



CSIRO Submission 10/406

Independent Review of Aid Effectiveness

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Executive Summary



Science, technology and innovation as a foundation for sustainable development

Science, technology and innovation (STI) has the potential to form an integral part of the Australian aid program, its approach to development, as well as an enabler of development. Significant economic, social and environmental benefits to developing countries can accrue from the astute application of new technologies, innovation and knowledge, together with building the capacity of countries to generate, apply, adopt and absorb STI. Similarly, research plays an important role in informing evidence-based decisions in both the aid policy and action context.

Response to Terms of Reference:

A. Structure of the program – geographic focus, sectoral focus, low/middle income country focus, modes/forms of aid delivery and funding

CSIRO believes that there are four ways in which innovation for development can assist in delivery of aid:

- Geographic and sectoral focus alignment to take advantage of STI skills, knowledge and assets of mutual relevance and impact.
- Understanding global future trends in a development context.
- Incorporating a research for development focus and approaches for effective aid delivery and impact including:
 - participatory/action based research design, methods and implementation;
 - integrated research – multi-country/cross sectoral approaches;
 - long term, larger scale commitments to research for development projects;
 - supporting capacity building of a country's whole national innovation system;
 - inclusive innovation.
- Mobilising broader development partnerships.

B. Performance and lessons learned from Australia's approach to aid effectiveness.

- Ensure that lessons learned from projects are undertaken, implemented and shared.

C. Approach to efficiency and effectiveness and systems, policies, and procedures in place to maximise effectiveness

- Transparency through improved external knowledge management systems.
- Incorporating a research for development focus and approaches for effective aid delivery and impact.

D. Future organisational structure for the aid program and coordination of ODA across public service and other donors and institutions.

- Increase internal AusAID science and technology expertise.

CSIRO Submission to Review



Introduction

The Commonwealth Scientific and Industrial Research Organisation (“CSIRO”) welcomes the opportunity to make a submission to the Independent Review of Aid Effectiveness (“the Review”). If required, CSIRO would be pleased to provide further information or elaboration to the Review panel on any issues presented in our submission.

CSIRO is Australia’s national research agency, constituted and operating under the provisions of the *Science and Industry Research Act (1949)*. CSIRO is one of the largest and most diverse scientific organisations in the world. It has over 6600 staff located across 56 sites throughout Australia and overseas. CSIRO carries out scientific research in areas including energy, the environment, information technology, health, mining, manufacturing, agriculture and natural resources (see www.csiro.au).

We seek to make a difference and generate impact by focusing on the nation’s big challenges and opportunities. Those challenges are also often global challenges such as climate change, water resources and food security. CSIRO has a global reach in its activities with many different international partners¹ – in both developed and developing countries – including research collaborations, joint publications, supervising students, commercial agreements, consultancy advice, representation on international bodies etc. CSIRO has been involved in research activities with a development application for many years in regions such as Africa, South and South East Asia, China and the Pacific. Annex A provides a number of examples of our research for development activities.

CSIRO has a long history of working with both ACIAR and AusAID, which it believes are professional organisations, dedicated to their mission of providing development assistance. In its interactions it has seen these agencies achieve real on-the-ground impact, often in difficult circumstances and demonstrated an efficient and effective approach to aid delivery. We see AusAID and ACIAR as strong and strategic partners in coordinating priorities and partnerships in research for development, as well as leveraging each other’s specialist capabilities and strategic international engagements.

CSIRO’s submission to the Review is made in the context of our role and function in the national and global innovation system and from the perspective of a mission-directed research organisation. Therefore our focus here is on the contribution that research, science, technology, innovation and entrepreneurship (broadly referred to throughout the submission as “STI”) can make to sustainable and effective development outcomes and the Australian aid program. We will address those terms of reference where we see STI as most applicable.

We consider science, technology and innovation as a foundation for sustainable development. STI has the potential to form an integral part of the Australian aid program, its approach to development, as well as an enabler of development. Significant economic, social and environmental benefits to developing countries can accrue from the astute application of new technologies, innovation and knowledge, together with building the capacity of countries to generate, apply, adopt and absorb STI. Similarly, research plays an important role in informing evidence-based decisions in both the aid policy and action context². Together we refer to these concepts as “research for development”. We make the distinction between research *for* development and research *on* development – with the later more focussed on research that primarily informs policy development and knowledge around development issues.³

A number of international donor agencies have strong research for development or STI components in their aid program,⁴ and Australia does this well and with depth in the agricultural space through ACIAR.

¹ see [CSIRO submission](#) to the Inquiry into Australia’s international research collaboration. House of Representatives Standing Committee on Industry, Science and Innovation February <http://www.aph.gov.au/house/committee/isi/intresearch/subs/sub65.pdf>

² see the Australian Foreign Minister - Speech to the Australian Council for International Development, Canberra, 20 October 2010. “[The Importance of Aid Effectiveness](#)” – second basic principle

³ Note a greater emphasis on research on development or development research in the current [AusAID Development Research Strategy 2008-10](#). http://www.ausaid.gov.au/publications/pdf/research_strategy.pdf

⁴ see other agencies and their STI components: UK- [DFID-R4D](#) Canada’s [JRDC](#), World Bank

Recently, USAID's new reform agenda "[USAID Forward](#)"⁵ and the [Presidential Policy Directive on Global Development Policy](#) have expressly placed STI as one of the central platforms to "transform USAID into the global leader in development by pioneering scientific, technological, research-motivated and innovative approaches to traditional development challenges". Some of those reform efforts are to:

- launch a set of Grand Challenges for Development;
- leverage the federal science agencies and academic research investments to address shared challenges that affect Americans at home and developing countries abroad;
- enhance, build, and support the scientific and technical expertise in the agency.

In simplistic terms and taking from the proverb "Give someone a fish and you feed them for a day. Teach them to fish and you feed them for a lifetime", STI in sustainable development is not about just providing fish, but "working with the fisherman to develop the most effective fishing rod". Indeed there is one last step "Create the technology and infrastructure to process, distribute and value-add to the fish, and the whole community will benefit through sustainable livelihoods" – the real power of STI.

As was identified in the study "Innovation: applying knowledge in development"⁶ by the UN Millennium Development Goals taskforce on Science and Technology, responding to challenges in areas such as economic productivity, agriculture, education, gender inequity, health, water, sanitation, environment, and participation in the global economy will require increased use of scientific and technical knowledge. Technological innovation has the potential to underpin long-term growth as part of strategies to strengthen the private sector, government institutions and sustainable development.

Response to Terms of Reference

A. Structure of the program – geographic focus, sectoral focus, low/middle income country focus, modes/forms of aid delivery and funding

In its interactions with AusAID, ACIAR and other aid providers, CSIRO believes that there are four ways in which innovation for development can assist in delivery of aid:

- Geographic and sectoral focus alignment to take advantage of skills, knowledge and assets of mutual relevance and impact
- Understanding global future trends in a development context
- Incorporating a research for development focus and approaches for effective aid delivery and impact
- Mobilising broader development partnerships

In looking at the structure of the Australian aid program, it may be useful to consider these issues. Each of these is expanded on in the following sections.

Geographic and sectoral focus alignment to take advantage of skills, knowledge and assets of mutual relevance and impact

CSIRO believes that there are some particular aid domains, both geographic and sectoral, which clearly align with key Australian STI skills, thereby creating a comparative advantage in their application to development outcomes. Much of that advantage relates to the similarity of Australian climate, environment, soils, biodiversity, natural resources and farming systems to various developing countries, particularly the semi-arid and sub-tropical environment. The application of those skills to meet for instance the Millennium Development Goals could be overlaid on any specific geographic or sectoral or income level focus.

⁵ see also: USAID initiative "[Transforming Development Through Science Technology and Innovation](#)" – building on the report: "[The Fundamental Role of Science and Technology in International Development](#): An Imperative for the U.S. Agency for International Development" (2006) Committee on Science and Technology in Foreign Assistance, National Research Council. Note also the [US Department of State – First Quadrennial Diplomacy and Development Review \(QDDR\)](#)

⁶ <http://www.unmillenniumproject.org/documents/Science-complete.pdf>

Some examples of relevant geographic and sectoral areas in an Australian aid and STI context include:⁷

- *Climate change* – Developing countries that are priorities for Australia’s aid program are also highly vulnerable to climate change, particularly those in the Pacific, South-East Asia, South Asia and Africa. Managing the risks of climate change requires an efficient and effective adaptation response that is underpinned by research and technology which can inform both national policy solutions and scaled up technical and management solutions at local scales.
- *Food security* – Low world food stocks, the food-fuel debate, climate change, increasing energy costs and population growth have re-ignited the issue of global food security. There is an international imperative for production of major food crops to increase in order to keep pace with projected increases in population and consumption patterns. In response to these challenges, Australia has a critical role to play both in terms of its agricultural production and exports as well as in its contribution to the international agricultural research, development and extension effort. The food security challenge requires a systems research response in which constraints to agricultural productivity are addressed across science disciplines. This includes broadly posed efforts to diagnose constraints at farm, regional and institutional scales and stimulate positive changes in technology and practice uptake, human capacity building, design and operation of input and output markets and a conducive institutional environment involving farm households, small agricultural business, NGO and government sectors. Sustainability of production from agricultural land and areas dedicated to production forestry is essential to protect key system values including stored carbon, water supply and biodiversity and reduce the need for farmers to degrade surrounding environments for survival.
- *Water* – STI has been a key component of the Australian water reform agenda to enable a rational and transparent approach to the development of public policy. The opportunity for aid in the water sector requires STI working in synergy with assistance into reform in public sector governance and institutions. In the water sector this includes the evolution of an entitlement-based system of property rights and the establishment of a robust water market. For these to be robust and effective requires good information about water informing policy makers on how much, where, when, future projections, and the consequences of different sharing options. Australia’s work in large river basins such as the Murray Darling Basin,⁸ provides a comparative advantage in addressing for instance critical needs in the basins draining the Himalaya which supply water to 60% of the global population especially India and China. The issue of climate change impacts on water resources and basin-wide water availability modelling in this region is also very important. A further area of Australian expertise is in the development of managed aquifer recovery systems in both a regional and urban setting with a emphasis on decentralised water delivery systems. Watershed protection and associated water quality risk analysis systems are particularly important from a sustainably perspective in a number of countries. In addition, the risks posed by contaminants such as pesticides can be modelled and mitigation strategies prepared for catchments, together with remediation technologies. The area of water data management systems will support policy decisions into the future in developing countries and while this has been a strong emphasis within the United Nations, Australia, through for instance CSIRO/Bureau of Meteorology remain key developers of these systems via the Water Information Research and Development Alliance ([WIRADA](#)). There is also broader application of these information management systems to other data systems especially in the effective use of information to assist in planning, execution and evaluation of humanitarian and disaster response.
- *Environmental information systems* – Australia has substantial capability in the development of systems for mapping, monitoring and forecasting the condition of terrestrial, freshwater and marine resources. These systems are essential for identifying regions where natural resource management can be improved (e.g. better cropping practices) and where significant environmental degradation is occurring (e.g. erosion, nutrient decline in soils, excessive clearing, mining of groundwater resources). Many developing countries can derive direct benefits through building capability and gaining access to these new technologies. By way of example, CSIRO is actively

⁷ In the context of overall research priorities for research in sustainable food production, see for example the UK Government Office of Science - Foresight Programme and its recent [Global Food and Farming Futures](#) report (Synthesis report C6), including the overlap with climate change, biodiversity, energy, health etc

⁸ see for instance the Sustainable Yields project for the MBD: <http://www.csiro.au/partnerships/SYP.html>

involved in several regional and global efforts to dramatically improve access to reliable information on environmental condition and trend. These activities are part of the Global Earth Observing System of Systems and they address key issues for developing countries (e.g. food production, hunger eradication, maintenance of ecosystem services). Examples include information systems for soils (www.globalsoilmap.net) and biodiversity (GEO-BON). Globalsoilmap, for example, has a strong focus on developing technical capacity in sustainable land management. CSIRO leads the Oceania Node and a strong network is developing throughout the Pacific and South East Asia.

- *Energy* – improving energy access and its sustainable generation and use can be afforded through the next generation of affordable renewable power systems (in particular solar thermal and geothermal) for remote communities in developing countries; the design and operation of (small) grids with a high share of intermittent renewable power; providing low cost solar air conditioning and chilling solutions for communities and enterprises.
- *Biodiversity and Ecosystem Services* – many of the world's biodiversity hotspots⁹ (ie megadiverse but with large rates of habitat loss) are in developing countries that suffer food insecurity and have high rates of population growth. Australia has experience in managing its own biodiversity hotspots. Food security relies on maintenance of healthy biodiverse ecosystems to underpin healthy, productive soils; new germplasm for crop breeding; and management of pests and diseases. Biodiversity also provides ecosystem services such as clean water and nutrient recycling. Australia is a world leader in the use of modern technologies to document biodiversity and to make this information universally accessible.¹⁰ We also have expertise in the integration of biodiversity data with other kinds of natural resource data to ensure whole of system management. Developing countries can also rely on data repatriation from countries like Australia to assist them understand their biodiversity without having to bear the cost of maintaining physical collections. Similarly a remote microscope system in developing countries for taxonomy and identification represents an opportunity for future activity.
- *Bioeconomy & Biosecurity* - Australia can significantly contribute to improving sustainable natural resource utilisation and specifically land use for a range of industrial bio-based energy and bio-product outcomes.¹¹ Furthermore, enabling plant and industrial biotechnology capabilities can contribute to the delivery of sustainable biomass and biofuel production systems and create value-adding opportunities for regional communities to secure additional returns. A sustainable bio-based economy can deliver health & nutrition, energy and materials, ecosystem services and pollution mitigation. As a corollary issue, biosecurity also needs to be an integral part of any bioeconomy approach.¹² Australia has significant biosecurity and pest management expertise based on its efforts to maintain its privileged pest and disease status which confers on it significant economic, environmental and community benefits.
- *Green Growth* – Economic growth is essential for developing countries seeking to improve the health and well-being of their people. There is increasing pressure to undertake this growth in a way that is sustainable - both economically and environmentally. This is where "Green Growth" principles come into play. Increasingly developing countries are looking to adopt green growth measures as a means of moving to a sustainable, low carbon economy. The OECD is currently undertaking a substantial body of work associated with Green Growth and in its draft Green Growth Strategy Synthesis report¹³ has identified issues relevant to developing countries. CSIRO is using its science expertise to support green growth. By way of example, the Future Manufacturing Flagship (FMF) is looking to exploit Australia's manufacturing capabilities such that

⁹ Myers et al 2000, [Biodiversity hotspots for conservation priorities](#) Nature 403, 853-858. See also the recent work "[The Economics of Ecosystems and Biodiversity](#)" (TEEB) which provides tools for policy makers in valuing ecosystem services

¹⁰ see for instance the [Atlas of Living Australia](#)

¹¹ See for example the World Economic Forum report 2010: [The Future of Industrial Biorefineries](#)

¹² Sheppard et al 2011 – [Biosecurity as an integral part of the new bioeconomy: a path to a more sustainable future](#).

¹³ "Green growth policies need to be embedded in a coherent, integrated strategy covering demand and supply aspects, both economy-wide and at the sectoral level. This will ensure that green growth is not a just a short-term response to the crisis but a transforming dynamic for both production processes and consumer behaviour. While green growth is relevant to all countries, the policies and approaches used will have to be tailored to specific national circumstances. The overarching priorities for most emerging and developing countries are still poverty eradication, the provision of basic education, ensuring food security, and delivering essential services such as water supply and sanitation. At the same time, a large share of their economies is dependent on natural resources and they are often particularly vulnerable to the impacts of climate change, especially in terms of security of food supply and access to water resources. As such, their economic development will depend on timely adaptation and the sound management of the natural resources that are such a critical base for their economies."

that manufacturing becomes a cross-cutting enabler across multiple industry sectors, including energy, transport, infrastructure, water, mining, health, food, communications and some services sectors. The opportunities include cleantech manufacturing for renewable energy, sustainable water products, green building materials, electric vehicles, etc. Similar activities take place across CSIRO to support mitigation and adaptation measures to support green growth. An opportunity exists to apply Australian expertise to developing countries to support their economic development objectives. Additional benefits in-country flowing from the application of green growth principles also include the development of absorptive capacity for green technologies and the enhancement and growth of local skills and enterprises.

- *ICT for remote areas* – the use of telehealth extends the provisions of specialist care reducing the costs of employing and deploying health specialists into regional, rural and remote areas. When coupled with the efficiency and safety benefits associated with removing the need to travel to potentially hostile or difficult to reach environments, telehealth opens the door to making many more specialist services available to more people. Australia with its sparsely distributed population has much experience in this domain.
- *Tropical Health* – as one of the few OECD countries with a tropical footprint, Australia is already undertaking a significant amount of research in this area.

Understanding global future trends in a development context

A sectoral focus can also benefit from looking at and anticipating global future trends and the impact that they may have on the societal, economic and technological environment within which the overall Australian aid program operates. Understanding what these trends may be can inform a wide range of strategic and long term planning activities for development – especially those trends that have greater impact on developing countries. Supporting research and STI that prepares for future trends can also have a far reaching effect. CSIRO has recently conducted its own foresighting process which identified a number of interrelated megatrends:¹⁴

- *More from less*. This relates to the world's depleting natural resources and increasing demand for those resources through economic and population growth. Coming decades will see a focus on resource use efficiency.
- *A personal touch*. Growth of the services sector of western economies is being followed by a second wave of innovation aimed at tailoring and targeting services.
- *Divergent demographics*. The populations of OECD countries are ageing and experiencing lifestyle and diet related health problems. At the same time there are high fertility rates and problems of not enough food for millions in poor countries.
- *On the move*. The movement of people from rural to urban areas, people are changing jobs and careers more often, moving house more often, commuting further to work and travelling around the world more often.
- *iWorld*. Everything in the natural world will have a digital counterpart. Computing power and memory storage are improving rapidly. Many more devices are getting connected to the internet.

Incorporating a research for development focus and approaches for effective aid delivery and impact

As mentioned in the introduction we see a benefit to the Australian aid program to include a focus on research for development as part of its activities.

CSIRO has used the following approaches to research for development projects or programs so that the boundaries between STI and society become more permeable with the aim of facilitating greater development outcomes and aid effectiveness:¹⁵

- participatory/action based research design, methods and implementation;

¹⁴ CSIRO (2010): [Our Future World: An analysis of global trends, shocks and scenarios](#). See other examples of foresight activity: UK Government Office of Science - Foresight Programme and its recent [Global Food and Farming Futures](#) report.

¹⁵ Note also the work on best practices for research in developing countries by the Swiss Commission for Research Partnerships with Developing Countries (KFPE) in the publication Maselli D, Lys J-A, Schmid J. 2006: Improving Impacts of Research Partnerships. Swiss Commission for Research Partnerships with Developing Countries, KFPE. GEOGRAPHICA BERNENSIA, Berne, 96 pp. http://www.kfpe.ch/download/KFPE_ImpactStudy-final.pdf

- integrated research – multi-country/cross sectoral approaches;
- long term, larger scale commitments to research for development projects;
- supporting capacity building of a country's whole national innovation system;
- inclusive innovation.

1. Participatory research approaches

With the proposition that STI can form a pillar of the Australian aid program, it is critical however that the science undertaken is closely connected to participatory research approaches – namely involving stakeholders as active participants throughout the research continuum, from design to inception and from development through to delivery. They should not be seen as passive recipients of knowledge and technologies. Without the participatory work at varying and inter-related scales, there is a risk that the science generation supported by Australia is not transformed into forms or products that can be applied by people, in policy, planning and action on the ground.

The [AusAID-CSIRO Research for Development Alliance](#) (“the RFD Alliance”) established in 2007, has adopted this participatory research approach working closely in-country with key posts, and country programs, government agencies, universities, NGOs and local communities. CSIRO believes the RFD Alliance model has been successful in bringing together a partnership of science and development skills to inform and support the approach, addressing a major challenge of all too frequent isolation of science research from real development impact.¹⁶

Box 1: The AusAID-CSIRO Research for Development Alliance

AusAID and CSIRO established the RFD Alliance in 2007 to address climate change, urban sustainability and integrated water resource management from a research for development perspective. From a suite of initial scoping projects, four main long term projects have emerged:

- *Mekong Region Futures* - assessing national and regional decision-making about complex issues in ‘the Mekong’ countries – the nexus of energy, water and food investments. The idea being investigated is around providing integrated, alternative scenarios of long-term future development to support the needs of Mekong Region decision-makers today who have to consider the interconnected domains of energy, waters and food security in the context of changes in climate, land use, technology, urbanisation and populations. The outcomes are also to help inform future development decisions.
- *Climate Adaptation through Sustainable Urban Development* - Collaborative urban case studies in Can Tho, Vietnam and Makassar, Indonesia will focus on integrated urban water management systems as a means of assessing the application of sustainable urban development principles. These principles include climate change, population growth and rising demands on regional resources such as water and energy. This project will explore how these factors can influence major urban infrastructure projects and integrated urban environmental management issues with policy makers, urban managers and researchers.
- *Climate Adaptation Strategies for Rural Livelihoods in Indonesia* - Working with the Government of Indonesia and Indonesian scientists this project will assess vulnerabilities to climate change in the Indonesian Province of Nusa Tenggara Barat. Detailed local climate projections will help different sectors including agriculture and coastal fisheries develop adaptation strategies. The research will work at both the government and community scale, to work out how best to support people as they prepare to adapt to climate change impacts.
- *Bangladesh Integrated Water Resources Assessment* - Bangladesh water demand will grow with the growing population and increasing economic development. Whereas surface water resources are well studied, there are significant knowledge gaps in groundwater resources, the joint use of surface and groundwater, management strategies that enhance the efficiency in the equitable allocation of scarce water resources and improve livelihoods, and the potential impacts of climate change. There is a real risk of reduced access to safe drinking and irrigation water in rural areas, and of induced contamination of groundwater by saline

¹⁶ See the Alliance website for descriptions of the scoping and current projects, methods and outcomes; http://www.rfdalliance.com.au/site/current_projects.php; as well as lessons learned to date: <http://www.rfdalliance.com.au/userfiles/file/Learnings%20from%20Phase%201%20Final.pdf>

intrusion and ingress of polluted surface waters. This project will conduct an integrated water resources / socio-economic study to provide a national overview of the resource, the impacts of development and climate change, and the way the impacts will affect the poor and vulnerable.

CSIRO believes that the establishment of this alliance was a far-sighted act by AusAID, and is a global best-practice example of how to establish a long-term, multidisciplinary research for development program with tangible benefits.

CSIRO's relationship with ACIAR has also generated numerous research for development partnerships making a significant difference to the livelihoods of agricultural producers in developing countries. Annex A and Box 2 below provide some examples of those interactions, together with the development impact they generate.

Box 2 – CSIRO-ACIAR Expanding the area for Rabi-season cropping in southern Bangladesh¹⁷

Farmers in southern Bangladesh currently depend primarily on one wet-season rice crop per year to provide income for their families, meaning that around 800,000 hectares lie uncultivated during the dry (rabi) season. This is primarily because irrigation resources are limited, but other constraints also add to the perception that the area is too risky for wheat in a rice-wheat rotation. This project builds on earlier research funded by ACIAR and FAO. Its major aim is to address the constraints of water and unsuitable management practices, thereby improving the livelihoods of these farmers by making their fallow lands productive during the post-rice rabi season.

Farmers in southern Bangladesh have faced issues due to:

- limited irrigation infrastructure
- long duration local kharif rice varieties and lack of new varieties
- hotter temperatures than the north (averages 3 °C) with a shorter potential season
- some saline soils
- weeds in the rabi season (an issue for mungbean)
- lack of farmer expertise and limited extension experience.

But these constraints are being overcome. In this ACIAR-CSIRO project, the CSIRO modelling suggests wheat and mungbean can be grown with low-risk, long-term economic feasibility, particularly if surface flood water, stored from the kharif season, is sufficient for an in-crop irrigation – potentially generating as much as a million tonnes of new wheat every year. By putting these findings into practice CSIRO researchers have demonstrated six modern wheat varieties at more than 200 farms across seven districts of the south (Barisal, Bhola, Noakhali, Jhalakathi, Barguna, Pirojpur and Patuakhali), generally in clusters of six farms - with the above varieties under irrigation and dry land.

Component research has been conducted at the same sites, which aims to develop management practices adapted to the environmental constraints and packaged for farmers.

2. Integrated research – multi-country/regional/cross-sectoral approaches

Many development challenges are common across countries or regions and across scientific disciplines. This means that there are opportunities to improve the effectiveness and efficiency of research for development initiatives by having some integrated responses at sectoral and cross sectoral scales. There clearly still needs to be implementation at a county scale targeted to individual needs at local scale but there are likely to be significant benefits from also having more strategic and integrated activities. Examples in the climate adaptation space include:

- *Cross-sectoral activities* - e.g. regional climate projections/scenarios, economics and social acceptance of adaptation options, underpinning principles and typologies to building adaptive capacity in communities and institutions, regional futures projects e.g. Mekong.
- *Urban and coastal communities* - e.g. urban design innovations such as timber-based solutions for low cost, low carbon climate-adaptive housing, managing urban heat islands, coastal engineering for low-lying coastal communities, climate induced migration to cities.

¹⁷ ACIAR: <http://www.aciar.gov.au/project/LWR/2005/146>

- *Health* - e.g. regional approaches to managing vector-borne and other diseases both in direct response to climate change and extreme events as well as indirectly through migration; harmonisation approaches to link adaptation to disaster relief and recovery.
- *Rural livelihoods* - e.g. new climate adapted crops, regional food security through modified farming and livestock systems and market pathways, managing plantation and native forest systems under climate change
- *Ecosystem management* - e.g. managing marine and coastal environments for intrinsic value and support of livelihoods, and protection of infrastructure (natural barriers).
- *Water* - e.g. regional water security, especially mega-rivers and deltas

3. Larger and long term commitments to research for development projects

It is important to take a long term strategic approach to research for development projects, with the timeline for their impact very much dependent on the type of work and complexity of issues being addressed. For instance in the breeding of new crops the timescale is often between 5 to 15 years at a minimum, with new technologies such as marker assisted breeding providing some time gains. STI requires a portfolio approach to investment, with agencies balancing delivery and impact across policy horizons.

Moving beyond short term, general linkage programs, larger projects such as the two CSIRO-AusAID alliances in the fields of food security, climate adaptation, integrated water management and sustainable urbanisation, provide a scale of operation that reduces transaction costs from a research provider's perspective and a more integrated approach from a recipient or country collaborator's perspective. This model of cooperation and engagement, in the CSIRO-AusAID African Food Security Initiative for instance, means that Australia's investment can i) maximise R&D impacts by working within African strategies and institutions; ii) ensure broad geographic coverage through engagement in regional or multi-country programs; and iii) ensure a high profile within Africa in niche areas where Australia is recognised as a world leader in the R&D domain.

Another good example of the major impact that can be achieved through long-term collaboration with suitable partner organisations, is CSIRO's long-term assistance to Vietnamese forest research, to underpin that country's successful expansion of productive forest plantations. In-country benefits are increased and sustainable wood supplies to Vietnam's forest industries, with the creation of many thousands of jobs and economic benefits valued at hundreds of millions of dollars, and there are spill over benefits to neighbouring countries. Sustainable enhancement of Vietnam's forest research capability has been achieved and this work is detailed in Annex B.

CSIRO has played a similar role in developing agricultural and forestry research capability in countries such as China, Indonesia, India and Thailand, with research collaboration often focussed around improved genetic resources and farming systems for agriculture and plantation forestry. Australian forest genetic resources are particularly important for plantation forestry worldwide, with over 20 million ha of eucalypt plantations and million ha of acacia plantations established globally.

4. Building STI capability in developing countries

An essential component to a STI approach to development is to ensure that the STI capability of a developing nation is improved so that they are able absorb, adapt, use, and diffuse technologies that benefit their needs. We recognise the efforts of AusAID and ACIAR in respect of scholarships and fellowships around fields of STI.

R.A. Mashelkar, Chairman of the [Global Research Alliance](#) (of which CSIRO is a founding member) has suggested that STI can also stand for "solve, transform, and impact" – that STI capacity building must be about building the technical, vocational, engineering, entrepreneurial, managerial, and scientific capacity to *solve* each country's pressing social and economic problems, *transform* their societies, and have a positive *impact* on the standards of living and quality of life of the poorest strata of society.

The World Bank STI Global Forum in its recent action plan¹⁸ on “Science Technology and Innovation Capacity Building Partnerships for Sustainable Development” provides a framework and action plan on how not only the World Bank, but other donors such as AusAID can participate with developing countries in building their indigenous STI capacity to address social and economic objectives. The plan suggests the development of a suite of skills and technical capabilities, all linked and essential in order to achieve effective development impact, and recognising all the different components in a national innovation system:

- training scientists, engineers, technicians, and policy makers;
- promoting grass-roots, “inclusive innovation”;
- developing local institutions that can scale-up locally generated grass roots innovations and also identify, evaluate, and import technology that is in widespread use around the world but which is not being used domestically to address local development objectives;
- strengthening the capacity of local scientific and engineering institutions to conduct the R&D needed to adapt these technologies for local use and to generate socially and economically relevant new technologies;
- developing the technology transfer know-how as well as the management of intellectual property rights, that will be required to move inventions from the laboratory to the market;
- helping local enterprises become more innovative; and
- improving the governance and financial sustainability of the national STI system.

A feature highlighted in the STI Global forum was the importance of including science management and technology transfer skills into STI capacity. Australian organisations have a wealth of expertise that can be mobilised and shared with developing countries in this respect – from the technology transfer offices of universities and research organisations (see [Knowledge Commercialisation Australasia](#)), our IP managers and attorneys (see [Licensing Executives Society](#), [Intellectual Property Society of Australia and NZ](#)), our lawyers (see [Society of University Lawyers](#), [Australian Corporate Lawyers Association](#)) our research managers (see [Australasian Research Management Society](#)), our science educators and communicators (see [Australian Science Communicators](#)) and the human resource, strategic policy and finance personnel of universities, government departments and research organisations that enable science delivery.

5. Inclusive innovation approach

Inclusive innovation is essentially about harnessing STI and associated knowledge to invent, design, produce and distribute high performance technologies at prices that can be afforded by the billions of people at the bottom of the pyramid – for instance a high quality cataract eye surgery (currently) costing \$3,000 available at 100 times less; an artificial foot (currently) costing \$10,000 available at 300 times less. It is a “more from less for more” approach, also including the poor and grass roots innovators in the co-creation and co-innovation and co-commercialisation of inclusive solutions.¹⁹ Improving the STI capacity of a country and the innovation chain, as mentioned previously plays an important role in an inclusive innovation approach.

However the inclusive innovation approach often requires high-quality science and research, as these solutions often push the limits of the “cost-performance” curve for products and services.

¹⁸ See Global Forum Action Plan: “Science Technology and Innovation Capacity Building Partnerships for Sustainable Development” September 1 2010.

http://siteresources.worldbank.org/INTSTIGLOFOR/Resources/STI_GlobalForum_ActionPlan.pdf

Note also the detailed book for an overview of STI for development: “Science, Technology, and Innovation Capacity Building for Sustainable Growth and Poverty Reduction, Alfred Watkins and Michael Ehst, Editors.

http://siteresources.worldbank.org/EDUCATION/Resources/278200-1099079877269/547664-1099079975330/DID_STI_Capacity_Building.pdf

¹⁹ see Global Forum Action Plan in footnote above; and also: “Promoting Inclusive Innovation in India” in “Unleashing India’s Innovation: Toward Sustainable and Inclusive Growth,” edited by Mark A. Dutz, World Bank, 2007; examples of inclusive innovation programs include: [MIT’s D Lab](#), Global Research Alliance partners; [Arizona State University-Global Resolve](#)

Mobilising broader development partnerships

CSIRO believes that AusAID plays a leading role in engaging, supporting and mobilising the social, intellectual, industrial and financial capital of Australian individuals and organisations for development purposes. However, the aid architecture could also potentially bring in more non-traditional partners, such as the private sector,²⁰ by increasing their participation in (and understanding of) the development dialogue and building flexible and innovative bridges or models of engagement to enable their greater involvement in aid funding and relationships.

Aspects of Australia's social capital are already being utilised through AusAID's volunteer and civilian corp programs and other examples in a STI context include initiatives such as [Scientists Without Borders](#); [Engineers Without Borders](#); [GISCorps](#); [Random Hacks of Kindness](#); [Global Science Corp](#). Less traditional sources also include the professional sector, for instance those professional, industry and science associations²¹ that are intermediaries in the innovation system within Australia supporting the delivery of STI outcomes. These associations invariably have global reach with international counterparts, and provide networking, knowledge sharing and convening power that can be utilised in a development context. They often also support the "soft infrastructure" of global commerce – intellectual property rights and access, corporate governance etc which contributes to economic growth and development outcomes. An example of connecting this soft infrastructure, professionals, industry and research providers is the [Global Access in Action](#) initiative – promoting globally responsible technology transfer for the benefit of the people at the bottom of the pyramid. Similarly, harnessing science diplomacy²² can contribute to knowledge transfer and engagement with developing countries.

The private sector is able to drive an aspect of development impact, namely economic growth, through their knowledge of marketing, internal processes, distribution channels, and business models – with the application of STI or "enterprise innovation" often forming an important enabler of inclusive business models for development, for instance ICT for mobile supported finance or services delivery,²³ packaging materials for products, decentralised energy generations etc. Research organisations bringing along their industry commercialisation partners in research for development projects presents another model for engagement. Similarly, initiatives such [Business for Millennium Development](#) in Australia aim to engage the Australian corporate world in contributing to alleviating poverty and driving sustainable development in the emerging economies of the Asia Pacific.

Partnerships and collaborative relationships with other bi-lateral and multilateral donors, and other technology driven funders such as the Gates Foundation are important in delivering impact, as is support and access to global standards initiatives to drive more efficient STI collaboration and implementation. Similarly support is essential for global public facilities and resources that contribute to production and application of STI especially in a development context – such as the [CGIAR](#) agencies – where for instance estimates of the benefits from CGIAR research since 1989 range from nearly US\$14 billion to more than \$120 billion. Even under the most conservative assumptions, they far outweigh total research expenditures of \$7.1 billion since 1960 (expressed in 1990 dollars).²⁴

²⁰ see also Jane Nelson 2010: "[The Private Sector and Aid Effectiveness: Toward New Models of Engagement](#)"; the IFC report 2010: "[Inclusive Business Solutions: Expanding Opportunity and access at the Base of Pyramid](#)"; UNDP report: "[Business and Millennium Development Goals – A Framework for Action](#)"

²¹ see those associations mentioned previously: Knowledge Commercialisation Australasia, Licensing Executives Society, Intellectual Property Society of Australia and NZ), Society of University Lawyers, Australian Corporate Lawyers Association), Australasian Research Management Society), Australian Science Communicators) but also industry associations such as AusBiotech, [The Australian Information Industry Association](#) etc and science academies and associations such as the [Australian Science Academy](#); [Australian Academy of Technological Sciences and Engineering](#); [The Association of Professional Engineers, Scientists & Managers, Australia](#) (see also the InterAcademy Council <http://www.interacademycouncil.net/>)

²² see for example SciDev and related links: <http://www.scidev.net/en/science-and-innovation-policy/science-diplomacy>; Fedoroff 2010: [Science Diplomacy in the 21st Century](#).

²³ see for example the CSIRO-Centrelink Humans Human Services Delivery Research Alliance (HSDRA) which addresses current and future challenges in improving Australians' lives by applying evidence-based methods that integrate ICT, mathematical and socio-economic sciences, with the goal of enabling a national service delivery system that is evidence-based, sustainable, people-centric and harmonised across government and public human service delivery dimensions.

²⁴ see other impact briefs at <http://impact.cgiar.org/impact-briefs>

B. Performance and lessons learned from Australia’s approach to aid effectiveness.

Ensure that lessons learned from projects are undertaken, implemented and shared

The CSIRO-AusAID RFD Alliance mentioned previously was established to address issues related to climate change, urban sustainability and integrated water resource management from a large, coordinated and systems-based approach to research for development. Some of the lessons learned from the implementation of the initial scoping projects in the RFD Alliance illustrate²⁵ some suggested approaches to improve the effectiveness and impacts of research for development projects, in particular:

- *identifying research needs and general project design principles* - including integrating participatory research approaches into project design, allowing sufficient time for phases of research to be undertaken (scoping and trust building, action phase, follow-up phase). See Table 2 in the report for detail.
- *in-country partnerships* – developing and maintaining relationships are often key to achieving sustainable development outcomes. To manage issues around meeting in-country expectations longer term projects with committed funding helps address this issue as well as avoiding perceptions of “fly-in-fly-out science”. See Table 3 in the report for detail.
- *strengthening institutional partnerships* – recognising different organisational aims, modes of operation and cultures, fostering an effective research for development partnership involves understanding these differences and undertaking activities to negotiate points of difference and gain synergies. Some suggested approaches and activities include: regular seminars, greater exposure of work within organisation communication channels, understanding of each other’s procedures and governance arrangements.

ACIAR undertakes and shares impact assessments of its projects and programs – these assessments provide an excellent resource to understand the outcomes from its research investment in terms of rates of return on investment and poverty alleviation. Many of these impact assessments illustrate the significant economic benefits (e.g. \$174 million from a \$1 million investment) accruing from sustainable research for development projects.²⁶

C. Approach to efficiency and effectiveness and systems, policies, and procedures in place to maximise effectiveness²⁷.

Transparency through improved external knowledge management systems

CSIRO’s experience is that AusAID is a professional and dedicated organisation with internal systems and procedures in place to manage the effective delivery of aid. It also participates in, and supports forums for public dialogue and debate on aid and development (see for instance the Lowy Institute conference on [Advancing Innovative Development and Aid Strategies in the Asia-Pacific: Accelerating the Millennium Development Goals](#)). However, one area in which AusAID may find benefits in promoting further transparency is through improved external knowledge systems.

Knowledge is often based on knowing what has gone on before – what work has already been done, whether certain approaches have worked and knowing what individuals or institutions one can contact regarding certain projects. What is important is not only the accessibility of that information but also the type of information made available and the freedom to use, adapt and reuse it.

AusAID has a wealth of knowledge which might be able to be more broadly shared in the following ways:

²⁵ Roth et al, CSIRO-AusAID Research for Development Alliance - [Learnings from Phase 1 Projects](#) – August 2010

²⁶ see for example the following impact assessments relevant to CSIRO related work: Forage research in Indonesia: <http://www.aciar.gov.au/node/12632>; Tree species for Indonesia: <http://www.aciar.gov.au/node/2677>; Acacia hybrids for Vietnam: <http://www.aciar.gov.au/publication/IAS27>

²⁷ see also approaches to maximise effectiveness of research for development projects outlined in our response to term of reference A – “incorporate a research for development focus and approaches for effective aid delivery and impact”

- *Accessibility* – ability to search full text of documents (noting many documents on the AusAID website are pdf), single resource bank of information, data and tools.
- *Type of information* – detailed project descriptions, methodologies, outcomes, lessons learned, project recipients, project outputs (tools, models, software, checklists etc), locations of projects
- *Rights to use* – consider open access²⁸ (e.g. creative commons) copyright arrangements for documents made publicly available so there is the ability for all, especially developing countries, to not just use the information for their own purposes, but adapt, modify, distribute the information.

Some examples of useful external knowledge management systems include:

- ACIAR – [Research program](#) details
- DFID – [Research for Development](#) (R4D)
- ADB - [statistics](#); [projects/proposals](#); [business opportunities](#)
- USAID - <http://www.usaid.gov/km/>;
- IDRC – [databases, publications, tools and training](#)
- World Bank – [Publications](#); [Data and Research](#)

D. Future organisational structure for the aid program and coordination of ODA across public service and other donors and institutions.

Increase internal AusAID science and technology expertise.

To help deliver on the development potential from STI it might be advantageous to increase the internal science and technology expertise within AusAID. This internal expertise, rather than purely relying on external experts, could provide internal leadership and advocacy around the role of STI in development, together with an important ability to work collaboratively with other organisations that have STI capabilities.

This increased internal expertise would make the organisation even more well-placed to understand, advise, assess and compare technical alternatives in research for development projects.

Some additional suggestions to marshal STI expertise for AusAID include:

- *Appointment of a chief science and technology advisor* (e.g. DFID - Head of Research/Chief Scientist; USAID - Science and Technology Advisor; World Bank - Science and Technology Coordinator)
- *STI Fellowships* – One year fellowship appointments from research organisations to work within AusAID thereby bringing with them their scientific expertise and experience, or fellowships from AusAID into research organisations to bring their aid and development expertise. These arrangements could also foster a mutual understanding and insight between the “science” or “aid” worlds.
- *Science and Technology Advisory Panel* – much like the recently established AusAID Economic Advisory Panel whereby external individuals and organisations can provide advice particularly at the strategic and advocacy level on STI related issues and future science trends.
- *Inclusive research investment panels* – an interesting model that may have application in the development space is that used by the Grains Research and Development Corporation around “regional panels”²⁹ that provide a pathway for end-user driven research investment. For instance growers (i.e. the end users of grains research) researchers, people in agribusiness, community groups are part of informing and directing GRDC’s investment planning and processes. This voice

²⁸ see the [Government 2.0](#) Taskforce report; and the [Commonwealth Intellectual Property Principles for Australian Government agencies](#) – especially principle 11(b).

²⁹ GRDC: www.grdc.com/director/about/panels

and integration into R&D investment helps ensure that work undertaken by GRDC responds to the relevant community's varying priorities and needs.

Promote a whole of government approach to leverage Australian government STI investment applicable to development

The Australian government makes significant STI investment for the benefit of Australia across many different departments and in many fields of science which may have application (either directly or possibly through adaption) in a development context. AusAID and ACIAR could provide leadership in fostering and mobilising greater coordination of this research effort to achieve in parallel benefits for developing countries. Approaches could include: "dual use" grants, leveraging off existing funding, and increasing the scale and applicability of funded activities. The effect of this coordination and co-contribution is in the scaling-up and bringing forward some of the impacts of projects for development purposes.

If STI were to be one of the pillars of the Australian aid program then the Review may wish to consider science representation on the Development Effectiveness Steering Committee (DESC).

The Review may wish to assess the level of direct (not supported by AusAID or ACIAR) research for development projects that Australian government research related agencies (e.g. CSIRO, ANSTO, AIMS, IP Australia) undertake which would be regarded as ODA eligible.

Annex A – selected CSIRO research for development activities

Africa

Overview

CSIRO is proud of its long standing efforts at building partnerships in the African region focused on research that can help support African development. The majority of CSIRO's engagement in Africa to date has been in the areas of land based agriculture with emerging activity in climate change adaptation and aquaculture in East Africa. Many of CSIRO's projects in Africa (e.g. South Africa, Kenya, Tanzania, Zimbabwe, Zambia, Malawi, Botswana, Mozambique, Nigeria, Eritrea, Ghana) have been based on the similarities in the agro-ecological systems in Australia and Africa. CSIRO's efforts in Africa have invariably been in partnership with other Australian agencies, most notably ACIAR and AusAID and with African individuals or institutions. Examples (including cases studies outlining impact and effectiveness) of research for development projects priorities for Africa and CSIRO's efforts in this respect are outlined in CSIRO's submissions to the Joint Standing Committee on Foreign Affairs, Defence and Trade: "Review of Australia's Relationship with the Countries of Africa (Dec 2007)"³⁰

Food security

In 2010 CSIRO and AusAID entered a significant "[African Food Security Initiative](#)" – a three year collaborative program with two African research agencies:

- The Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles (CORAF)/West and Central African Council for Agricultural Research and Development (WECARD)
- Biosciences Eastern and Central Africa (BECA) hosted and managed by the International Livestock Research Institute (ILRI).

The program will develop country-initiated projects in west-central Africa examining crop-livestock farming systems, opportunities for strengthening seed systems, and integrated control of ticks and tick-borne diseases. Whereas in east-central Africa, animal health and human nutrition projects will be the primary focus. The aim of the program is to improve food security in Africa by fostering integrated agricultural research for development with African research agencies, improving agricultural productivity and sustainability of agricultural systems, including farming practices.

Vietnam

CSIRO's relationship with Vietnam has primarily been in the environment/agribusiness area – especially in capacity building and developing sustainable agricultural industries. Many of the interactions are supported by AusAID and/or ACIAR.

Animal health

Scientists at CSIRO Livestock Industries and its Australian Animal Health Laboratory (AAHL) are supporting South-East Asian countries in their efforts to control and eradicate infectious animal diseases. Some of these projects include:

- A AusAID funded project as part of the Vietnam-Australia Collaboration for Agriculture and Rural Development (CARD) Program, aiming to provide veterinary laboratories in Vietnam with the testing capability to diagnose foot and mouth disease (FMD) infection and to apply this capability in field studies.

³⁰ submission: <http://www.apf.gov.au/house/committee/jfadt/africa%2009/subs/Sub%2014.pdf>; Supplementary submission/questions on notice: <http://www.apf.gov.au/house/committee/jfadt/africa%2009/subs/Sub%2081.pdf>

- A AusAID funded project building capacity in relation to avian influenza (AI) diagnosis in Vietnam.
- A Vietnam-Australia CARD project aiming to improve classical swine fever diagnosis and produce a new vaccine against the pig disease.
- An Australian Centre for International Agricultural Research (ACIAR) funded project aimed at improving capability for shrimp virus PCR testing laboratories in Vietnam in order to enhance reliability of shrimp production for small-holder farmers in Vietnam.

Agricultural sustainability – acacia and eucalypts plantations

Over the last two decades, CSIRO has worked with research agencies, wood-growing and wood-processing industries, and rural communities in Indonesia and Vietnam to develop a sustainable plantation resource based on tropical Acacia species. This provides opportunities for developing countries to contribute to reductions of global CO2 emissions. There are projects aimed at reducing plantation fertiliser inputs, minimise off-site impacts and improve soil carbon storage as well as evaluation of Acacia genetic resources and tree breeding programs and identification of the best species for different planting environments. Pest and disease management research has involved collaboration between Indonesia, Malaysia and Vietnam. CSIRO receives funding support from ACIAR and AusAID.

Collaborating institutions in Vietnam include the Forest Science Institute of Vietnam; and various forest industry companies and smallholder tree growers. (See Annex B for further detail)

Marine aquaculture

CSIRO Marine and Atmospheric Research and the Food Futures Flagship are engaged in a long term project with ACIAR aimed at improving feed sustainability for marine aquaculture in Vietnam and Australia. The project looks at issues related to diet development and low-value fish replacement, and brings together a collective of important aquaculture sectors in Vietnam. The key subjects for study will be finfish (barramundi/Asian seabass, grouper and cobia), mud crabs and spiny lobster. The research team will seek to identify the extent of feed ingredient resource risks and the barriers (perceived and real) to adoption of manufactured feed by marine aquaculture sectors. The aim of the project is to lead to greater adoption of manufactured feed in Vietnam and improved use of alternative raw materials in both Vietnam and Australia.

Collaborating institutions in Vietnam include the Research Institute for Aquaculture and Nha Trang University.

Rodent management

This is a project supported by ACIAR and is aimed at implementing rodent management systems in intensive irrigated rice production systems in Indonesia and Vietnam. This project was designed to implement ecologically-based rodent management (EBRM) which can reduce rat damage, increase yields and reduce the reliance on rodenticides. Project activities in Vietnam occurred in lowland irrigated rice systems such as Ha Nam province in the Red River Delta and An Giang province in the Mekong River Delta. Farming communities in each area were trained and supported in implementing EBRM.

Collaborating institutions in Vietnam include World Vision of Vietnam; Plant Protection Department, Vietnam

Thailand

CSIRO worked with Mahidol University in Bangkok, Thailand to produce a kit that can detect the presence of two prawn viruses. The Australian Centre for International Agricultural Research (ACIAR) provided funding to develop the kit. The kit can detect the presence of both Gill-associated virus (GAV) and yellow-head virus (YHV), which are closely related. GAV poses a major threat to Australia's farmed prawn stocks, while YHV is a major killer of farmed prawns in Asia.

Indonesia

Increasing beef production in eastern Indonesia

The demand for beef cattle in Indonesia is rising and presents a potential for smallholder farmers. However, in the mixed crop-livestock farming systems of eastern Indonesia, expansion of cattle production is currently constrained by availability and quality of forage, poor herd management and limited understanding of trade-offs associated with management actions.

CSIRO and Indonesian researchers and smallholder farmers from Sulawesi, Lombok and Sumbawa developed and tested a range of 'best bet' practices for improving livestock production in existing farm systems.

The feedback from farmers and the results from monitoring the on-farm trials indicate quantifiable gains in forage and livestock production, labour savings and gains in household income; the intention of most farmers to continue successful strategies; and evidence of significant adoption/adaptation of the livestock improvement technologies by other (non-project) farmers.

Current research is focussed on understanding the adoption and dissemination process, studying farmer decision-making and flows of information through communities, and tracking livelihoods impacts associated with changing farm management practices.

<http://aciar.gov.au/system/files/node/10942/PMg%20Mar-Jun09%20Part8.pdf>

Australia's National Carbon Accounting System helping Indonesia

CSIRO, together with the Department of Climate Change and Energy Efficiency (DCCEE) and the Australian National University have developed a world-leading tool to measure greenhouse gas emissions and carbon sinks across Australia's landscape. The tool is called Australia's National Carbon Accounting System (NCAS). Australia is now sharing this technology with the world. In partnership with the DCCEE, CSIRO is working with a team of Indonesian scientists and officials to build an Indonesian NCAS as part of the Indonesia-Australia Forest Carbon Partnership. This team has also built a carbon accounting system for the Guangxi Autonomous Region in China as a pilot project for a future national system.

<http://www.csiro.au/partnerships/NCASpartnership.html>

Papua New Guinea

Improved livelihoods in integrated coffee/food garden farming systems in the Highlands of Papua New Guinea

Coffee is Papua New Guinea's (PNG) second largest agricultural export after oil palm, and approximately 370 000 smallholder households in 12 of the country's 19 provinces are involved in its production. It is the primary source of household income for many Highlands communities, especially in Eastern and Western Highlands where more than 80% of PNG's coffee is produced. Over 85% of PNG's coffee is produced by smallholders as part of a food garden/cash crop farming system.

The Sustainable Agriculture Flagship is developing new farmer-driven models to improve nutrient management, new technological applications and the mobilisation of labour for improved livelihoods in integrated coffee/food garden farming systems. CSIRO is working in partnership with ACIAR, local farmer communities, Curtin University and local and international Non-Government Organisations.

This project will also complement and inform a World Bank-funded project which commenced in 2010, thereby scaling-up and bringing forward some of the impacts of the project findings.

China

Capacity Building in China through Managed Aquifer Recharge (MAR) workshops

Researchers from the CSIRO Water for a Healthy Country Urban Water Flagship, in conjunction with the University of Jinan, Tsinghua University, the China Geological Survey and the Chinese Academy of Sciences conducted a Managed Aquifer Recharge (MAR) training workshop in Jinan, China 27-31 October 2010. The workshop, funded by the AusAID Public Sector Linkages Program, was hosted by the University of Jinan who sourced support from the National Natural Science Foundation of China, Jinan Water Resources Bureau and the Shandong Institute of Geological Survey. It was followed by a second workshop held in conjunction with the ReUse09 conference in Brisbane, September 2009, also supported by the AusAID PSLP grant.

MAR, including Aquifer Storage and Recovery, currently supplies 3GL/yr and is projected to recycle 250GL/yr stormwater and reclaimed water in Australian cities to supplement mains water supplies. Opportunities in China for use of this Australian-led passive technology to meet water shortages, improve water quality and assist in urban environmental protection are immense and likely to be among the cheapest ways of securing urban water supplies.

The activity was designed for skill transfer to enable the use of MAR in water resource management. Sustainability of the intended benefits requires continued knowledge transfer from those attending the MAR Training Workshops to colleagues and collaborators. The mechanisms to assist in this process included:

- involving participants from a range of backgrounds and organisations, including the counterpart organisations and their collaborators, to the intensive training workshop
- publication of the training material in Chinese
- written reports and seminars targeting various audiences, from activities within each organisation to more regional based activities (eg seminar on MAR in Shandong)

An immediate outcome from the workshop was the transfer of knowledge gained through experience in MAR within Australia. The knowledge transfer was assisted by publication of the training material in Chinese and English, translation of powerpoint presentations prior to the workshop and excellent translation throughout the workshop. Following the workshop, the training material was published as 'Recent Advances in China-Australia Managed Aquifer Recharge' ISBN 978-7-807354-572-5. Additional outcomes of the workshop include a commitment to form a Chinese working group on MAR and a network of demonstration sites.

Opportunities for Water Resource management in China

China's five year plan will set the research priorities into the near future and this can be a blueprint for development funding in this country. Some notable challenges include:

- Water over-allocation, industrial pollution are problems in China in the North China plain
- Inland river basins are over allocated (similar to the Murray Darling Basin) – large projects have been active in this area and it is mooted to again be included in the next five year plan
- Quantity, quality and governance of water are important
- Ecological requirements of inland river basins
- Monitoring, data collection and data sharing
- Protection of water supplies, both groundwater and surface water
- Recycling, desalination and stormwater in the context of urban water
- Pollution from industry and organic pollutants
- Governance issues, policies, etc re the water resource
- Integrated modelling work (i.e. eWater)
- Improving science management, coordination of agencies and scientific organisation

Annex B – Case Study – Vietnam

Forestry

CSIRO has been collaborating with the Forest Science Institute of Vietnam (FSIV) since 1992, on breeding and silviculture of fast-growing Australian tree species which are now widely planted in Vietnam. The combined area of acacia and eucalypt plantations in Vietnam now totals 900,000 hectares, and they have become a critical resource for industrial wood production in that country. Vietnam's paper pulp production is rapidly increasing, and its furniture industry earns over \$2 billion per year, although it imports the majority of the timber required for this industry (see the article "Rebuilding Vietnam's war-torn forests" in ECOS, edition 144 <http://www.ecosmagazine.com/?paper=EC144p26>).

Through a series of ACIAR and AusAID-funded projects FSIV established many genetic research trials that tested tree species, and provenance and family seedlots of the most promising species, supplied by CSIRO's Australian Tree Seed Centre (ATSC). The introduced seedlots formed the genetic base of FSIV's acacia and eucalypt breeding programs, which are now well-advanced and deliver genetically improved planting stock for faster-growing, higher value tree plantations. The economic impact is very substantial, with an independent evaluation indicating net present benefits of over \$120M (<http://www.aciar.gov.au/files/node/2677/IAS47%20part%201.pdf>)

CSIRO scientists have played a crucial role in developing research capability of Vietnam's forest researchers, enabling them to carry out the research in genetics, silviculture and wood quality that underpins sustainable and profitable development of Vietnam's forest plantations. CSIRO scientists have assisted with supervision of at least ten Vietnamese postgraduate research theses. They have provided insights into the genetic resources, breeding and silviculture of the plantation species under study, bringing insights from the domesticating these species in many other countries. Modern communications, particularly e-mail, together with project visits to Vietnam, enable CSIRO to effectively co-supervise Vietnamese students attached to universities outside Australia, notably in Sweden.

In addition to their long-term role in thesis supervision, CSIRO scientists have led many short-term training courses in Vietnam and Australia, in subjects such as tree breeding, experimental design and analysis, plantation silviculture, extension methods and wood processing. Over 200 Vietnamese scientists and technicians have received training through such courses. Leading Vietnamese researchers can now carry out this specialised training, so an independent training capability has been developed.

Prof Le Dinh Kha, and Dr Ha Huy Thinh, the past and present directors of FSIV's Research Centre for Forest Tree Improvement, have inspired, encouraged and supported their young scientists to set their standards high and become world-class researchers. CSIRO is well placed to carry out further high-level collaborative forest research projects in Vietnam, thanks to the advanced forest research programs and the strong research capability that has been developed at Vietnam's Forest Science Institute.

The forest plantation capability built in Vietnam now has significant spill-over benefits to neighbouring countries. Improved seedling and clonal varieties, including the highly productive acacia hybrid clones developed in Vietnam following an initial CSIRO-led project in Malaysia (<http://www.aciar.gov.au/publication/IAS27>), are under test and being adopted commercially for plantations in Laos and Cambodia.