 Dec 2011	'farmer field school' AND agric*	33	10	1	11
07 Dec 2011	'public private partnership' AND agric*	12	0	0	0
07 Dec 2011	'action research' AND agric* AND capacity	16	10	0	0
07 Dec 2011	national agricultural research system	0	0	0	0
07 Dec 2011	network AND agric* AND capacity AND research	30	10	0	0
07 Dec 2011	'postgraduate training' AND agric*	2	1	0	0
07 Dec 2011	'graduate training' AND agric*	3	1	0	0
07 Dec 2011	'distance learning' AND agric*	1	0	0	0
07 Dec 2011	'higher education qualification' AND agric*	0	0	0	0
Total		559	97	1	31

Specialist web portals

3IE

3IE is an international initiative for impact evaluation. It funds quality evaluation studies that will have a real policy impact. The publications on the 3IE website (www.3ieimpact.org) were searched by hand. Out of the 196 references, two publications were selected (Table A-15).

Table A-15: Search results: 3IE publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
31 Oct 2011		196	0	0	2

AGRIS

AGRIS is a global public domain database of the FAO with over 2,600,000 structured bibliographical records on agricultural science and technology. The majority of records (82 percent) are citations from scientific journals. AGRIS has limited facilities for combining search terms. Therefore, simpler searches were carried out, making use of more generic search terms. Out of 786 references (excluding duplicates), seven publications were selected; only abstracts were available for another 11 references (Table A-16)

Table A-16: Search results: AGRIS database

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
01 Dec 2011	'capacity development' AND agric*	32	10	0	0
02 Nov 2011	'capacity building' AND agric*	517	55	11	5
02 Nov 2011	'capacity strengthening' AND agric*	62	11	0	1
13 Jan 2012	'technical assistance' AND agric* AND capacity	6	3	0	0
13 Jan 2012	mentoring AND agric*	15	0	0	0
13 Jan 2012	institutional development AND agric*	37	5	0	0
13 Jan 2012	secondment AND agric*	2	0	0	0
13 Jan 2012	attachment AND agric* AND capacity	8	0	0	0
13 Jan 2012	change management AND agric*	7	0	0	0
13 Jan 2012	experiential learning AND agric*	28	0	0	0
13 Jan 2012	'information systems' AND agric* AND capacity	36	10	0	0
13 Jan	innovation system AND agric*	16	2	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
2012					
13 Jan 2012	'research into use' AND agric*	22	2	0	0
13 Jan 2012	'innovation platform' AND agric*	2	2	0	0
13 Jan 2012	'farmer field school' AND agric* AND capacity	4	2	0	1
13 Jan 2012	'public private partnership' AND agric*	14	3	0	0
13 Jan 2012	'action research' AND agric* AND capacity	1	1	0	0
13 Jan 2012	national agricultural research system	36	2	0	0
13 Jan 2012	network AND agric* AND capacity AND research	45	19	0	0
13 Jan 2012	'postgraduate training' AND agric*	6	0	0	0
13 Jan 2012	'graduate training' AND agric*	6	2	0	0
13 Jan 2012	'distance learning' AND agric*	17	4	0	0
13 Jan 2012	'higher education qualification' AND agric*	0	0	0	0
Total		919	133	11	7

ASTI

The Agricultural Science and Technology Indicators (ASTI) initiative compiles, analyses and publicises data on institutional developments, investments and capacity in agricultural Research and Development. The publications on the ASTI website (www.asti.cgiar.org) were searched by hand. Four publications were selected out of 36 references (Table A-17).

Table A-17: Search results: ASTI publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
28 Oct 2011		36	2	0	4

CGIAR

The CGIAR virtual library (vlibrary.cgiar.org) gives access to the online libraries of the Consultative Group on International Agricultural Research (CGIAR). Searches were also carried out in CG books. The CGIAR specialises in agriculture in developing countries, and therefore different sets of search terms were used. Forty-two publications were selected out of 1,368 references (excluding duplicates); only abstracts were available for another 28 references (Table A-18).

Table A-18: Search results: CGIAR virtual library

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
03 Nov 2011	CG libraries: 'capacity development' [b]	32	7	4	4
03 Nov 2011	CG libraries: 'capacity building' [a]	212	7	15	17
03 Nov 2011	CG libraries: 'capacity strengthening'	90	1	4	3
17 Jan 2012	CG libraries: 'technical assistance'	34	1	0	0
17 Jan 2012	CG libraries: mentoring	2	1	0	0
17 Jan 2012	CG libraries: institutional development	38	11	0	1
17 Jan 2012	CG libraries: secondment AND capacity	0	0	0	0
17 Jan 2012	CG libraries: attachment AND capacity	0	0	0	0
17 Jan 2012	CG libraries: 'change management'	37	1	0	0
17 Jan 2012	CG libraries: 'experiential learning'	6	0	0	0
17 Jan 2012	CG libraries: 'information systems' AND capacity	3	2	0	0
17 Jan 2012	CG libraries: 'innovation system'	4	2	0	0
17 Jan 2012	'research into use'				
17 Jan 2012	CG libraries: 'innovation platform'	0	0	0	0
17 Jan 2012	CG libraries: 'farmer field school'	24	3	4	1
17 Jan 2012	CG libraries: 'public private partnership'	7	0	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
17 Jan 2012	CG libraries: 'action research' AND capacity	1	0	0	0
17 Jan 2012	CG libraries: 'national agricultural research system' AND capacity	14	0	0	0
17 Jan 2012	CG libraries: network AND capacity	16	0	0	0
17 Jan 2012	CG libraries: 'postgraduate training'	13	1	0	0
17 Jan 2012	CG libraries: 'graduate training'	12	1	0	0
17 Jan 2012	CG libraries: 'distance learning'	6	1	0	0
17 Jan 2012	CG libraries: 'higher education qualification'	0	0	0	0
11 Nov 2011	CG books: 'capacity development'	467	266	0	2
03 Nov 2011	CG books: 'capacity building'	464	106	1	10
03 Nov 2011	CG books: 'capacity strengthening'	297	0	0	4
Total		1,779	411	28	42

[a] The libraries of IRRI and IWMI were not available

[b] The libraries of IRRI, IWMI, and ICRISAT were not available

Eldis

The Eldis portal contains editorially selected content from over 7,500 development organisations. Eldis has limited facilities for combining search terms. Therefore, simpler searches were carried out, making use of more generic search terms, and fixed terms given by the portal. Twelve publications were selected out of 547 references (excluding duplicates); only abstracts were available for another seven references (Table A-19).

Table A-19: Search results: Eldis portal

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: natural resource management]	76	33	1	1

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: biotechnology]	34	17	0	0
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: environmental policies and management]	18	13	0	2
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: inputs]	17	10	0	0
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: international cooperation for development]	108	60	0	1
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: rural development]	31	17	0	0
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: technology and innovation]	59	53	0	1
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: agricultural networking]	5	4	0	1
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: agroforestry]	8	6	0	0
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: communication, training and extension]	27	19	0	1
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: environmental protection and natural resource management]	66	43	0	1
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: institutions and policy processes]	22	19	0	0
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: market oriented production and trade]	41	31	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: strengthening economic planning and analysis]	59	58	0	0
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: agricultural markets and marketing]	12	11	0	0
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: agricultural policy]	90	77	0	0
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: animal production and health]	30	12	0	0
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: crop production, seeds and fertilizers]	21	21	0	0
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: extension]	28	27	0	0
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: farmer participation in research]	14	14	0	0
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: indigenous knowledge]	12	12	0	0
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: pastoralism]	45	36	0	0
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: role of agriculture in development]	19	16	0	0
29 Jul 2011	'capacity development' AND [category: agriculture] AND [sub-category: structural adjustment policies]	29	16	0	0
29 Jul 2011	'capacity building' AND [category: agriculture]	302	1	6	4
Total		1,173	626	7	12

NEPAD

NEPAD, the New Partnership for Africa's Development, is a programme of the African Union that aims to enhance Africa's growth, development and participation in the global economy. The Comprehensive Africa Agriculture Development Programme (CAADP) was established as part of NEPAD in July 2003 and focuses on improving and promoting agriculture across Africa. CAADP publications (i.e. CAADP reports, non-CAADP documents, pillar 1-4 documents and case studies) were searched by hand to find relevant references. Out of the 116 references, none were considered to be relevant for the systematic review (Table A-20).

Table A-20: Search results: NEPAD-CAADP publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
10 Nov 2011		116	26	0	0

R4D

Research4Development (R4D) is the portal to DFID centrally funded research. The R4D database was searched using simple search terms as the database does not allow complicated search combinations. Out of 449 references (excluding duplicates), seven publications were selected (Table A-21).

Table A-21: Search results: R4D database

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
30 Nov 2011	capacity development AND agric* AND [publication type: documents]	99	0	0	3
30 Nov 2011	capacity building AND agric* AND [record type: documents]	55	36	0	0
30 Nov 2011	capacity strengthening AND agric* AND [record type: documents]	17	15	0	0
01 Dec 2011	technical assistance AND agric* AND [record type: documents]	5	1	0	0
01 Dec 2011	mentoring AND agric* AND [record type: documents]	2	2	0	0
01 Dec 2011	Institutional development AND agric* AND [record type: documents]	74	19	0	1
01 Dec 2011	secondment AND [record type: documents]	2	0	0	0
01 Dec 2011	attachment AND agric* AND	1	0	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
	[record type: documents]				
01 Dec 2011	change management AND agric* AND [record type: documents]	57	14	0	1
01 Dec 2011	experiential learning AND agric* AND [record type: documents]	3	1	0	1
01 Dec 2011	Information system AND agric* AND [record type: documents]	44	16	0	0
01 Dec 2011	innovation system AND agric* AND [record type: documents]	30	15	0	0
01 Dec 2011	research into use AND [record type: documents]	51	4	0	0
01 Dec 2011	Innovation platform* AND agric* AND [record type: documents]	7	3	0	0
01 Dec 2011	farmer field school AND [record type: documents]	26	0	0	0
02 Dec 2011	public private partnership AND agric* AND [record type: documents]	5	5	0	0
02 Dec 2011	action research AND agric* AND [record type: documents]	51	21	0	0
02 Dec 2011	national agricultural research system AND [record type: documents]	33	22	0	0
02 Dec 2011	network AND agric* AND [record type: documents]	61	3	0	1
02 Dec 2011	'postgraduate training' AND [record type: documents]	0	0	0	0
02 Dec 2011	'graduate training' AND [record type: documents]	2	0	0	0
02 Dec 2011	'distance learning' AND agric* AND [record type: documents]	1	0	0	0
02 Dec 2011	'higher education qualification' AND [record type: documents]	0	0	0	0
Total		626	177	0	7

RIU

The Research Into Use (RIU) programme, funded by DFID, aims to accumulate and evaluate evidence to shape and share lessons on how best to enable innovation in the agricultural sector so as to achieve social and economic gains in diverse developing country settings. The RIU publications (discussion papers, practice notes

and final publications) were searched by hand. Six publications were selected out of 54 references (Table A-22).

Table A-22: Search results: RIU publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
05 Dec 2011		54	0	0	6

RUFORUM

The Regional Universities Forum for Capacity Building in Agriculture (RUFORUM: www.ruforum.org) is a consortium of 29 universities in Eastern, Central and Southern Africa, established in 2004. It has a mandate to oversee graduate training and networks of specialisation in the Common Market for Eastern and Southern Africa (COMESA) countries. RUFORUM publications were searched by hand, but no publications were selected (Table A-23).

Table A-23: Search results: RUFORUM publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
05 Dec 2011	[RUFORUM publications]	11	0	0	0
05 Dec 2011	[literature on higher education]	13	0	0	0
05 Dec 2011	[proceedings from conferences and workshops]	7	0	0	0
05 Dec 2011	[RUFORUM policy documents]	11	0	0	0
Total		42	0	0	0

Search4Dev

Search4Dev (www.search4dev.nl) is an online library for digital documents from Dutch development organisations. The search4dev database was searched using simple search terms as the database does not allow complicated search combinations. Out of the 60 references (excluding duplicates), only one publication was selected (Table A-24).

Table A-24: Search results: Search4Dev database

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
04 Nov 2011	capacity development AND agric*	5	4	0	0
29 Jul 2011	capacity building AND agric*	31	1	0	0
04 Nov 2011	capacity strengthening	6	0	0	0
05 Dec 2011	technical assistance AND agric*	0	0	0	0
05 Dec 2011	mentoring AND agric*	0	0	0	0
05 Dec 2011	institutional development AND agric*	0	0	0	0
05 Dec 2011	secondment AND agric*	0	0	0	0
05 Dec 2011	attachment AND agric*	0	0	0	0
05 Dec 2011	change management AND agric*	0	0	0	0
05 Dec 2011	experiential learning AND agric*	0	0	0	0
05 Dec 2011	information system AND agric*	1	0	0	0
05 Dec 2011	innovation system AND agric*	0	0	0	0
05 Dec 2011	research into use AND agric*	0	0	0	0
05 Dec 2011	innovation platform AND agric*	0	0	0	0
05 Dec 2011	farmer field school	0	0	0	0
05 Dec 2011	public private partnership AND agric*	1	0	0	0
05 Dec 2011	action research AND agric*	0	0	0	0
05 Dec 2011	national agricultural research system	0	0	0	0
05 Dec 2011	network AND agric*	21	0	0	1
05 Dec	postgraduate training AND agric*	0	0	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
2011					
05 Dec 2011	graduate training AND agric*	0	0	0	0
05 Dec 2011	distance learning AND agric*	0	0	0	0
05 Dec 2011	higher education qualification AND agric*	0	0	0	0
Total		65	5	0	1

Donor web pages

ACIAR

The ACIAR is the Australian Centre for International Agricultural Research (aciar.gov.au), which operates as part of the Australian government. The ACIAR database was searched using simple search terms as the database does not allow complicated search combinations. The database did not recognise the search term 'agric*', and therefore the term 'agriculture' was used instead. Out of 150 references (excluding duplicates) four publications were selected (Table A-25).

Table A-25: Search results: ACIAR publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
23 Nov 2011	'capacity development' AND agriculture AND research AND [publication type: impact]	6	6	0	0
23 Nov 2011	'capacity development' AND agriculture AND research AND [publication type: final reports]	2	2	0	0
23 Nov 2011	'capacity development' AND agriculture AND research AND [publication type: science]	0	0	0	0
18 Nov 2011	'capacity building' AND agriculture AND research AND [publication type: impact]	35	0	0	2
18 Nov 2011	'capacity building' AND agriculture AND research AND [publication type: final reports]	24	0	0	1
18 Nov 2011	'capacity building' AND agriculture AND research AND [publication type: science]	15	0	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
23 Nov 2011	'capacity strengthening'	5	0	0	0
23 Nov 2011	technical assistance OR mentoring OR 'institutional development' OR secondment OR attachment OR 'change management' OR 'experiential learning' OR 'information systems'	17	4	0	0
23 Nov 2011	'innovation system' OR 'research into use' OR 'innovation platform' OR 'farmer field school' OR 'public-private partnership' OR 'action research' OR 'national agricultural research system' OR network AND [publication type: impact]	23	19	0	1
23 Nov 2011	'innovation system' OR 'research into use' OR 'innovation platform' OR 'farmer field school' OR 'public-private partnership' OR 'action research' OR 'national agricultural research system' OR network AND [publication type: final reports]	31	14	0	0
23 Nov 2011	'innovation system' OR 'research into use' OR 'innovation platform' OR 'farmer field school' OR 'public-private partnership' OR 'action research' OR 'national agricultural research system' OR network AND [publication type: science]	41	10	0	0
	'postgraduate training' OR 'graduate training' OR 'distance learning' OR 'higher education qualification' AND publication type	9	3	0	0
Total		208	58	0	4

African Development Bank

The African Development Bank (www.afdb.org) is a regional multilateral development bank, engaged in promoting the economic development and social progress of its regional member countries. The AfDB publications were searched using fixed search terms. Only two publications out of 343 references were selected (Table A-26).

Table A-26: Search results: AfDB publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
24 Nov 2011	[Evaluation reports: agriculture and agro-industries]	83	0	0	0
24 Nov 2011	[Evaluation reports: higher education, science and technology]	0	0	0	0
24 Nov 2011	[Evaluation reports: NEPAD]	0	0	0	0
24 Nov 2011	[Publications: agriculture and agro-industries]	6	0	0	0
24 Nov 2011	[Publications: higher education, science and technology]	0	0	0	0
24 Nov 2011	[Publications: NEPAD]	0	0	0	0
24 Nov 2011	[Project and operations: agriculture and agro-industries]	245	0	0	2
24 Nov 2011	[Project and operations: higher education, science and technology]	0	0	0	0
24 Nov 2011	[Project and operations: NEPAD]	9	0	0	0
Total		343	0	0	2

AusAID

AusAID is the Australian Government Overseas Program (www.ausaid.gov.au). The AusAID reports were searched by hand. Five publications out of 240 references (excluding duplicates) were selected (Table A-27).

Table A-27: Search results: AusAID publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
11 Jan 2012	[evaluation reports]	108	0	0	3
11 Jan 2012	[research]	116	18	0	2
11 Jan 2012	[policy documents]	38	4	0	0
Total		262	22	0	5

DANIDA

DANIDA is the Danish government agency responsible for development co-operation. The DANIDA publications (www.danida-publikationer.dk) were searched using limited search terms because the database does not allow complex search combinations. Only one publication was selected out of 23 references (Table A-28).

Table A-28: Search results: DANIDA publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
17 Nov 2011	'capacity development' AND agric*	1	0	0	1
17 Nov 2011	'capacity building' AND agric*	0	0	0	0
17 Nov 2011	'capacity strengthening' AND agric*	0	0	0	0
17 Nov 2011	capacity	22	0	0	0
Total		23	0	0	1

DFID

The Department for International Development (www.dfid.gov.uk) is the UK government department responsible for promoting development and the reduction of poverty. DFID publications were searched using limited search terms because the database does not allow complex search combinations (www.dfid.gov.uk/what-we-do/publications/). The 277 references (excluding duplicates) did not include any relevant publications (Table A-29).

Table A-29: Search results: DFID publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
17 Nov 2011	'capacity development'	0	0	0	0
17 Nov 2011	'capacity building'	0	0	0	0
17 Nov 2011	'capacity strengthening'	0	0	0	0
28 Nov 2011	capacity	4	0	0	0
28 Nov 2011	category: [archived evaluation studies]	275	2	0	0
Total		279	2	0	0

DGIS

The Netherlands Directorate-General for International Cooperation (DGIS) is responsible for development co-operation policy, its co-ordination, implementation and funding (www.minbuza.nl). Three publications out of 171 references (excluding duplicates) were selected (Table A-30).

Table A-30: Search results: DGIS publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
11 Jan 2012	[evaluation reports] AND capacity	11	0	0	3
11 Jan 2012	[evaluation reports]	161	1	0	0
Total		172	1	0	3

FAO

The Food and Agriculture Organization (www.fao.org) is a specialised agency of the United Nations with a mandate to achieve food security for all by raising levels of nutrition, improving agricultural productivity, bettering the lives of rural populations and contributing to the growth of the world economy. The FAO publications were searched using simple search terms because the database does not allow complex search combinations. Out of 207 references (excluding duplicates), three publications were selected (Table A-31).

Table A-31: Search results: FAO publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
28 Nov 2011	FAO Corporate Document Repository: capacity development	23	0	0	0
28 Nov 2011	FAO Corporate Document Repository: capacity building	20	19	0	0
28 Nov 2011	FAO Corporate Document Repository: capacity strengthening	20	19	0	0
28 Nov 2011	FAO Corporate Document Repository: technical assistance OR mentoring OR 'institutional development' OR secondment OR attachment OR 'change management' OR 'experiential learning' OR 'information systems'	22	22	0	0
28 Nov	FAO Corporate Document	22	18	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
2011	Repository: 'innovation system' OR 'research into use' OR 'innovation platform' OR 'farmer field school' OR 'public-private partnership' OR 'action research' OR 'national agricultural research system' OR network				
28 Nov 2011	FAO Corporate Document Repository: postgraduate training OR graduate training	22	13	0	0
28 Nov 2011	FAO Corporate Document Repository: distance learning	22	7	0	0
28 Nov 2011	FAO Corporate Document Repository: 'higher education qualification'	0	0	0	0
28 Nov 2011	FAO Technical Cooperation Department/publications: capacity	13	0	0	0
28 Nov 2011	FAO catalogue: capacity development	2	0	0	0
28 Nov 2011	FAO catalogue: capacity building	4	0	0	0
28 Nov 2011	FAO catalogue: capacity strengthening	3	2	0	0
28 Nov 2011	FAO catalogue: technical assistance	0	0	0	0
28 Nov 2011	FAO catalogue: mentoring	0	0	0	0
28 Nov 2011	FAO catalogue: institutional development	1	0	0	0
28 Nov 2011	FAO catalogue: secondment	0	0	0	0
28 Nov 2011	FAO catalogue: attachment	0	0	0	0
28 Nov 2011	FAO catalogue: change management	1	0	0	0
28 Nov 2011	FAO catalogue: experiential learning	0	0	0	0
28 Nov 2011	FAO catalogue: information system	2	0	0	0
28 Nov	FAO catalogue: innovation system	0	0	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
2011					
28 Nov 2011	FAO catalogue: research into use	0	0	0	0
28 Nov 2011	FAO catalogue: innovation platform	0	0	0	0
28 Nov 2011	FAO catalogue: farmer field school	0	0	0	0
28 Nov 2011	FAO catalogue: public private partnership	0	0	0	0
28 Nov 2011	FAO catalogue: action research	0	0	0	0
28 Nov 2011	FAO catalogue: national agricultural research system	0	0	0	0
28 Nov 2011	FAO catalogue: network	5	0	0	0
28 Nov 2011	FAO catalogue: postgraduate training	5	1	0	0
28 Nov 2011	FAO catalogue: graduate training	21	1	0	0
28 Nov 2011	FAO catalogue: distance learning	29	1	0	0
28 Nov 2011	FAO catalogue: higher education qualification	0	0	0	0
28 Nov 2011	FAO capacity development network: [good practices case study series]	17	0	0	2
28 Nov 2011	FAO capacity development portal: [learning resources	56	0	0	1
Total		310	103	0	3

FARA

FARA is the Forum for Agricultural Research in Africa (www.fara-africa.org), an umbrella organisation bringing together and forming coalitions of major stakeholders in agricultural research and development in Africa. Searches were carried out in the FARA online library using limited search terms. Two publications were selected out of 12 references (Table A-32).

Table A-32: Search results: FARA online library

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
09 Nov 2011	'capacity development'	2	0	0	1
09 Nov 2011	'capacity building'	0	0	0	0
09 Nov 2011	'capacity strengthening'	10	0	0	1
Total		12	0	0	2

IDRC

The International Development Research Centre is a public corporation created by the Canadian government that supports research in developing countries to promote growth and development. The IDRC publications were searched using simple search terms because the database does not allow complex search combinations. Out of 202 references (excluding duplicates), three publications were selected (Table A-33).

Table A-33: Search results: IDRC publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
28 Nov 2011	capacity development	18	0	0	1
28 Nov 2011	capacity building	47	0	0	2
28 Nov 2011	capacity strengthening	3	0	0	0
28 Nov 2011	technical assistance	10	1	0	0
28 Nov 2011	mentoring	15	3	0	0
28 Nov 2011	institutional development	1	0	0	0
28 Nov 2011	secondment	2	0	0	0
28 Nov 2011	attachment	1	0	0	0
28 Nov 2011	change management	0	0	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
28 Nov 2011	experiential learning	1	0	0	0
28 Nov 2011	information system	26	2	0	0
28 Nov 2011	innovation system	6	2	0	0
28 Nov 2011	research into use	1	1	0	0
28 Nov 2011	innovation platform	0	0	0	0
28 Nov 2011	farmer field school	3	0	0	0
28 Nov 2011	public private partnership	4	2	0	0
28 Nov 2011	action research	39	8	0	0
28 Nov 2011	national agricultural research system	2	0	0	0
28 Nov 2011	network AND research	44	8	0	0
28 Nov 2011	postgraduate training	0	0	0	0
28 Nov 2011	graduate training	2	1	0	0
28 Nov 2011	distance learning	6	1	0	0
28 Nov 2011	higher education qualification	0	0	0	0
Total		231	29	0	3

NORAD

The Norwegian Agency for Development Cooperation (www.norad.no) is a specialised directorate under the Ministry of Foreign Affairs. NORAD's publications were searched by hand using limited simple or fixed search terms. Four publications were selected out of 152 references (Table A-34).

Table A-34: Search results: NORAD publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
25 Nov 2011	[joint evaluations]	27	0	0	0
25 Nov 2011	capacity AND [evaluation reports]	22	0	0	3
25 Nov 2011	[evaluation studies]	16	0	0	0
25 Nov 2011	capacity AND [NORAD collected reviews]	72	0	0	1
25 Nov 2011	capacity AND [NORAD report: synthesis reports]	15	0	0	0
Total		152	0	0	4

SDC

The Swiss Agency for Development and Cooperation (www.sdc.admin.ch) is Switzerland's international co-operation agency within the Federal Department of Foreign Affairs (FDFA). The SDC publications were searched using simple search terms because the database does not allow complex search combinations. No publications were selected out of the 35 references (Table A-35).

Table A-35: Search results: SDC publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
29 Nov 2011	capacity development AND [publications]	1	0	0	0
29 Nov 2011	capacity building AND [publications]	0	0	0	0
29 Nov 2011	capacity strengthening AND [publications]	0	0	0	0
29 Nov 2011	technical assistance AND [publications]	3	0	0	0
29 Nov 2011	mentoring AND [publications]	0	0	0	0
29 Nov 2011	institutional development AND [publications]	0	0	0	0
29 Nov 2011	secondment AND [publications]	0	0	0	0
29 Nov	attachment AND [publications]	0	0	0	0

2011					
29 Nov 2011	change management AND [publications]	0	0	0	0
29 Nov 2011	experiential learning AND [publications]	0	0	0	0
29 Nov 2011	information system AND [publications]	0	0	0	0
29 Nov 2011	innovation system AND [publications]	0	0	0	0
29 Nov 2011	research into use AND [publications]	0	0	0	0
29 Nov 2011	innovation platform AND [publications]	0	0	0	0
29 Nov 2011	farmer field school AND [publications]	0	0	0	0
29 Nov 2011	public private partnership AND [publications]	0	0	0	0
29 Nov 2011	action research AND [publications]	0	0	0	0
29 Nov 2011	national agricultural research system AND [publications]	0	0	0	0
29 Nov 2011	network AND [publications]	0	0	0	0
29 Nov 2011	postgraduate training AND [publications]	0	0	0	0
29 Nov 2011	graduate training AND [publications]	0	0	0	0
29 Nov 2011	distance learning AND [publications]	0	0	0	0
29 Nov 2011	higher education qualification AND [publications]	0	0	0	0
29 Nov 2011	[evaluations]	31	0	0	0
Total		35	0	0	0

Sida

The Swedish International Development Cooperation Agency (www.sida.se) is a Swedish government agency that is responsible for development assistance. The Sida publications were searched using simple search terms because the database does not allow complex search combinations. Nineteen publications out of the 327 references (excluding duplicates) were selected; for one more publication, only the abstract was available (Table A-36).

Table A-36: Search results: Sida publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
29 Nov 2011	capacity development	110	0	0	8
29 Nov 2011	capacity building	86	40	0	7
29 Nov 2011	capacity strengthening	21	14	0	1
29 Nov 2011	technical assistance	32	8	0	0
29 Nov 2011	mentoring	0	0	0	0
29 Nov 2011	institutional development	69	19	0	1
29 Nov 2011	secondment	0	0	0	0
29 Nov 2011	attachment	1	0	0	0
29 Nov 2011	change management	17	4	0	0
29 Nov 2011	experiential learning	0	0	0	0
29 Nov 2011	information system	23	2	0	0
29 Nov 2011	innovation system	5	2	0	0
29 Nov 2011	research into use	4	1	0	1
29 Nov 2011	innovation platform	0	0	0	0
29 Nov 2011	farmer field school	0	0	0	0
29 Nov 2011	public private partnership	2	0	0	0
29 Nov 2011	action research	10	4	0	0
29 Nov 2011	national agricultural research system	1	0	0	1
29 Nov 2011	network	62	23	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
29 Nov 2011	postgraduate training	0	0	0	0
29 Nov 2011	graduate training	1	0	0	0
29 Nov 2011	distance learning	0	0	0	0
29 Nov 2011	higher education qualification	0	0	0	0
29 Nov 2011	[evaluations]	31	0	0	0
Total		475	117	0	19

UNDP

The United Nations Development Programme (www.beta.undp.org) is the United Nation's global development network, an organisation advocating for change and connecting countries to knowledge, experience and resources. The UNDP publications were searched using simple search terms because the database does not allow complex search combinations. Despite the 141 references (excluding duplicates), no publications were selected (Table A-37).

Table A-37: Search results: UNDP publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
30 Nov 2011	[capacity development]	14	0	0	0
30 Nov 2011	capacity development AND agriculture	3	0	0	0
30 Nov 2011	capacity building	25	1	0	0
30 Nov 2011	capacity strengthening	12	4	0	0
30 Nov 2011	technical assistance	7	1	0	0
30 Nov 2011	mentoring	1	0	0	0
30 Nov 2011	institutional development	24	6	0	0
30 Nov 2011	secondment	0	0	0	0

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
30 Nov 2011	attachment	0	0	0	0
30 Nov 2011	change management	36	6	0	0
30 Nov 2011	experiential learning	0	0	0	0
30 Nov 2011	information system	7	0	0	0
30 Nov 2011	innovation system	1	0	0	0
30 Nov 2011	research into use	0	0	0	0
30 Nov 2011	innovation platform	0	0	0	0
30 Nov 2011	farmer field school	0	0	0	0
30 Nov 2011	public private partnership	3	0	0	0
30 Nov 2011	action research	18	1	0	0
30 Nov 2011	national agricultural research system	0	0	0	0
30 Nov 2011	network	12	3	0	0
30 Nov 2011	postgraduate training	0	0	0	0
30 Nov 2011	graduate training	0	0	0	0
30 Nov 2011	distance learning	0	0	0	0
30 Nov 2011	higher education qualification	0	0	0	0
Total		163	22	0	0

USAID

USAID is the US government agency (www.usaid.gov) providing economic and humanitarian assistance worldwide. The USAID publications were searched using limited search terms because the database does not allow complex search combinations. Fifteen publications were selected out of 390 references (excluding duplicates); only abstracts were available for another two references (Table A-38).

Table A-38: Search results: USAID publications

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
17 Nov 2011	capacity development AND [categories: agriculture, development assistance, human capacity, science and technology]	101	3	2	5
17 Nov 2011	capacity building AND [categories: agriculture, development assistance, human capacity, science and technology]	135	25	0	7
17 Nov 2011	capacity strengthening AND [categories: agriculture, development assistance, human capacity, science and technology]	94	20	0	0
17 Nov 2011	institutional development AND [categories: agriculture, development assistance, human capacity, science and technology]	119	11	0	3
Total		449	59	2	15

World Bank

The World Bank provides financial and technical assistance to developing countries. The World Bank E-library (elibrary.worldbank.org) was searched using simple search terms as the database does not allow complicated search combinations. Two publications were selected out of 523 references (excluding duplicates); for three references only abstracts were available (Table A-39).

Table A-39: Search results: World Bank e-library

Date	Search terms	Hits	Duplicates	Selected references	
				Abstracts only	Full text
09 Nov 2011	Full text: 'capacity development' AND agric*	97	61	0	0
09 Nov 2011	Full text: 'capacity building' AND agric*	479	0	3	2
09 Nov 2011	Full text: 'capacity strengthening' AND agric*	11	3	0	0
Total		587	64	3	2

Appendix 3: Selected publications for systematic review

The abstracts of the selected references from the literature search (Appendix 2) were screened independently by two reviewers in order to select the publications to be included in the systematic review. In case of disagreement, the full text was analysed to come to a final decision on inclusion or exclusion of the publication. Below the selected publications are listed by database.

Online search engines

Africana Periodical Literature
A total of three references were selected during the literature search. One duplicate was removed after screening the abstracts and full text of the references; no publications were selected for the systematic review.

AgEcon
A total of 19 references were selected during the literature search. Five duplicates were removed after screening the abstracts and full text of the references. Four publications were selected for the systematic review: Brennan and Quade (2004), Howes (1992), Jamora *et al*. (2011) and Spielman *et al*. (2007a).

AJOL
Only one reference was selected during the literature search, but after screening the abstract and full text the publication was not selected.

EBSCO
A total of 459 references were selected during the literature search. Four duplicates were removed after screening the abstracts and full text of the references; 14 publications were selected for the systematic review:

Anderson *et al*. (2004); Ayele and Wield (2005): Badu-Apraku *et al*. (2004a, b); Beye (2002); Eley *et al*. (2003); Low *et al*. (2001); Mackay *et al*. (1998); Nyirenda and Tostensen (2005); Oloruntoba (2002a, b); Patel and Woomer (2000); Ryan *et al*. (2007); Ynalvez and Shrum (2009).

IBSS
A total of 20 references were selected during the literature search. Fifteen duplicates were removed after screening the abstracts and full text of the references; no publications were selected for the systematic review

IDEAS
A total of 13 references were selected during the literature search. Eleven duplicates were removed after screening the abstracts and full text of the references. One publication was selected for the systematic review: Spielman *et al*. (2007b).

Ingenta Connect
A total of 14 references were selected during the literature search. Nine duplicates were removed after screening the abstracts and full text of the references; no publication was selected for the systematic review.

JSTOR
A total of eight references were selected during the literature search. After screening the abstracts and full text of the references, no publication was selected for the systematic review.

SciVerse SCOPUS
A total of 134 references were selected during the literature search. Thirty duplicates were removed after screening the abstracts and full text of the references; seven publications were selected for the systematic review: Hagmann

et al. (2002); Horton *et al*. (2010); Madzudzo (2011); Ortiz *et al*. (2008); Spielman *et al*. (2010); Vandergeest *et al*. (2003); Wanjiku *et al*. (2010).

SpringerLink
A total of 21 references were selected during the literature search. Four duplicates were removed after screening the abstracts and full text of the references; no publications were selected for the systematic review.

SwetsWise
A total of 32 references were selected during the literature search. Seventeen duplicates were removed after screening the abstracts and full text of the references; only two publications were selected for the systematic review after screening the abstracts and full text of the references: Brennan and Quade (2006); Clark *et al*. (2003).

Specialist web portals

3IE
Only two references were selected during the literature search. After screening the abstracts and full text of the references, no publications were selected for the systematic review.

AGRIS
A total of 18 references were selected during the literature search. One duplicate was removed after screening the abstracts and full text of the references; only one publication was selected for the systematic review: Percy (2002).

ASTI
Four references were selected during the literature search. After screening the abstracts and full text of the references, no publications were selected for the systematic review.

CGIAR
A total of 70 references were selected during the literature search. Six duplicates were removed after screening the abstracts and full text of the references; thirteen publications were selected for the systematic review: Babu *et al*. (2007); Bennett-Lartey *et al*. (2003a); Campilan *et al*. (2009); Cooksy and Arellano (2006); Eley *et al*. (2002); Horton (1999); Njuki *et al*. (2006); Paul *et al*. (1996); Pray (2006); Rao and Abeywickrema (1992); Ryan (1999); Stern *et al*. (2006); Vernooy *et al*. (2009).

Eldis
A total of 19 references were selected during the literature search. After screening the abstracts and full text of the references, three publications were selected for the systematic review: Baur and Kradi (2001); Bennett-Lartey *et al*. (2003b); Hartwich *et al*. (2007).

R4D
A total of seven references were selected during the literature search. After screening the abstracts and full text of the references, only one publication was selected for the systematic review: Almond and Kisauzi (2005).

RIU
A total of six references were selected during the literature search. After screening the abstracts and full text of the references, only two publications were selected for the systematic review: Dijkman (2010); Ugbe (2010).

Search4Dev
Only one reference was selected during the literature search. After screening the abstract and full text, this publication was not selected for the systematic review.

Donor web pages

ACIAR
Four references were selected during the literature search. After screening the abstracts and full text of the references, three publications were selected for the systematic review: Fisher and Gordon (2008); Longmore *et al*. (2007); Mauldon (1998).

African Development Bank
Two references were selected during the literature search. After screening the abstracts and full text of the references, one publication was selected for the systematic review: OSAN (2009).

AusAID
Five references were selected during the literature search. After screening the abstracts and full text of the references, no publications were selected for the systematic review.

DANIDA
Only one reference was selected during the literature search. After screening the abstract and full text, this publication was not selected for the systematic review.

DGIS
Three references were selected during the literature search. After screening the abstracts and full text of the references, one publication was selected for the systematic review: Snelder (2010).

FAO
Only three references were selected during the literature search. One duplicate was removed after screening the abstracts and full text of the references; no publication was selected for the systematic review.

FARA
Two references were selected during the literature search. After screening the abstracts and full text of the references, no publications were selected for the systematic review.

IDRC
A total of three references were selected during the literature search. After screening the abstracts and full text of the references, no publication was selected for the systematic review.

NORAD
Four references were selected during the literature search. After screening the abstracts and full text of the references, three publications were selected for the systematic review: Berg (1998); NORAD (2009); Nyirenda and Tostensen (2009).

Sida
A total of 19 references were selected during the literature search. After screening the abstracts and full text of the references, 11 publications were selected for the systematic review: Alberts *et al*. (2003); Carlsson and Wohlgemuth (1996); Eduards *et al*. (2007); Fones-Sundell and Teklehaimanot (2007); Forss (2002); Freeman *et al*. (2010); Freudenthal (2009); Hydén (2006); Morris and Louwaars (2004); Tengnäs *et al*. (2005). Thulstrup *et al*. (2006).

USAID
A total of 17 references were selected during the literature search. After screening the abstracts and full text of the references, three publications were selected for the systematic review: Horton *et al*. (2000); Mackay and Horton (2002); USAID (1995).

World Bank

Five references were selected during the literature search. After screening the abstracts and full text of the references, no publication was selected for the systematic review.

Contacts

The following reports were obtained through contacts who work in the field of capacity strengthening: Gaillard and Zink (2003); Gaillard *et al*. (2002); Robson (2010).

Appendix 4: Data extraction template

1.1	Database code	
1.2	Title	
1.3	Author(s)	
1.4	Year of publication	
1.5	Publication details[1]	
1.6	Language	
1.7	Data extraction done by	
1.8	Date of data extraction	

[1] Other details of publication: e.g. journal title, volume, issue, pages; book publisher.

Description of capacity strengthening programme

2.1 Name of capacity strengthening programme (if known): .....

2.2 Region(s) where programme took place (tick boxes):

	sub-Saharan Africa
	South-East Asia
	Latin America
	Other (specify):

2.3 Developing countries where programme took place: .....

2.4 Developed countries involved in programme implementation: .....

2.5 Financial backing for the programme comes from (tick boxes – if joint funding tick multiple boxes):

	Unclear/unspecified
	Donor (specify):
	Government (specify):
	NGO (specify):
	Private sector (specify):
	Other (specify):

2.6 Technical backstopping for the programme comes from (tick boxes):

	Unclear/unspecified
	International research institute (specify):

	University (specify):
	NGO (specify):
	Other (specify):

2.7 Capacity strengthening target (tick boxes):

	Higher education institutes (e.g. universities)
	National agricultural research institutes
	Extension services
	Local NGOs
	Private sector
	Farmers
	Entire innovation system
	Other (specify):

2.8 Key elements of capacity strengthening programme (tick boxes):

	Professional training (graduate and postgraduate qualification)
	Skills training (e.g. management, research skills)
	Vocational training
	Technical assistance/secondment/attachment/exchange
	Mentoring
	Public-private partnership
	Institutional development
	Upgrading information systems/(ICT) infrastructure
	Innovation platforms
	Farmer field schools
	Other (specify):

2.9 Timeline of capacity strengthening programme:

Start date of programme: .....

End date of programme: .....

2.10 Detailed description of programme activities (what has been done, how, when, etc.):

2.11 Detailed description of beneficiaries (who were the beneficiaries, how many, gender, age group, job role, etc.):

2.12 Total project costs

Description of programme evaluation (methodology)

3.1 Evaluators (tick boxes):

	External evaluation of programme
	Internal evaluation of programme
	Other (specify):

3.2 Objectives of evaluation (tick boxes):

	Developmental impact of programme
	Assessment of programme outcomes
	Lesson learning
	Examine use of resources, activities and outputs (logframe indicators)
	Inform policy
	Other (specify):

3.3 Conceptual framework of evaluation (tick boxes):

	Quasi-experimental approaches
	Non-experimental approaches
	Use of logframe and outcome indicators
	Theory of change
	Outcome mapping
	Other (specify):

3.4 Evaluation methodology used for publication (tick boxes):

	Survey (questionnaires) of beneficiaries and non-beneficiaries on programme impact
	Survey (questionnaires) of beneficiaries only on programme impact
	Programme evaluation of programme activities and outputs
	Semi-structured interviews key informants
	Focus group discussions with key informants/beneficiaries

	Narrative programme implementation and lesson learning
	Other (specify):

3.5 Research methods used (tick boxes):

	Quantitative methods with control group
	Quantitative methods without control group
	Qualitative methods

3.6 Detailed description of methodology used for evaluation (type of outcomes assessed, research methods used, indicators used for evaluation, etc.):

3.7 Detailed description of data collection for evaluation (type of data collected, time of data collection, etc.):

Description of programme impact (results)

4.1 Detailed description of results/outcomes of capacity strengthening programme (positive and negative impacts on capacity and performance) – include quantitative results (disaggregated by categories of beneficiaries – e.g. gender, age, job role) if available:

4.2 Detailed description of factors that play a (positive or negative) role in achieving beneficial impacts through capacity strengthening:

Conclusions

5.1 Detailed description of conclusions of study:

5.2 Detailed description of weaknesses in study according to authors (e.g. methodology, timing, evaluation bias, data gaps):

5.3 Detailed description of study recommendations:

5.4 Weaknesses in study according to reviewers (e.g. methodology, timing, evaluation bias, data gaps):

5.5 Comments

5.6 Quality of study (high, medium, low)

Appendix 5: Overview of methods and quality of studies

Impact of capacity strengthening in academic disciplines/research

CS initiative	Reference	Publication type	Evaluation team	Evaluation objectives	Methods	Comments on methods (weaknesses)
Support to the University Eduardo Mondlane, Mozambique; funded by Sida	Alberts *et al.*, 2003	Published report	External	Outcomes Lesson learning	Logframe indicators Cross-reference of information between university staff and management	Lack of data on specific use of support and funds
Renewable Natural Resources Research Strategy	Almond and Kisauzi, 2005	Working paper	External	Lesson learning Inform policy	Interviews with beneficiaries Narrative	Data was incomplete (e.g. funding allocated to overseas partners) No interviews conducted with representatives of programme beneficiaries
AGERI (Egypt) and MSII (Mali)	Ayele and Wield, 2005	Scientific journal paper	External	Lesson learning	Interviews with beneficiaries Narrative Case studies	Incomplete description of methodology. Source of opinions often unknown
WECAMAN	Badu-Apraku *et al.*, 2004a, b	Scientific journal papers	Internal	Outcomes Outputs	Logframe indicators Survey (beneficiaries only) Narrative Training evaluation forms	Incomplete description of methodology. Question of attribution is not rigorously dealt with
Support to the Plant Genetic Resources Center (PGRC)	Bennett-Lartey *et al.*, 2003a, b	Published reports	Internal	Lesson learning	Interviews with beneficiaries Focus group discussions Review of project documents Self-assessments	Lack of detailed data on staff trained, programme activities and workshop results. More focused on processes than impact

CS initiative	Reference	Publication type	Evaluation team	Evaluation objectives	Methods	Comments on methods (weaknesses)
Institutional co-operation (twinning) between Sokoine and Norwegian agricultural universities	Berg, 1998	Published report	External	Outcomes Lesson learning	Logframe indicators Interviews with beneficiaries and stakeholders	No data on project costs. Lack of consistent and systematic monitoring data
Wheat rust resistance in India, funded by ACIAR	Brennan and Quade, 2004, 2006	Conference paper Scientific journal paper	External	Impact	Used secondary data on training levels of Indian scientists in rust disease resistance and wheat productivity as affected by rust diseases	The paper describes a theoretical framework which might be criticised as a curve-fitting exercise which may or may not be related to the effect of training. No validation of the model was done
Capacity building and networking (meta-evaluation); funded by Sida	Carlsson and Wohlgemut, 1996	Published report	Unknown	Impact Outcomes Lesson learning	Meta-evaluation	Summary and comparisons of nine evaluation reports
CIMMYT training programme	Cooksy and Arellano, 2006	Published report	External	Impact Outcomes	Survey (beneficiaries only) Interviews with key informants	No data on the extent of impact. Selection of interviewees may have introduced bias in data

CS initiative	Reference	Publication type	Evaluation team	Evaluation objectives	Methods	Comments on methods (weaknesses)
Research Co-operation for Livestock Based Sustainable Farming Systems in the Lower Mekong Basin (MEKARN); funded by Sida	Eduards *et al.*, 2007	Published report	Internal	Outcomes Lesson learning	Logframe indicators Interviews Review of project documents	Little information on collected data and evidence
ILRI graduate fellows programme	Eley *et al.*, 2002, 2003	Published report Scientific journal paper	Internal	Impact Lesson learning	Survey (beneficiaries only) Interviews	Authors make recommendations on methodology (e.g. increase in number of respondents) but have tried to limit any possible bias
Breeding and feeding pigs in Australia and Vietnam; funded by ACIAR	Fisher and Gordon, 2008	Published report	External	Impact Outcomes	Survey (beneficiaries only) Cost-benefit analysis	Authors acknowledge that precise attribution is not possible. Not clear if all costs of technology transfer are included
The African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE) and Zambian Agroforestry Project (ZAP); funded by Sida	Fones-Sundell and Teklehaim-anot, 2007	Published report	External	Impact Outcomes Inform policy	Logframe indicators Interviews Review of project documents	Very little information on data/evidence

CS initiative	Reference	Publication type	Evaluation team	Evaluation objectives	Methods	Comments on methods (weaknesses)
Bilateral programme of research co-operation between Vietnam and Sweden	Forss, 2002	Published report	External	Outcomes Lesson learning	Logframe indicators Interviews	Little specific information is presented as the responses of the beneficiaries or those interviewed
Enhancing research capacity at Makerere University, Uganda; funded by Sida	Freeman *et al.*, 2010	Published report	External	Outcomes Lesson learning	Survey (beneficiaries only) Logframe indicators Interviews Focus group discussions Review of project documents	Limited time for field visit, incomplete M&E data
Enhancing research capacity in Vietnam; funded by Sida	Freudenthal, 2009	Published report	External	Impact Outcomes Lesson learning	Survey (beneficiaries only) Logframe indicators Interviews Focus group discussions	Using mixed methods the authors tried to limit bias
IFS support to research capacity in Tanzania and Cameroon	Gaillard *et al.*, 2002 Gaillard and Zink, 2003	Published reports	Internal	Outcomes	Survey (beneficiaries only) Interviews	There is no acknowledgement of any possible bias. The conclusions seem to reflect the authors' opinion rather than based on evidence

CS initiative	Reference	Publication type	Evaluation team	Evaluation objectives	Methods	Comments on methods (weaknesses)
Collaborative research support programme on dry grain pulses funded by USAID	Jamora *et al.*, 2011 Howes, 1992	Working paper MSc thesis	Internal	Impact Outcomes Lesson learning	Survey (beneficiaries only) Interviews Review of project documents	Third of total sample of beneficiaries could not be traced which may have created bias in results, but this is not discussed by Jamora *et al.* (2011) Small sample sizes, no statistical testing (Jamora *et al.*, 2011; Howes, 1992)
Improvement of sorghum varieties in India and Australia; funded by ACIAR	Longmore *et al.*, 2007	Published report	External	Impact Outcomes	Survey (beneficiaries only) Interviews Cost-benefit analysis	Difficult to estimate attribution because subsequent impacts of capacity building depended on funding from other donors of much greater magnitude
The East African Regional Programme and Research Network for Biotechnology, Biosafety and Biotechnology Policy Development (BIO-EARN); funded by Sida	Morris and Louwaars, 2004	Published report	External	Outcomes Inform policy	Interviews with key informants	Lack of quantification of impacts of training
ICRAF training programme	Njuki *et al.*, 2006	Book chapter	Internal	Outcomes	Project review	There is no explanation of where data/evidence comes from, but seems largely based on the authors' experiences

CS initiative	Reference	Publication type	Evaluation team	Evaluation objectives	Methods	Comments on methods (weaknesses)
NUFU and NOMA programmes	NORAD, 2009	Published report	External	Outcomes Lesson learning	Survey (beneficiaries only) Logframe indicators Interviews Focus group discussions Narrative Review of project documents	There is no control group, but the authors make some effort to compare the programmes with similar programmes funded by the Swedish and Dutch governments
Norwegian support to Bunda College of Agriculture	Nyirenda and Tostensen, 2005, 2009	Published reports	External	Impact Outcomes Lesson learning Outputs	Survey (beneficiaries only) Logframe indicators Interviews Focus group discussions Review of project documents	Limited data on costs; time constraints for thorough data gathering
Support by AfDB to the National Agricultural Research and Extension Programme (NAREP) in Cameroon	OSAN, 2009	Published report	External	Outcomes Outputs	Logframe indicators Field trips Monitoring forms	Limited information on methodology. Lack of M&E data
Forum for Agricultural Resource Husbandry	Patel and Woomer, 2000	Scientific journal paper	Internal	Impact Lesson learning	Observations and discussions with beneficiaries	No control group taken from fellow students without access to grant scheme. Anecdotal evidence on economic impact

CS initiative	Reference	Publication type	Evaluation team	Evaluation objectives	Methods	Comments on methods (weaknesses)
Support to the Asian Maize Biotechnology Network (AMBIONET) from the Asian Development Bank	Pray, 2006	Published report	External	Impact Outcomes Lesson learning	Survey (beneficiaries only) Interviews Review of project documents	Measured impact of programme on maize breeding research
Dryland Agriculture Applied Research Project in Morocco	Ryan *et al.*, 2007	Scientific journal paper	Internal	Outcomes Lesson learning	Process monitoring (narrative)	No methods are explained and evidence base of opinions is not clear
CGIAR training and capacity strengthening	Stern *et al.*, 2006	Published report	External	Lesson learning	Survey (beneficiaries only) Interviews Review of project documents	Lack of consistent M&E data
South Asian Network for Agroforestry Education; Agroforestry Support Project for Vietnam and Laos; funded by Sida	Tengnäs *et al.* 2005	Published report	External	Outcomes Lesson learning Outputs	Logframe indicators Interviews Review of project documents	Lack of consistent M&E data. Report lacks synthesis
Support to two universities and the Education Ministry in Bolivia; funded by Sida	Thulstrup *et al.*, 2006	Published report	External	Impact Outcomes Outputs	Interviews Focus group discussions Workshop	Very little information on collected data/evidence
ICRAF training programme	Wanjiku *et al.*, 2010	Scientific journal paper	Internal	Outcomes Lesson learning	Survey (beneficiaries only) Interviews	Small sample sizes for certain courses. Used Kirkpatrick's learning model

CS initiative	Reference	Publication type	Evaluation team	Evaluation objectives	Methods	Comments on methods (weaknesses)
Postgraduate training in USA, Japan and Australia	Ynalvez and Shrum, 2009	Scientific journal paper	External	Outcomes Lesson learning	Survey (with control group) Interviews	No information on beneficiaries who pursued academic career abroad. No information is given on control group

Impact of capacity strengthening in AR4D management

CS initiative	Reference	Publication type	Evaluation team	Evaluation objectives	Methods	Comments on methods (weaknesses)	Quality
ISNAR review	Anderson *et al.*, 2004	Published report	External	Impact Outcomes Lesson learning	Surveys (beneficiaries only) Case studies	Authors acknowledge challenges of measuring causality and attribution	High
Capacity development at MoFA, Ghana	Babu *et al.*, 2007	Working paper	External	Outcomes Lesson learning	Survey (beneficiaries only) Interviews Focus group discussions	Sample was not fully randomised as questionnaires were only sent to participants of national and regional meetings, and not to all staff.	Medium
Strengthening research management capacity at the National Agricultural Research Institute (INRA) in Morocco	Baur and Kradi, 2001	Working paper	Internal	Outcomes Lesson learning	Process monitoring (narrative)	Reflection on authors' experiences and processes during project implementation and therefore limited evidence on impact	Medium

CS initiative	Reference	Publication type	Evaluation team	Evaluation objectives	Methods	Comments on methods (weaknesses)	Quality
Capacity building in Planning and M&E, ISNAR	Horton *et al.*, 2000 Mackay and Horton, 2002	Published report Working paper	Internal	Outcomes Lesson learning	Survey (beneficiaries only) Logframe indicators Interviews Narrative	The response rate for the training survey was 45%, introducing some bias as the respondents had been more intensively involved in the training programme than non-respondents	Medium
Faculty Research Funds at universities in Mozambique, Tanzania and Uganda; funded by Sida	Hydén, 2006	Published report	External	Outcomes Outputs Lesson learning	Interviews Review of project documents	Incomplete M&E data. No attempt to evaluate the impact on researchers' capacity or career	Medium/ Low
Technical assistance Ministry of Agriculture Namibia; funded by EU	Low *et al.*, 2001	Scientific journal paper	Internal	Lesson learning	Interviews Narrative	Lack of baseline or control to measure impact	Medium/ Low
Support to national agricultural research systems by ISNAR	Mackay *et al.*, 1998	Published report	External	Impact Outcomes Outputs Lesson learning	Survey (beneficiaries only) Interviews Case studies	Incomplete M&E data. Low response rate to survey.	Medium/ High
Support from USAID to Egerton University in Kenya	USAID (1995)	Published report	External	Outcomes Outputs Lesson learning	Logframe indicators Interviews Narrative Review of project documents	Lack of M&E data. Limited information on methodology (interviews)	Medium/ High

CS initiative	Reference	Publication type	Evaluation team	Evaluation objectives	Methods	Comments on methods (weaknesses)	Quality
Agricultural research management training programme in Nigeria	Oloruntoba, 2002a, b	Scientific journal papers	Unknown	Outcomes Lesson learning	Survey (with control group)	Only abstracts were available, therefore it is not possible to assess methodology	Not enough inform-ation available
Capacity strengthening by the International Service for National Agricultural Research	Paul *et al.*, 1996	Published report	External	Impact Outcomes	Logframe indicators Interviews Review of project documents Case studies	This was a very extensive review of ISNAR	High
Gender-sensitive agricultural extension planning at the Ministry of Agriculture of Ethiopia, funded by DGIS	Percy, 2002	Scientific journal paper	Internal	Lesson learning	Narrative	The narrative is based on the author's experiences but there is no robust evidence on impact	Low
Strengthening national capacity for irrigation management and research	Rao and Abeywick-rema, 1992	Published report	Internal	Outcomes Lesson learning	Case studies Narrative	Study gives a review of the history of the intervention, but no robust evidence on impact	Low
Strengthening Capacity for Agricultural Research for Development in Africa (SCARDA); funded by DFID	Robson, 2010	Unpublished report	External	Outputs	Logframe indicators Narrative	Mid-term review of the programme, so limited data on impact	Medium/ Low

CS initiative	Reference	Publication type	Evaluation team	Evaluation objectives	Methods	Comments on methods (weaknesses)	Quality
IFPRI support to Malawi for Food Security and Improved Nutrition	Ryan, 1999	Scientific journal paper	Internal	Outcomes Lesson learning	Process monitoring (narrative)	No description of methodology, which limits the validity	Medium/ Low
Agriterra's support to farmer organisations; funded by DGIS	Snelder, 2010	Published report	External	Outcomes Lesson learning	Interviews Case studies	There is no triangulation or discussion of the robustness of results	Medium
Capacity building at the National University of Laos in Vietnam	Vandergeest *et al.*, 2003	Scientific journal paper	Internal	Outcomes Lesson learning	Process monitoring (narrative) Focus group discussions	Describes process and lessons learned, but no robust evidence on impact	Medium/ Low
Evaluating capacity development, funded by IDRC	Vernooy *et al.*, 2009 Campilan *et al.*, 2009	Working papers	Internal	Lesson learning	Process monitoring (narrative) Review of nine evaluations	No description of methodology	Medium

Capacity strengthening of NARS

CS initiative	Reference	Publication type	Evaluation team	Evaluation objectives	Methods	Comments on methods (weaknesses)	Quality
Development of tomato packaging technology in India	Clark *et al.*, 2003	Scientific journal paper	External	Impact Outcomes Lesson learning	Interviews Process monitoring (narrative)	This is a case study rather than evaluation of an entire programme	Medium
Support to innovation platforms in country programmes supported through the Research into Use programme	Dijkman, 2010	Working paper	Internal	Lesson learning Inform policy	Case studies Narrative	Lessons were derived from a review of six country programmes. It is not a formal review or evaluation	Medium /Low
Integrated Natural Resource Management Zimbabwe	Hagmann *et al.*, 2002	Scientific journal paper	Internal	Impact Lesson learning	Process monitoring (narrative)	The narrative is based on the authors' experiences but there is no robust evidence on impact	Medium
Support for public-private partnership building in Latin America	Hartwich *et al.*, 2007	Working paper	Internal	Outcomes Lesson learning	Case studies Action research Process monitoring	Lack of information on outputs or outcomes, paper is more focusing on processes	Medium /Low
Participatory Market Chain Analysis in Uganda	Horton *et al.* 2010	Scientific journal paper	Internal	Outcomes Lesson learning	Interviews Focus group discussions Process monitoring (narrative)	Lack of information on outputs or outcomes; paper is more focusing on processes	Medium
Fodder innovation project in Nigeria	Madzudzo, 2011	Scientific journal paper	Unknown	Impact Outcomes	Case studies Project review (narrative)	Lack of robust evidence on impact	Medium /Low

CS initiative	Reference	Publication type	Evaluation team	Evaluation objectives	Methods	Comments on methods (weaknesses)	Quality
Collaboration between the International Potato Center and CARE in Peru	Ortiz *et al.*, 2008	Scientific journal paper	Internal	Outcomes Lesson learning	Interviews Workshops	Focuses on partnerships and participatory research. Little robust evidence on impact	Medium
Facilitating public-private partnerships in agricultural research for development	Spielman *et al.*, 2007a, b, 2010	Working papers	External	Outcomes Lesson learning	Interviews with key informants Review of project documents Case studies	This was a review of 75 case studies to derive lessons	Medium
Support to innovation platforms in Nigeria through the Research into Use programme	Ugbe, 2010	Working paper	Unknown	Lesson learning	Narrative	No description of methodology. This paper presents emerging lessons rather than a formal review	Medium /Low

Appendix 6: Results summary on the impact of capacity strengthening on AR4D

Impact of capacity strengthening in academic disciplines/research

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
Support to the University Eduardo Mondlane, Mozambique; funded by Sida	Alberts *et al.*, 2003		1998-2003	Postgraduate training through Swedish universities. Management support to the university.	Significant improvement in staff development and researchers obtaining postgraduate qualifications.	
Renewable Natural Resources Research Strategy	Almond and Kisauzi, 2005		1994-2005	11 research programmes under DFID's Renewable Natural Resources Research Strategy. Each programme developed its own approach to capacity development within the overall guidelines set by DFID	A total of 102 PhDs and 220 MSc/MPhil degrees were reported. Other examples were: (1) strengthening of networks through approaches such as the 'institute without walls' used in the plant sciences programme; (2) Enhanced success in winning grant funding following training in proposal writing.	
AGERI (Egypt) and MSII (Mali)	Ayele and Wield, 2005		AGERI: 1989-2005 MSII: 1983-	Building capacity for biotechnology in terms of human resources, infrastructure and partnerships for innovation, and technical	Egypt 69 PhDs, 73 Masters supported; Mali MSII has 12 PhD researchers and 50 technicians and assistants - some were understood to have been trained in the	Egyptian institute AGERI has achieved greater impact and sustainability due to engaging researchers in universities inside and outside Egypt

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
			2005	assistance.	US by the programme. In Mali, the capacity to undertake biotechnology research and see impacts was limited by lower levels of investment and capacity, as well as cultural separation between research institutes and universities, and between them and the private sector.	and undertaking public sector initiatives. Weaker impacts are seen in Mali due to lack of these interactions
WECAMAN	Badu-Apraku *et al.*, 2004a, b		1987-2004	WECAMAN assists national maize programmes in West and Central Africa to harness their resources together in order to tackle production problems through the development and transfer of appropriate and sustainable technologies.	High yielding drought- and disease-resistant maize varieties have been developed through collaborative research efforts of the network member countries. Improved capacity of NARS to effectively transfer new technologies to farmers in the sub-region.	Over the last two decades, the development, promotion and adoption of high yielding, disease- and pest-resistant maize varieties have resulted in increased maize yield in several countries in WCA, especially in Ghana, Mali and Burkina Faso. WECAMAN has played a catalytic role in the dissemination of the improved maize cultivars among NARS.

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
Support to the Plant Genetic Resources Center (PGRC)	Bennett-Lartey *et al.*, 2003		1980-1999	Capacity development of the PGRC, Ghana, to conserve, evaluate and utilise Ghana's plant genetic resources. Secondly, support to PGRC's development from the International Plant Genetic Resources Institute and the Genetic Resources Network of West and Central Africa.	Increased staff number, better qualified staff, budget allocation and greater operational autonomy at the PGRC.	The enhanced individual and organisational capacity led to an increased number of germplasm accessions conserved and the development of programmes to promote the use of conserved germplasm for research and in farmers' fields.
Institutional co-operation (twinning) between Sokoine and Norwegian Agricultural Universities	Berg, 1998	NOK 250 million	1974-2000	Training, research and staff development in the fields of agriculture and allied sciences at Sokoine. Strengthening the central functions of the university, primarily through provision of equipment and rehabilitation of dilapidated physical infrastructure and the communication system.	Postgraduate training of university staff at MSc (122 scientists) and PhD (21 scientists) levels. Enhanced capacities to identify, design and implement research projects, and to assess and adjust research findings for local application. Some faculties and institutes within Sokoine were strengthened as independent education and research units, but unbalanced support	

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
					hindered wider impact at university managerial level.	
Wheat rust resistance in India, funded by ACIAR	Brennan and Quade, 2004, 2006	A$400,000	1985-1991	Collaborative research and training of three Indian scientists in rust disease resistance and wheat productivity.	For each plant pathologist trained, the human research capacity increases by 5 years.	The annual gain in wheat productivity resulting from this increased human capacity is estimated between 0.7% and 1.7%, at a value of between A$1.8 and $4.5 million per year.
Capacity building and networking (meta-evaluation); funded by Sida	Carlsson and Wohlgemut, 1996			Each of the 9 evaluated projects was concerned with building and maintaining research networks. Building of research capacities (primarily at national level) as well as promoting result-oriented research.	The evaluations show the research networks as being successful in achieving their objectives and in producing some high-quality research. The main weakness has been in dissemination of results and in engaging with other actors outside the networks.	Only support to the CGIAR was evidenced in a way that showed impact on agricultural production. Evaluations of the other projects show limited impact of the research networks on stakeholders, including training institutions and policy makers.
CIMMYT training programme	Cooksy and Arellano, 2006	US$5.5 million in 2001, US$4.8 million in 2002, US$ 4.2 million per year for 2003-2005 (5-7% of	1991-2001	CIMMYT offers long courses focused on basic and advanced skills in maize and wheat breeding and on crop management, and shorter courses on	Individual trainees developed new knowledge and skills. Trainees often shared knowledge with colleagues and brought new research materials and approaches to their	

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
		CIMMYT's budget)		specialised topics.	own institute. These new materials and approaches can create changes in agricultural practices, e.g. involving farmers in the development of new varieties, increasing productivity or improving the quality of seed.	
Research co-operation for livestock-based sustainable farming systems in the Lower Mekong Basin (MEKARN); funded by Sida	Eduards *et al.*, 2007	SEK 32.5 million	2004-2007	Short courses, MSc and PhD training; support for technology development, regional co-operation in research, production of training materials and databases, and information sharing.	Development of a critical mass of researchers with new skills. 34 MSc students (38% women), 17 PhD students (53% women); 83 scientific publications. Reorientation of research agendas of target organisations from commercial to smallholder production systems and poverty alleviation. Development of new technologies for resource-poor farmers.	The impact on poor farmers in the region is assessed as high by the reviewers, but little evidence is presented to support this conclusion. N.B. the adoption of biogas systems is given as an example (see Freudenthal, 2009).
ILRI graduate fellows programme	Eley *et al.*, 2002, 2003		1978-1997	ILRI offers a graduate fellowship programme for scientists from developing and developed countries	307 graduate fellows carried out their research projects at ILRI. The training contributed	

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
				to carry out postgraduate research projects at ILRI centres	to the development of scientific leadership, with faster promotions to senior scientific positions, and increased number of publications. Graduates passed on knowledge within their institutes. Most fellows were bonded to their employers, resulting in high return rates to their places of employment.	
Breeding and feeding pigs in Australia and Vietnam; funded by ACIAR.	Fisher and Gordon, 2008	AUS$ 1,367,389 from ACIAR (and AUS$ 2,135,548 in-kind contributions from research institutes)	1995-2001	Training of 19 persons in a 3-week Genetic Improvement and Pig Production Essentials course; 'a number' had longer 3-6 month training in Australia; one PhD supported.	Survey results show that capacity was built and applied, and led to proposals that generated additional funding. Resulting research led to advances in pig breeding and in feeding regimes.	The training and research made a significant economic contribution to the increased productivity of pigs equivalent to A$424m, a cost benefit ratio of 256:1, or a return on investment of 24.5% (estimated).
The African Network for Agriculture, Agroforestry and Natural Resources	Fones-Sundell and Teklehaim-anot, 2007	US$862,000 (phase 4)	2003-2006	Strengthening capacity in agroforestry in 127 African universities and colleges by linking colleges and universities with schools and local communities;	Curricula in universities and colleges reflect substantially more and better quality agroforestry content. Increase in the number of graduate theses	The rate of adoption of new or improved agroforestry innovations by farmers was very slow, particularly in the Sahel and African humid tropics.

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
Education (ANAFE) and Zambian Agroforestry Project (ZAP); funded by Sida				production of training materials; training of trainers; fellowships for 117 students for on-farm research; on-farm testing of innovations; support to national agroforestry training teams.	and training products. Application by farmers of practices promoted in the training, including the use of food and fodder banks.	This was attributed to an unfavourable institutional and policy environment constraining scaling up.
Bilateral programme of research co-operation between Vietnam and Sweden	Forss, 2002	SEK 54 million	2000-2002 (co-operation since 1979)	Support for 31 PhDs, 28 Masters, BSc students, short-term training courses, overseas study tours and seminars. Infrastructure development such as investment in laboratory equipment, library services and information technology. Networking activities such as promotion of collaboration particularly between universities and research institutes and some overseas networking.	A cadre of 31 PhD and 28 MSc graduates (50% female) in health and farming systems. The success of the programmes was evidenced by 540 publications in international and national scientific publications, conferences and workshops. Programmes with longer-term support were more likely to lead to the development of national and regional networks of collaboration.	Viable networks of co-operation. Development of hybrid acacia and eucalyptus clones for reforestation. Farming Systems Research has developed new knowledge of animal feed and husbandry practices, as well as new types of biogas converters adopted by 15,000 households
Enhancing research capacity at	Freeman *et al.*, 2010	SEK ~200 million or USD 25.3 million	2000-2008	Support for Masters and PhD studentships at Makerere University with	Increases in: (1) numbers of PhD teaching staff, supervisors, academic	

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
Makerere University, Uganda; funded by Sida				co-supervision from researchers at universities in Sweden.	promotions and appointments to leadership roles; (2) representation of women in research groups; (3) international publications; (4) international collaboration; (5) research awards for 'best paper'; (6) teamwork.	
Enhancing research capacity in Vietnam, funded by Sida	Freudenthal , 2009		Since early 1990s	PhD training of 14 Vietnamese researchers through a sandwich model in which most of the research was done at their home organisation.	Most students remained at their home institutes after graduating and occupied senior positions. 72% of respondents had published in international peer-reviewed journals. Research capacity was strengthened. New techniques and innovations to help poor farmers were developed and disseminated.	One example of the impact of PhD research is new knowledge on animal feed and husbandry practices, as well as new types of biogas converters, resulting in 80,000 farm households installing biogas systems.
IFS support to research capacity in Tanzania and Cameroon	Gaillard *et al.*, 2002 Gaillard and Zink,	Approximately 1 million Euros for research and travel grants	1974-2000	IFS supported 55 scientists in Tanzania and 44 scientists in Cameroon with research grants. In addition, travel grants	IFS grants were instrumental in retaining trainees in their home institutions and contributed to research	Anecdotal evidence that IFS grants led to economic development in Tanzania. One outstanding case was the commercial

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
	2003	Tanzania Approximately US$1.4 million for research grants in Cameroon		were provided to allow trainees to attend scientific meetings and to visit research institutes abroad.	capacity building in Tanzania. IFS grantees in Cameroon achieved important positions in the scientific community. Women were underrepresented amongst the grantees. IFS alumni have strong publication records.	development of the seaweed industry, generating export earnings of over US$10 million annually and employing more than 40,000 persons (mostly women). The impact in Cameroon is unclear.
Collaborative research support programme on dry grain pulses funded by USAID.	Jamora *et al.*, 2011 Howes, 1992	US$2.55 Million for training between 2002 and 2006; about US$7 million for 200 (MSc and PhD) students from 1981 to 2006	1981-2006	Almost 500 postgraduate students were supported by the CRSP, in the USA and home countries as part of wider research projects.	Increased number of national researchers with advanced degrees and enhanced professional skills. 86% of the overseas students returned to their home country and continued bean/cowpea research. Strengthened linkages between farmers and researchers, researchers and policy makers and among researchers.	
Improvement of sorghum varieties in India and	Longmore *et al.*, 2007	AUS$ 788,737 from ACIAR (and AUS$1,327,500	1996-1999	Collaborative research and skills training of three Indian researchers.	The project contributed to building knowledge and skills, as well as important research technology. The	The project failed to deliver the expected outputs in India due to the technical difficulties

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
Australia; funded by ACIAR		in-kind contributions from research institutes)			training contributed to the establishment of a programme for genetic transformation of sorghum in India.	involved with the science. Yet the project acted as a catalyst for subsequent research projects, resulting in the planned release of new pest-resistant varieties from 2015 onwards.
The East African Regional Programme and Research Network for Biotechnology, Biosafety and Biotechnology Policy Development (BIO-EARN); funded by Sida	Morris and Louwaars, 2004		1999-2004	MSc and PhD training through preparatory courses and sandwich mode arrangements. Research visits by faculty staff. Short-term training and 'hands-on training' on various biotechnology policy issues, including bio-safety capacity building (e.g. training courses, workshops, internships etc.). Investments in laboratory and informatics equipment.	Improvements in biotechnology and IT skills through the postgraduate and faculty training. Enhancements in laboratory infrastructure. Increase in the number of scientists and policy makers within the region with knowledge of bio-safety risk assessment procedures.	Contribution of BIO-EARN partners to the development of national biotechnology policies in Kenya, Uganda, Ethiopia and Tanzania. Raised awareness of biotechnology related issues in the region.
ICRAF training programme	Njuki *et al.*, 2006		1996-2006	Training at postgraduate level, postgraduate research, review of curricula to include	Large increase in the number of higher education institutes offering agroforestry	

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
				agroforestry and networking between institutions. Provision of technical support, including attaching students to Centre scientists and carrying out thesis research in Centre field sites.	courses or as subjects within other disciplines.	
NUFU and NOMA programmes	NORAD, 2009	NUFU programme (136 projects): NOK 329 million. NOMA programme (36 projects): NOK 187 million	NUFU: 2002-2006 NOMA: 2007-2008	The main objectives of the NUFU and NOMA programmes were to contribute to competence building in developing countries through North-South and South-South co-operation. Collaboration was primarily in the form of research and training of PhDs and Master's students.	By 2012, 574 master students and 329 PhD candidates were expected to complete their studies under the NUFU programme. Under the NOMA programme, 200 female and 370 male students followed Masters training in 2008. Capacity building was primarily focused on individual researchers.	
Norwegian support to Bunda College of Agriculture	Nyirenda and Tostensen, 2005, 2009	NOK 35 million	2001-2004	The support was to 'improve the performance of the College in learning, teaching and research to enable it to play a significant role in the	Notable achievements included a strategic plan for the College; the commercialisation of Bunda Farm; resuscitation of the *Bunda Journal of*	

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
				development of Malawi and attract other sources of funding for its programmes'. Junior staff were targeted to be upgraded to Master's and preferably to PhD levels.	*Agriculture, Environmental Science and Technology*; upgrading of ICT facilities; rehabilitation of buildings; upgrading of library; 4 BSc graduates, 8 MSc graduates, 5 PhD graduates.	
Support by AfDB to the National Agricultural Research and Extension Programme (NAREP) in Cameroon	OSAN, 2009	5163.6 million CFAF (~US$ 10 million)	2000-2007	Support to the Institute of Agricultural Research for Development through (a) upgrading of equipment and services and (b) seminars and short-term training courses for the scientific, technical, administrative and financial staff. (Support for research activities was also provided.)	Limited progress in upgrading IRAD's physical capacity, due to problems with procurement. IRAD's technical interventions were improved and its enhanced credibility helped to attract additional donor funding. The motivation of researchers was increased. Stronger links were made with extension, leading to productivity gains.	Research, in synergy with extension activities, resulted in improved productivity of the supported plant and animal production, in a range of 20 to 30%, between 2000 and 2004. The increase in farmers' incomes is estimated at 20%, and the economic internal rate of return at 11.5%.
Forum for Agricultural Resource Husbandry	Patel and Woomer, 2000	US$4.6 million	1992-2000	The Forum for Agricultural Resource Husbandry (FORUM) was initiated in 1992 by The Rockefeller Foundation to stabilise	56 grants were awarded to 40 principal investigators at nine universities in the participating countries resulting in 121	It was suggested that some of farmers and communities benefited from the interaction through the development

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
				faculties of agriculture in Kenya, Malawi, Mozambique, Uganda and Zimbabwe by providing resources, mission and peer support, leading to knowledge contributing to improved lives of smallholder farmers. The focus of this effort was improvement in the quality of training at the Master of Science (MSc) level.	studentships. 37 students received their MSc degrees. Research funded by the programme resulted in 34 conference papers and 22 journal papers. Some research projects involved working with farmers and raised research students' and supervisors' awareness through working with farmers.	and dissemination of new technologies.
Support to the Asian Maize Biotechnology Network (AMBIONET) from the Asian Development Bank.	Pray, 2006	US$2.4 million from ADB and about US$1.3 million in kind from CIMMYT	1998-2005	Training, collaborative research and information sharing, focusing on the application of molecular markers to (a) develop improved maize varieties that have high yield, resistance against diseases, and tolerance to abiotic stresses and (b) develop enhanced nutritional qualities and resistance to banded leaf and sheath blight.	Maize research in Asia was strengthened, particularly at the institutes participating in AMBIONET in China, India, Indonesia, and Vietnam. Increased number of maize scientists, stronger skills, and closer inter-country links. Good progress was made toward developing improved, disease resistant lines that can be used in breeding programmes. All countries	The support induced more expenditure on maize research. Impact at the farm level was not quantified, but anticipated future impacts were expected to be large.

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
					increased the number and quality of scientific publications.	
Dryland Agriculture Applied Research Project in Morocco	Ryan *et al.*, 2007	USAID: $50 million; Government of Morocco: $28 million	1982-1994	The programme included: (1) infrastructure development to establish a dryland research centre and a network of agricultural research substations; (2) human resources capacity building, involving postgraduate training of junior scientists; and (3) establishment of a viable research programme related to dryland agriculture. The scientific mentoring and programme development was done by a small team of expatriate technical advisors.	45 PhD students and 16 MSc students from among junior national scientists. Staff trained went on to obtain jobs at other institutions in Morocco and international centres in the region. Other areas of expertise developed included planning and prioritisation, and establishing linkages between technology generation and transfer.	
CGIAR Training and capacity strengthening	Stern *et al.*, 2006		1990-2004	Individual (30,000 persons) and group (90,000 persons) training ranging from less than 10 days to over 2 years. This includes a substantial number of	Increased ability to set priorities and define goals. New knowledge, attitudes and technologies acquired. About one third of respondents considered	The impacts of training and capacity building of NARS is variable between countries and depends on the strength of the organisation.

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
				degree students, but it was not possible to determine the numbers.	there was great change, and an additional 50% some change, in their skills and capacity. Training has considerably contributed to NARS capacity but weaker organisations have benefited less.	
South Asian Network for Agroforestry Education; Agroforestry Support Project for Vietnam and Laos; funded by Sida	Tengnäs *et al*. 2005	Nearly SEK 13 million to SEANAFE and SEK 8.7 million to VACB/ASP. ICRAF contributed SEK 0.75 million. Total cost is about SEK 22.5 million	1997-2003	SEANAFE: Establishment of a network of tertiary education institutes teaching agroforestry. Development of agroforestry curricula and content. Training of staff and awareness raising among stakeholders. ASPV&L: Training of trainers and development of course materials. Testing of and training in tools for landscape analyses and watershed research. Policy workshops with stakeholders. Studies in policy and governance and training in policy	SEANAFE: Strengthening of national agroforestry networks. SEANAFE's membership increased from 33 to 76 educational institutes. ASPVL&I: Better linkages between officials from the forestry and agricultural research institutes in Vietnam and Laos. Limited effectiveness of project activities after 1999 due to deficiencies in management and oversight.	The regional network SEANAFE has served as a catalyst for national processes and networks. SEANAFE has been more successful in linking up with research than with extension and farmers.

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
				analytical methods and tools.		
Support to two universities and the Education Ministry in Bolivia; funded by Sida	Thulstrup *et al.*, 2006	SEK 85 million	2000-2006	Support to two universities in Bolivia (UMSS and UMSA) through the provision of research funds and grants for development of research management. Further support was given for postgraduate training, upgrading laboratories and the establishment of an ICT network. Support was also given to the Vice Ministry for Higher Education, Science and Technology for planning.	Work on the formulation of policies, reformation of processes, and the definition of an S&T (research) plan for Bolivia did not lead to practical changes. The research fund model developed at one university (UMSS) shows great potential and can be replicated at other universities. Interesting results have been produced from the investments in training and infrastructure, but the publication record is weak.	
ICRAF training programme	Wanjiku *et al.*, 2010		1999-2002	Provision of courses in training of trainers, markets, extension, tree domestication, data management and modelling, participatory research, etc.	200 researchers trained annually; trainees were generally positive about the training - 80% indicated they applied the new skills in their work	

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
Postgraduate training in USA, Japan and Australia	Ynalvez and Shrum, 2009			Training of 312 agricultural scientists from national research institutes and state universities	Most prevalent international collaboration is with Japan, followed by Australia and then USA. Japanese training, but not networks, is associated with such collaborations.	

Impact of capacity strengthening in AR4D management

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
ISNAR review	Anderson *et al.*, 2004		1997-2002	ISNAR's aim is to strengthen NARIs and NARS. It develops new tools and methods for improved management of research, provides advisory and training services, and disseminates good practice.	Many useful materials and tools have been developed. The training modules most valued include those on programme management and evaluation, strategic planning, priority setting and biotechnology/biosafety. Significant positive behavioural changes were noted in participating staff, who gained confidence, increased their knowledge and	ISNAR has been quite effective in sponsoring and supporting institutional innovations that are widely used in different regions and cultures, and in stimulating systemic policy reforms. There have also been noticeable positive changes in attitudes to and perceptions of agricultural research and development.

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
					trained others. Improvements were also reported in writing skills, involvement in planning, proposal writing, M&E and performance in workshop facilitation.	
Capacity development at MoFA, Ghana	Babu *et al.*, 2007			Short-term training courses and (post)graduate training for staff members.	The majority (89%) of the respondents reported that they used the skills gained in the training courses in their current jobs.	40% of the respondents thought that the training they received helped to improve the organisational capacity of their institution.
Strengthening research management capacity at the National Agricultural Research Institute (INRA) in Morocco	Baur and Kradi, 2001			Institutional capacity development for participatory research, undertaken by INRA in Morocco. The field work comprised a first stage of participatory rapid appraisal (PRA) training and a second stage of developing and testing a locally adjusted methodology for participatory research programme planning.	The initial training had limited effects in changing perceptions of researchers to embrace PRA. Following the second stage of support, a more favourable environment to user participation in adaptive research developed within INRA.	

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
Capacity building in PM&E, ISNAR	Horton *et al.*, 2000 Mackay and Horton, 2002		1992-1998	Regional, multi-site capacity development project, undertaken to strengthen PM&E in the field of agricultural research through distribution of training materials, regional workshops, and support to organisational change processes in four pilot cases.	Individual level: enhanced motivation of managers and appreciation of the need for change and the role of PM&E. Capacities of 150 managers were enhanced through training in PM&E, strategic management and management of organisational change. Organisational level: improved strategic planning. Some improvements in monitoring process. More progress was made at project level rather than at higher decision-making levels.	Nearly 60% of the impacts on the organisations, as reported by national agricultural research leaders, related to organisational capacity, 20% related to organisational motivation, 15% to organisational environment, and only 5% to organisational performance.
Faculty research funds at universities in Mozambique, Tanzania and Uganda; funded by Sida	Hydén, 2006	SEK 39,000 million between 2001-2005 to four universities	1998-2005	Provision of research funds to be managed by the university as a competitive fund for university research staff.	Results from research supported through the funds were highly variable and the publication record was often poor. Management of the funds was sub-optimal.	Research funds achieved the objective of building capacity but generated new knowledge to a lesser extent.

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
Technical assistance to Ministry of Agriculture Namibia; funded by EU	Low *et al.*, 2001		1994-2000	Technical assistants were employed at the Ministry of Agriculture to equip local staff through 'learning by doing' in skills such as project and policy preparation, general administration, data analysis and M&E.	Increased appreciation of the roles and functions of the planning directorate. Establishment of management and supervision procedures improved organisational capacity. Some human resource capacity was built. However, skills and confidence needed to be developed further.	
Support to national agricultural research systems by the International Service for Agricultural Research (ISNAR)	Mackay *et al.*, 1998		1991-1996	Support to NARS to enhance their capacity and to establish effective research policies, strategies and management systems through the integration of advice, research, and training. ISNAR programmes were supported by specialised service units comprising training, computer services, publications and library services.	Beneficial outcomes included: (1) valued achievements in key agricultural research policy and management areas where NAROs demonstrated the need and desire for organisational strengthening; (2) promotion of a climate of awareness, understanding and productive communication between NARS and superordinate national and regional bodies; (3) c.1,000	

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
					publications, though dissemination was not so effective.	
Support from USAID to Egerton University in Kenya	USAID (1995)	US$23.6m	1986-1995	1. Curriculum development. 2. Developing improved management of information, data and finances and other non-academic support services through computerisation and other methods. 3. Upgrading the skills of the faculty and administrative staff. 4. Developing upgraded educational materials for use in regular curricula and outreach activities and developing adaptive research and continuing education programmes.	Eleven administrative and support staff received special short-term training; 45 faculty members were trained at MSc or PhD level; 60 staff were trained in computer skills; exchange visits were organised between staff and students of the partner universities. Egerton students benefited from new courses and educational materials. Research capacity at Egerton was enhanced through skills training and by the establishment of the Integrated Biotechnology Research Laboratory. The project did not deliver is some key areas, including developing a new financial management system and	The training of Egerton faculty and staff contributed positively to the development of Egerton as a centre of excellence in agricultural sciences. However, the expanded pool of technical and managerial human resources for agriculture did not result in immediate economic impact as the labour market seemed to be saturated.

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
					modernising the library.	
Agricultural research management training programme in Nigeria	Oloruntoba, 2002a, b			Training in agricultural research management in Nigeria.	Results revealed that the trainees acquired and were utilising more managerial skills than those in the comparison group. In general, the majority of the trainees claimed that the training inspired more confidence in their jobs.	
Capacity strengthening by the International Service for National Agricultural Research	Paul *et al.*, 1996	ISNAR's 1996 budget was US$10m, 73% of which was for strengthening NARS	1991-1996	Strengthening of NARS through institutional development, component strengthening and knowledge generation and information dissemination, each of which had a service, a research and a training component.	Stronger NAROs with enhanced research management and information systems.	Impact was in the areas of raising awareness about research policy and management issues, influencing research policies in developing countries, helping develop research systems and institutions, introducing useful management tools, and in training.
Gender-sensitive agricultural extension planning at the Ministry of Agriculture of	Percy, 2002	US$600,000	1994-1996	Guide for extension staff on PRA and gender analysis. Training of trainers on participation and development. A cyclical process of training	Awareness raising of gender among extension staff. Staff gained the skills to do gender analysis with communities using	The project served as a catalyst for further and more widespread capacity building in gender-sensitive PRA in the Southern Region. As the

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
Ethiopia, funded by DGIS				and implementation was applied.	participatory approaches.	practice of PRA became more common, rural men have gradually accepted women's involvement in and contribution to the process.
Strengthening national capacity for irrigation management and research	Rao and Abeywick-rema, 1992		1984-1992	Reinforcing research capacity in national organisations and management capacity in irrigation management organisations through collaborative research, postgraduate training, staff exchanges, training, management training for institutional development, irrigation network, farmer networks, publications.	Activities with the greatest short-term impact were institution building, management training, strategic planning, human resource development, policy dialogues and information exchange.	
Strengthening Capacity for Agricultural Research for Development in Africa (SCARDA); funded by DFID	Robson, 2010	£8.7 million	2007-2010	Support of 12 research organisations through three sub-regional organisations. Activities included: short courses in agricultural research management, M&E, writing research proposals, etc.;	580 managers attended SCARDA events, and over 100 managers were mentored; this created potential for strengthened research management. 78 researchers received MSc training. 91 researchers from satellite institutes	SCARDA brought significant changes in the way the research institutes were operating and their interactions with other organisations in the NARS.

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
				postgraduate training; mentoring of managers.	attended short courses.	
IFPRI support to Malawi for Food Security and Improved Nutrition	Ryan, 1999		1989-1996	Training of enumerators, field officers, survey supervisors, analysts, planners, nutritionists and policy makers all over the country. Assistance with the establishment of an MSc programme in agricultural economics in the Rural Development Department of Bunda College. Support for visits to IFPRI HQ in Washington, and for workshops.	Cadre of professionals in food security and nutrition. Availability of household-level data and use by government in policy formulation. Change from reliance on per capita production as an indicator of food and nutritional security. Disaggregated household data now used.	Influenced the inclusion of a formal food security and nutrition policy statement in the national plan in 1990. Survey data informed the responses of the government of Malawi to the regions most adversely affected by the 1991-92 drought. 'This, no doubt, saved lives, reduced malnutrition, and resulted in significant economies.'
Agriterra's support to farmer organisations; funded by DGIS	Snelder, 2010			Support for implementation of strategic plans of farmer organisations. This included support to set up internal systems, strengthening networks, developing transparent governance structures, service delivery, and salary support in some cases.	Agriterra's support has been effective in terms of enabling the organisations to increase their activities through enhanced organisational capacity. The funding made it possible to hire more trained staff and thus enhance the organisations' outreach. Institutional advice led to improved	The three farmer organisations have grown considerably and have improved their capabilities thanks to a strong internal dynamics and their membership spirit. The organisations have increased their outreach, the number of regions, the number of members – particularly the females

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
					performance internally, such as financial administration, and recruitment, planning and monitoring procedures. The technical support impacted on members but also on staff who received on-the-job training. Agriterra insisted on strengthening economic activities, on including women and youth, and establishing links with other organisations.	and youth – and their training and extension activities. In addition to improving land access rights for small farmers, the organisations also have helped farmers develop new economic activities.
Capacity building at the National University of Laos in Vietnam	Vandergeest *et al.*, 2003		1998-2002	The central project activity was the coaching of eleven faculty members through a research project cycle, from writing proposals to disseminating research results. The project also helped create a resource centre on resource tenure and management for Lao researchers and students; translated key papers and government documents	Improved capacity to manage research at the university. The emphasis of the project changed from the original objective of influencing policy processes and facilitating changes at community level to a focus on skills development.	

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
				into Lao; and worked closely with a university-level process to identify ways of institutionalising research at NUOL.		
Evaluating Capacity Development, funded by IDRC	Vernooy *et al.*, 2009 Campilan *et al.*, 2009		2006-?	The Evaluating Capacity Development (ECD) initiative brought together nine Asian partner organisations (all working on participatory, community-based, natural resource management) in an informal network to develop and pilot methods for evaluating capacity development processes and outcomes, promote the effective use of evaluation by organisations engaged in capacity development efforts, and facilitate wider learning and use of evaluation in capacity development.	Each organisation developed different sets of capacities according to the context (local needs and interests, previous efforts, resources at hand, the policy situation). Organisations adopted more participatory decision-making processes, or strategic directions became clearer.	

Capacity strengthening of NARS

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
Development of tomato packaging technology in India	Clark *et al.*, 2003		1999-2001	Participatory needs assessment which identified a focus on packaging of tomatoes. Literature searches and visits to research organisations to identify the most suitable technology. Testing the technology by a trial involving road transport to the Delhi market, physical analysis of the packaging and its contents and discussion with all participants in the marketing chain.	A cardboard carton was developed that can transport tomatoes from Himachal Pradesh to the Delhi market with acceptable levels of tomato quality deterioration. New institutional arrangements established between different actors in the value chain. Recognition by the project leader, IDE, that social science approaches are needed to complement a technological focus.	The intervention's impact was inclusive of the poor and lightened women's burdens. Furthermore, the project resulted in technological innovation (cardboard boxes) and institutional innovation (strengthening of innovation system and increased willingness to collaborate).
Support to innovation platforms in country programmes supported through the Research into Use programme	Dijkman, 2010		2007-2010	Establishing and supporting innovation platforms for specific commodities and experimenting with ways of developing innovation capacity that enables research to be put into use. Activities within each	Stronger linkages between different organisations in selected value chains in the target countries. Improved institutional arrangements include the establishment of decentralised pig marketing structures in	Projected impacts include improved livelihoods of farmers resulting from improvements in fingerling production in Malawi; the commercialisation of storage bags for cowpea; and increased adoption of potato micro-tubers in

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
				innovation platform varied but usually involved a combination of technical skills training with the facilitation of linkages between different actors and engagement with policy processes.	Malawi; establishment of a partnership of service providers in Sierra Leone which has started to influence policy processes; enhanced access of rice farmers to financing through contract farming arrangements.	Rwanda.
Integrated Natural Resource Management Zimbabwe	Hagmann *et al.*, 2002		1990-2002	The INRM approach was a community-based learning process in which local people and external service providers shared ideas and learn together. This included enhancing farmers' capacity to adapt and innovate, and negotiation of management of natural resources through stakeholder platforms.	More than 20 innovations in the field of land husbandry were developed in co-operation with farmers. Capacity increased for adaptive management, self-organisation, problem solving and collective decision making. Women's articulation was increased. More than 300 extension agents developed facilitation competencies.	Development and institutionalisation of an approach for participatory and integrated NRM research and extension.
Support for public-private partnership building in Latin America	Hartwich *et al.*, 2007			Building of public-private partnerships for innovation in seven value chains in Latin America through participatory research,	19 partnership proposals and concept notes of high quality were developed. Not all proposals attracted third-party funding,	The project contributed value not only by developing the proposals, but also by strengthening the capacity of the

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
				workshops and training.	however.	partners and others involved to instigate and participate in partnerships in the future.
Participatory market chain analysis in Uganda	Horton *et al*. 2010		2005-2007	Innovation platforms were created for three value chains. Project activities included: participatory planning and decision making; South–South learning exchanges; action-oriented PMCA training; knowledge sharing among practitioners; and learning-oriented evaluations.	Individual and organisational capacities were strengthened. Attitudinal changes among value chain actors towards collaboration. The main innovations developed in the value chains were improved packaging and labelling.	Improved packaging has resulted in increased sales and growing businesses for processors.
Fodder innovation project in Nigeria	Madzudzo, 2011		2003-2007	Initial technology transfer activities in the first phase changed to action research experiments to explore how to strengthen innovation capacity among livestock-dependent people. Partner organisations of the International Livestock Research Institute were	Some evidence that brokering functions, supported by the NGO SG2000, led to changes in habits and practices among the partner organisations.	

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
				given a basic induction in innovation systems, capacity development and the role of habits and practices in innovation. They were then supported to develop implementation plans.		
Collaboration between the International Potato Center and CARE in Peru	Ortiz *et al.*, 2008		1993-2007	Activities were in three phases: (1) promotion of sustainable methods for pest control on the potato crop; (2) adapting participatory research and training methods for the integrated management of potato late blight; (3) interactive and mutual learning processes among a larger set of institutions for the analysis of participatory methods and technologies.	The first 3-year phase of the project yielded a rate of return on investment of about 30%. Enhancement of (a) farmers' knowledge and decision-making process for potato pest control and (b) technical and methodological knowledge of CARE extension workers. Improved understanding of the requirements for successful action research and social learning processes.	After the first phase, benefits for potato growers were estimated to be from US$100 to US$175 per hectare per year. Following the action research phase, the figure was estimated to be about US$350/ha from new technologies and US$246 from using the new knowledge to make improved management decisions. Joint learning and collaboration through participatory research improved the effectiveness of both organisations.
Facilitating	Spielman		2003-	A variety of approaches to	There has been a shift	PPPs have changed the

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
public-private partnerships in agricultural research for development	*et al.*, 2007a, b Spielman *et al.*, 2010		2004	support collaboration between research institutes and private sector organisations.	from the traditional emphasis on increasing food security by enhancing yield and output, to new areas such as post-harvest value addition and value chain development. There has also been a slow move from a narrow focus on research for technological innovation, to a wider focus on concurrent organisational and systemic innovation. But these changes are not universal and there are few examples of joint innovation involving CGIAR Centres and the private sector.	way that CGIAR centres organise their research programmes. ILRI's East Coast Fever Vaccine project demonstrates how PPPs can extend beyond technology transfers to include joint planning and execution of research through repeated and durable interactions.
Support to innovation platforms in Nigeria through the Research into Use programme	Ugbe, 2010		2007-2010	Facilitation of networking among AR4D actors. Engaging with relevant national policies, institutions, processes and priorities. Collaboration with development agencies in specific value chains, for example, co-	Successful establishment of three innovation platforms in which NAROs and other organisations were engaged. Institutional changes included: the creation of a co-operative society by members of the cassava	Adoption of mosaic-resistant cassava varieties by more than 40,000 farmers in Abia State. About 6,000 cowpea farmers using improved cowpea varieties in Kano State and 4,000 out-growers adopted rust-

CS initiative	Reference	Project costs	Project period	Activities	Outcomes	Impact
				ordination of the cassava policy stakeholders' forum. This was done with the facilitation of the Agricultural Research Council of Nigeria.	innovation platform in Abia State; the establishment of a network of adoption villages; and collaboration with the World Bank's West African Agricultural Productivity Programme.	resistant soybean varieties in Kaduna State. Adoption of triple bagging by about 600,000 farmers and traders in cowpea producing areas in 6 states.

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