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Review of Australia's Relationship with the Countries of Africa

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Inquiry into Australia's Relationship with the Countries of Africa

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Introduction

CSIRO is proud of its long-standing efforts at building partnerships in the African region focused on research that can help support African development. CSIRO's efforts in Africa have invariably been in partnerships with other Australian agencies, most notably ACIAR and AusAID and with African individuals or institutions.

CSIRO's international strategy recognises "research for development" in an international context as an important means whereby CSIRO can help to support Australia's national interests. CSIRO has sought to ensure Australian science is available to help deliver on Australian government priorities in the African region over at least the last 25 years. Emerging global challenges such as food security and climate change are not contained within national boundaries and it is important that Australia's science investment is well connected to the global research efforts in both the developed and developing world.

CSIRO also recognises many benefits that flow back to Australia and to CSIRO from building research for development partnerships in Africa. These are discussed in more detail in the examples that follow but they include direct science discoveries or methods development, indirect development of skills and capabilities within our staff, attraction and retention of staff motivated by the research challenges involved in working in Africa.

The majority of research to date has been in the areas of land based agriculture, but an emerging activity in aquaculture is developing in East Africa.

CSIRO's response to this enquiry focuses on the terms of reference:

3. ***Cultural, scientific and educational relations and exchanges***;

For the purposes of this enquiry, CSIRO has interpreted that scientific relations and exchanges represent the actual conduct of our research in Africa, as does the attendant knowledge sharing implicit in this process.

4. ***Development assistance co-operation and capacity building***;

CSIRO's efforts have been shaped by our interests in supporting the Australian Government's development assistance program in the African region, in which there was a strong alignment of a science need and an Australian capacity to help meet this need. Some examples are provided below.

CSIRO Activities in Africa

CSIRO has a long-established reputation for its contribution to international research and development (R&D), both through leadership of development aid projects undertaken in developing countries and via science collaboration with international R&D agencies. In most cases, CSIRO deploys its research principally through partnerships with Australian and international development agencies and in-country government, non-government and agribusiness organisations. Our key partner in much of the past and current activities is the Australian Centre for International Agricultural Research (ACIAR). Other partners have included AusAID and donor organisations such as World Vision, Rockefeller Foundation, USAID, and, more recently, the Bill and Melinda Gates Foundation.

Australia has significant expertise and comparative strength in agriculture and natural resource management and this is both integrative and participatory. Like Africa, Australian agriculture is based largely on extensive farming systems on soils of low inherent fertility and under high climate variability. Many of CSIRO's projects in Africa have been based on the similarities in the agro-ecological systems between Australia and Africa. CSIRO has experience in working in a range of African countries such as South Africa, Kenya, Tanzania, Zimbabwe, Zambia, Malawi, Botswana, Mozambique, Nigeria and Eritrea.

A) Agricultural research and development

CSIRO priorities in agricultural R&D address some of the major challenges facing the African region, and have assisted in the capacity building required to address these challenges. Current low world food stocks, the food-biofuel debate, climate change, increasing energy costs and population growth have re-ignited the issue of global food and fibre security. While livelihoods and prosperity are increasing in some parts of the world, driving increased dietary diversification and fibre and energy consumption, other parts of the world, particularly sub-Saharan Africa (due to economic, geographic, and human capital constraints) will find it harder to meet basic requirements for daily food intake, acquire energy for heating and cooking, and access wood-based construction materials. There is therefore an international imperative for the production of major food and tree crops to increase in order to keep pace with projected increases in world population, especially in many African nations.

However, emerging evidence suggests a slowing in the rates of agricultural productivity both in Australia and overseas. Agriculture is thus faced with the challenge of needing to increase production alongside the emerging constraints to land and water resources as well as new imperatives to reduce greenhouse gas emissions in the face of a carbon-constrained world.

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 R&D effort. Accordingly, CSIRO recently initiated its Sustainable Agriculture Flagship (SAF)[1] which explicitly incorporates goals that address the global challenges of food and fibre security and greenhouse emissions mitigation. This is achieved through partnerships at home and abroad which both increase the capacity of participants and identify pathways to develop and improve sustainable livelihoods.

Examples of research priorities for Africa and past and current CSIRO efforts include:

(i) Fertilizer-augmented soil enrichment strategies

Despite poor soil fertility and low or declining crop productivity in Africa, smallholder farmers are reluctant to invest in fertilizer technologies. The expected productivity gains from fertilizer use remain under-exploited in these farming systems despite a long history of research endeavour demonstrating significant increases in crop productivity. The recent evolution in soil fertility R&D efforts in Africa has moved to micro-dosing of fertilizer inputs as a means for farmers to initiate and experience the use of fertilizers without undue risk. Raising soil fertility and crop yields through use

[1] www.csiro.au/org/SAF-overview.html

of fertilizers, augmented by manure and legumes, remains a priority for R&D investment in Africa by both donor and research agencies.

From 1985 to1995, CSIRO led a 10 year ACIAR-funded research program in Kenya[2] whereby experimental research and simulation modelling suggested a strategy of augmenting traditional soil enrichment practices, based on manure and legumes with modest amounts of fertilizer, was economically feasible for many farmers. The local collaborator was the Kenyan Agricultural Research Institute (KARI) and, through this project, a number of its researchers were trained to MSc and PhD levels. This Australian work was one early basis for subsequent emphasis on micro-dosing strategies throughout Africa.

(ii) Farming systems research to enhance the effectiveness of agricultural change agents in Africa

Lack of access to both input and output markets is a key constraint to the uptake of crop technologies by smallholder farmers in the drier regions of Africa. Development of local markets is seen as a prerequisite for providing efficiencies that will encourage farmers to invest scarce resources in modern management strategies which provide up-side productivity benefits but also downside risk. Government departments and policy advisers, farmer organisations, non-government organisations (NGOs) and agribusiness companies are thus all key change agents in the design, promotion and delivery of technologies aimed at smallholder farmers in drier regions. Identifying low risk crop management strategies, as well as setting the level of surety on which agribusiness can expect reward, are key attributes needed in designing such interventions. CSIRO has pioneered a new form of farming systems research which is supported by systems simulation and has provided a novel approach to allow change agents to explore their options in designing and delivering services for smallholder farmers. This approach has had promising success in changing how NGOs and agribusiness view and service smallholders in southern Africa.

Between 1996 and 2005, CSIRO partnered with Australian development agencies (ACIAR, AusAID), international research centres (ICRISAT, CIMMYT) and national R&D agencies in southern Africa (Zimbabwe, Malawi, South Africa) to provide new insights into how systems models can be applied to assist change agents better understand how resource poor farmers prioritise investment options and how this influences technology choice[3]. This effort provided the entry for researchers to engage NGOs and agribusiness in their design of services for smallholder farmers. For example, agribusiness companies in Limpopo Province in South Africa introduced small packets of fertiliser and seed (10 kg bags) specifically for use by smallholder farmers based on simulation-supported evidence of their benefits[4]. Many of the current researchers employed in systems analysis activities in sub-Saharan Africa can relate their training back to this project.

(iii) Improved integration of livestock within cropping systems

Most African smallholder farmers have some livestock, yet both the performance of animals and their path to market are not regarded as priorities for many farmers. Enhanced integration of livestock within cropping systems can provide economic and

[2] www.aciar.gov.au/publication/PR041
[3] www.aciar.gov.au/system/files/sites/aciar/files/node/686/ACRC138_layout_A4.pdf - page 13.
[4] Whitbread, A.M.., Robertson, M.J., Carberry P.S. and Dimes J.P., 2009. How farming systems simulation can aid the development of more sustainable smallholder farming systems in southern Africa. European Journal of Agronomy, 32:51-58.

social benefits through enterprise diversification and income stabilisation. Livestock also impact on the soil resource; positively through providing manure for use as organic fertiliser but negatively by fully utilising crop residues as a feed resource and thus exposing the soil to erosion risk and nutrient depletion. Improving the performance of animals within cropping systems requires an integrated whole-of-system approach which has seldom been a feature of past R&D efforts in this domain.

Between 1999 and 2009, CSIRO-led, ACIAR-funded projects[5] in southern Africa (Zimbabwe, South Africa) concentrated on improved integration of livestock into cropping systems via improved forage and marketing strategies. Integrated crop-livestock systems are the basis of much of Australia's agriculture and this expertise was deployed by CSIRO in these Africa projects.

(iv) Improved crop varieties and their distribution

Low yields of staple crops in sub-Saharan Africa can be attributed, in part, to low adoption of improved varieties due to an inability of local support systems to access, generate, maintain and supply viable seed of staple crops to farmers. A gap exists in many countries between public breeding programs run by the national departments and industry needs for seed supply systems. There are also major issues with seed quality (viability and vigour) accessed by farmers. Poor seed vigour and susceptibility to pests are major constraints of crop yields. A current imperative is to foster effective linkages between the public and private sectors in the promotion and supply of seed with both quality genetics and viability.

Australia has extensive experience in the process of breeding, releasing and distributing new varieties, including the development and testing of germplasm, seed multiplication, and varietal release. Australia also has expertise in seed processing (harvesting, processing and packaging). For example, in research supported by the African Agricultural Technology Foundation and grants from the Rockefeller Foundation and USAID, CSIRO is currently undertaking research with partners in sub-Saharan Africa into developing genetically modified (GM) cowpeas with built-in resistance to pod borers[6].

(v) Lifting water-use-efficiency in rain-fed and irrigated agriculture in the semi-arid tropics

Extreme climate variability and the risk of drought are dominating constraints to dryland agriculture in the semi-arid tropics worldwide. The key to farming survival in these environments is to ensure water is utilised efficiently. Yet in semi-arid Africa, the water-use-efficiency (WUE, kg yield / mm water) of most crops is disappointingly low; due to poor rainfall capture and its utilisation. The conundrum for Africa is that lifting soil fertility will readily lift WUE but high rainfall variability is the root of farmer disincentive to invest in fertilizers due to the downside risks – farmers could purchase and use fertilizer but poor in-season rainfall and thus low yields will result in economic losses in such seasons. Technologies which improve rainfall capture (conservation agriculture, in-field ridges and pitting, local watershed development, irrigation schemes) will increase WUE, as has been demonstrated in many regions of the world. Their adaptation to African smallholder agriculture does warrant further exploration. Such examination should include irrigated agriculture.

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[5] www.aciar.gov.au/system/files/sites/aciar/files/node/555/proc115.pdf
[6] http://www.csiro.au/files/files/pjra.pdf

For both farmers and researchers in Australia, WUE is the acknowledged performance indicator for both rain-fed and irrigated agriculture. Australia leads the world in WUE measurement and research to gain even greater efficiencies through application of technology. Such expertise is well suited to the challenge of increasing WUE in Africa as demonstrated by CSIRO collaboration between 2000 and 2009 with researchers in South Africa on research funded by the South African Water Research Commission. This project aimed at improving irrigation practices of smallholder farmers in South Africa[7] by designing and producing a commercial product (the Wetting Front Detector) which is now in use by farmers and extension workers in South Africa.

(vi) Coping with increasing vulnerability due to climatic change

The world community faces many risks from climate change and the scenarios generally indicate higher temperatures and more erratic rainfall in sub-Saharan Africa. The hardest hit will be the rural poor in the drier areas, where crop failure due to drought is already common and chronic food emergencies afflict the region in most years. Lessons can be learnt on how the rural poor currently cope with the vagaries of climate and be used to help them adapt their current production systems to the future threats of further climate change. But this assumes the institutions that work towards the economic empowerment of the rural poor have the requisite skills to understand their current coping strategies and how adaptation can be facilitated.

Since 2007, CSIRO has partnered African researchers in training local change agents to support smallholder communities in adapting their agricultural practices to current climate variability and projected climate change – this work has been funded by the Canadian International Research Development Centre and supported by CSIRO's Climate Adaptation Flagship[8]. It is intended that the capacity of African scientists, regional organizations and decision makers in dealing with the issues of climate change and adaptation will be enhanced.

(vii) Food security in coastal Africa from aquaculture

The rise of aquaculture has been identified as one of the major global trends towards more sustainable agriculture and food production[9]. CSIRO Food Futures Flagship developments in aquaculture offer food security and export market creation opportunities for tropical and sub-tropical coastal Africa. They provide the opportunity to produce healthy seafood grown in drought-proof environments using ecologically sustainable systems sensitive to climate change. Whilst aquaculture has traditionally been dominated by China and South East Asia, coastal Africa's geography, history and cultural complexity position it well to develop aquaculture at the local farming system level and from there develop an industry. The aquaculture systems developed by CSIRO (based on unique genetic improvements and environmentally sustainable production systems) have ultra low-cost inputs with high value outputs, and the products from village-scale production systems can drive self sufficiency in seafood and produce an export market of high quality seafood. The CSIRO Food Futures Flagship is working in East Africa with *CORDIO* (an African coastal protection and research programme funded by Sida (Swedish International Development Co-operation Agency), a variety of Nordic NGOs and the World Bank) and local coastal communities from Tanzania (Tanga), and Kenya (Mombasa & Lamu), providing an effective mechanism for R&D engagement and delivery.

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[7] www3.interscience.wiley.com/cgi-bin/fulltext/121647158/PDFSTART
[8] www.csiro.au/org/ClimateAdaptationFlagship.html
[9] http://cleantech.com/news/5342/ten-cleantech-predictions-2010

(viii) Delivering improved tree germplasm for African agroforestry systems

Australian tree species, for example certain eucalypts, have been integrated into many African farming systems. Of particular note is the Australian Silky oak, *Grevillea robusta*, which is very widely grown on small farms in the densely populated equatorial highlands (Burundi, Ethiopia, Kenya, Rwanda, and Tanzania). This tree is favoured by farmers because it competes less with adjacent food crops than alternative timber species and provides valuable fuel wood, poles and building timber. Its initial introduction to Africa in the early 1900s involved a very narrow genetic base and inbreeding led to reduced tree vigour in farmers plantations. From the late 1980s, CSIRO forestry divisions collaborated with ICRAF (International Centre for Research in Agroforestry), and country research agencies on a series of projects that made rangewide seed collections, evaluated genetic variation in the species under African conditions, and developed scientific breeding programs and seed orchards that now deliver improved planting stock of Silky Oak to many farmer growers in the African highlands. This enables African farmers to increase their timber yields and associated income.

Benefits to Australia through engaging in Research for Development in Africa

The case examples in this submission point to real benefits on-ground in Africa from CSIRO's contribution to research for development projects across a portfolio of research domains and African countries. CSIRO also recognises the benefits to Australia from its involvement in research for development projects in Africa. Such benefits include:

- **Increased regional stability and prosperity:** CSIRO's international development work in Africa draws on Australia's research in dryland and irrigated agriculture in order to enhance the economic and regional security of the African continent through improved food production, the creation of African domestic markets and by providing enhanced research capability that can be applied to Africa's domestic research needs.

- **Solving regional problems and testing research:** Many Australian national challenges require regionally and globally deployed solutions, and in applying CSIRO research to a wider range of geographic settings across Africa, the science quality and applicability within Australia will be increased. A clear example of such benefit is Australia's internationally-recognised farming systems research and climate risk management capability. Built up around the APSIM systems model[10], its genesis and development over the past 20 years grew from the research imperatives which CSIRO progressed in both Australia and African farming systems.

- **Talent development:** CSIRO's current and future talent will be deployed into and attracted by research for development activities in Africa. A number of current science leaders in CSIRO were involved in the research examples provided in this submission and such work contributed to their broad systems view of the research agenda for CSIRO nationally and internationally.

- **Reputation and investment in the future:** Significant opportunities for participation will arise through collaboration and engagement with other research

[10] www.APSIM.info

institutions (African and other International research agencies active in the continent), development banks, and donor and recipient agencies. CSIRO develops partnerships for regional aid and development opportunities as a good global citizen, and following this, forms strong long-term relationships with its neighbours as their economies emerge.

- **A stronger national innovation system**: The large scale and scope of some development and major global change challenges (such as food security) offers the opportunity for increased coordination and leadership by CSIRO of evidence-based approaches with consortia of government agencies, industry and the university sector.

Conclusions

Over the past 25 years, CSIRO has supported Australian Government priorities in research for development activities in Africa, particularly in improving the livelihoods of African smallholder farmers. Indeed, there are demonstrable returns from CSIRO research both in Africa and in Australia. Consequently, we see a strong case for continuing Australian support for Africa via research for development initiatives.

CSIRO has been able to work in Africa to a large extent through the support that has been forthcoming from other Australian Government agencies, most notably ACIAR and AusAID. CSIRO values these partnerships enormously and seeks to continue to grow them in scale and effectiveness.

In line with current Australian Government priorities, CSIRO positively supports its continued involvement in the ongoing global research imperatives addressing food security and climate change. Sub-Saharan Africa is particularly vulnerable to these global challenges and Australia, and CSIRO, is well placed to assist in meeting these challenges.