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Committee Secretary
House of Representatives Standing Committee on Agriculture and Industry
PO Box 6021
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Friday, 25 September 2015

Dear Committee Secretary,

Inquiry into the role of technology in increasing agricultural productivity in Australia

Please find attached the Australian Centre for International Agricultural Research (ACIAR) submission to the inquiry into the role of technology in increasing agricultural productivity in Australia.

The ACIAR contact officer for the inquiry is Mr David Shearer.

I trust the attached submission is of assistance and would be delighted to meet with the Committee to discuss ACIAR's submission. My best wishes for a successful and productive inquiry.

Yours faithfully,

Nick Austin
Chief Executive Officer



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Executive Summary

The Australian Centre for International Agricultural Research (ACIAR) mission is to achieve more productive and sustainable agricultural systems for the benefit of developing countries and Australia, through international agricultural research partnerships. ACIAR is a key part of the Australian Government's aid program, which promotes Australia's national interests by contributing to sustainable economic growth and poverty reduction.

As Australia's specialist agricultural research-for-development agency, ACIAR brokers research collaborations between Australians and researchers from developing countries in the Indo-Pacific to build healthier, more equitable and more prosperous societies. Although focussed on developing countries, these research collaborations also contribute to increasing agricultural productivity in Australia through the development and adoption of new and emerging technologies.

ACIAR's contribution to increasing Australian agricultural productivity through the development and application of technology in Australia is rich and multifaceted. Being an international research broker and funded with Australian aid, ACIAR is a unique operator. ACIAR contributes to agricultural innovation in Australia, through research projects it commissions as partnership between developing countries scientists and Australian scientists; the communication and dissemination of research findings; and through its support of the international agricultural research centres of the CGIAR¹.

ACIAR-supported biosecurity projects, for example, investigating invasive plant and animal pathogens currently absent in Australia, ensure that Australian research capacity to address future biosecurity threats is maintained and developed. Innovative ways to deal with biosecurity threats include biocontrol agents and pre-emptive breeding of resistant varieties or strains. While some of these projects may seem irrelevant to Australia in the short term, they represent a source of innovation and cost-effective risk management which deserves ongoing support. This was clearly demonstrated when ACIAR-sponsored research findings were deployed to control the recent outbreak of Panama disease in the Tully Valley in March 2015 (see enclosed case study for more detail).

This submission illustrates ACIAR's contribution to increasing agricultural productivity and the role of technology in Australian agricultural productivity through a series of short case studies. The case studies demonstrate the diverse ways in which ACIAR's research collaborations deliver an impressive return on investment – conservatively five dollars for every dollar invested – and change the lives of smallholder farmers in some of the poorest regions of the world and make a contribution to agricultural productivity in Australia.

¹ Formerly the Consultative Group on International Agricultural Research

Case studies illustrating ACIAR's role in increasing agricultural productivity in Australia

Support for the CGIAR Centres

Improved plant and animal varieties are a major source of innovation with the potential to vastly improve the productivity of Australian farmers. Through ACIAR projects, over the past 3 decades, plant breeding organisations (public and private) in Australia have been able to access a broad range of genetic diversity, the raw material of plant breeding. The application of plant genomics data is now accelerating the breeding of new varieties. ACIAR projects on water-efficient sorghum, deep-rooted wheat and disease-resistant mungbean provide the framework to exchange promising genetic material with partner countries. However, the continuous breeding and release of improved varieties will remain dependent on regular access to genetic diversity.

This will require Australia to continue to support the International Agricultural Research Centres of the CGIAR and the gene banks they host and manage. It is also important that Australia remains engaged in the international negotiations about genetic resources: the International Treaty on Plant Genetic Resources for Food and Agriculture provides a workable legal framework but only covers a subset of crop species. Under the Biodiversity Convention, access to genetic resources is more constrained and may act as a barrier to future productivity improvements.

According to the Crawford Fund (2013)², Australia's contribution to three CGIAR Centres are especially relevant to Australian crops: the International Maize and Wheat Improvement Center, the International Crops Research Institute for the Semi-arid Tropics and the International Center for Agricultural Research in the Dry Areas. These have delivered annual benefits to Australia from plant genomics and resources estimated at more than \$100 million a year.

Benefits from deep-rooted wheat in India and Australia

ACIAR is supporting an Indo-Australian project on root and establishment traits for greater water use efficiency in wheat. It is utilising an Indo-Australia Program on Marker Assisted Wheat Breeding (IAP-MAWB) modality. **This innovative partnership modality will assist in increasing agricultural productivity in Australia.**

The project is developing wheat varieties with deeper, faster-growing roots that better exploit soil moisture and increase yields in rainfed or minimally irrigated systems in India and Australia.

At core sites in both countries, root growth rates, rooting depth and potential for genetic improvement is being researched as the two countries also co-develop protocols to measure root growth in controlled environments and leaf temperature in the field.

Wheat breeding populations are being developed, combining desirable traits for roots and shoots. Parallel with this, molecular markers for root traits are being developed via an over-arching joint program for faster wheat breeding in both countries. The second phase of this research aims to apply these outputs to deliver useful breeding lines and molecular markers. The parental lines identified using the tools and methods developed in the project will be used to genetically map the root traits and breed deep-rooted adapted wheat varieties. The benefit of deep water uptake on yield and water use efficiency will be determined.

² Doing Well by doing good: International agricultural research – how it benefits Australia as well as developing countries

At three Australian and five Indian core sites the joint research team will study root growth rates, rooting depth and potential for genetic improvement. The team will also co-develop protocols to measure root growth in controlled environments and leaf temperature in the field. In addition, the team will investigate shoot characteristics that influence crop establishment and water-use efficiency.

Desired outcomes are development of wheat breeding populations that combine desirable traits for increasing yields in water limited conditions in Australia and India, and also identification of molecular markers that indicate traits for deeper roots and better crop establishment.

The benefits for Australia of battling Panama disease in Indonesia and the Philippines

The unfortunate discovery in 2015 of *Fusarium Wilt Tropical Race 4* in bananas in the Tully Valley and the current battle to contain it, has highlighted the considerable contribution that ACIAR has played through recent project work in Indonesia and the Philippines. **The Australian researchers involved, as well as the research outputs generated, are proving to be of enormous benefit to the management of the current outbreak in North Queensland** and will continue to add value as the Philippines project delivers on planned milestones for research in the partner country and Australia. Learnings from the research will provide the Queensland industry with the tools to continue production for many years as the industry evolves to take on better varieties and new production systems.



Figure 1: Australian and Filipino researchers discuss the management of *Fusarium Wilt*. Source: Richard Markham, ACIAR

Water-efficient sorghum benefiting global cropping systems

Sorghum grown in India in the post-rainy season (Rabi), and **within Australia's cropping systems**, relies on residual soil moisture, and the crop is commonly exposed to terminal drought stress. But there is a ready market for its high-quality grain and stover (used as fodder on dairy farms). Steps to improve productivity while maintaining quality offer an attractive opportunity for sorghum farmers to improve incomes and farm profitability.

Genetically improving the efficiency of using stored soil moisture is a prime target to maximise grain/stover production and quality of sorghum. ACIAR's support to international research partnerships is achieving this through the application of DNA sequences known as quantitative trait

loci (QTLs). The project scientists will introduce marker-assisted introgression of stay-green QTLs into sorghum lines, enhancing both the quality and the quantity of grain/stover of postrainy sorghum.

The partnership will also use modelling to identify the key physiological traits involved in a higher, more stable yield across water-limited environments of India and Australia, and the key stay-green QTLs contributing to these traits.

Plantation forestry improvements in Indonesia and Australia

Between 1987 and 2006, ACIAR invested in twelve forestry projects in Indonesia with the aim of improving plantation forestry in both Indonesia and Australia. These projects focussed on the domestication and silviculture of Australian trees and other multi-purpose trees such as sandalwood. They also undertook research on genetic improvement of plantation trees, control of fungal diseases and insect pests and on policy instruments for sustainable plantation management.

An independent impact assessment calculated benefits worth AUD 11.914 billion from the 12 projects. For the cluster of projects on Australian trees, evidence of impact was only found in Indonesia, associated with the expansion and improved productivity of *Acacia* and *Eucalyptus* industrial pulpwood plantations. Conversely, for the agroforestry and multi-purpose trees cluster of projects, **the study found evidence of impact only in Australia, related to the development of the Ord River sandalwood plantation industry, with estimated to be worth AUD 766.48 million.**



Figure 2 Product of ACIAR Forestry projects in Indonesia. Source: Tony Bartlett, ACIAR



Figure 3 Dr Eko Hardiyanto University of Gadjra Mada measuring an Acacia tree in Indonesia. Source: Tony Bartlett, ACIAR

This program of research has generated very high returns and benefits to both Indonesia and Australia. In Indonesia most of these benefits relate to the large expansion of short rotation plantations of *Acacias* and *Eucalyptus* that produce wood for Indonesia's pulp mills – which produce paper that Australia buys. In Australia it led to the development of the sandalwood industry around Kununurra.

Feed improvement for mariculture in Vietnam and Australia

An ACIAR Fisheries project has brought together researchers, feed millers and fish producers in Vietnam and Australia in a partnership to improve all aspects of feed formulation, manufacture and use in fish farming in both countries. The project improved the capacity for nutritional research in Vietnam and consolidated nutritional research capacity in Australia. Nutritional models were

developed to account for growth prediction and utilisation of nutrients. Finfish (barramundi, grouper and cobia), mud crab and spiny lobster were the key species studied. The project built on efforts related to diet development and replacement of fish meal and fish oils from three previous ACIAR projects.

The project initiated the Regional Aquafeed Forums (RAFs), which is an annual meeting of feed manufacturers, fish farmers, researchers and policy makers in Vietnam. The RAFs have directly facilitated the integration of the various sectors of the aquaculture industry, helping it to become a mature and economically important industry (aquaculture exports from Vietnam are worth approximately US\$5 billion annually). Continuation of the RAFs will ensure the impacts of the project will continue in the future.



Figure 4 Feeding fish in marine cages in Vietnam. Source: Chris Barlow ACIAR



Figure 5 Brett Glencross and barramundi in Indonesia. Source: Chris Barlow ACIAR

The project team was successful in developing nutritional technology for barramundi, cobia, grouper, mud crabs and lobster. The skills and knowledge gained can be applied to other species. There is potential to apply the lessons from this research to Australia. Project partners include CSIRO Marine and Atmospheric; Vietnam Research Institute for Aquaculture No. 2; University of Nha Trang Vietnam; and NSW Fisheries.

Disease-resistant mungbean

Mungbean is one of the most important food legumes in Asia and the most important summer legume in northern Australia.

An ACIAR project is addressing major constraints to mungbean productivity by bringing together the the World Vegetable Centre and the Australian mungbean breeding program based at the Queensland Department of Agriculture, Fisheries and Forestry. Building on available genetic material allowing for a fast start of activities, co-funded by the Grains Research and Development Corporation and ACIAR, will identify key areas for germplasm enhancement, and use available genetic resources to study resistance to three biotic stresses.

Conclusion

ACIAR makes a unique contribution to the development and deployment of technology to increase agricultural productivity in developing countries and in Australia. Independent studies show benefits that have flowed to Australia to exceed \$2.5 billion, and Australia's contribution to international agricultural research centres delivering annual benefits to Australia estimated at more than \$100 million a year.

Future increases to agricultural productivity in Australia, through improvements in the efficiency of agricultural practices due to new technology; emerging technology relevant to the agricultural sector; and overcoming barriers to the adoption of emerging technology, will continue to be dependent on the connectivity between Australia and international agricultural research.

Appendix

About ACIAR

ACIAR has, for more than 30 years, played a highly specialised and important role in advancing Australia's economic and foreign policy interests. Through increasing agricultural productivity in developing countries in our region, ACIAR contributes to the Government's key objectives of building prosperity and providing new trade, investment and business opportunities for Australia. This role also delivers benefit for Australian agriculture, including improving the productivity of Australian agricultural systems through the development, access and deployment of technology.

ACIAR, a statutory body with the CEO accountable directly to the Minister for Foreign Affairs, is closely integrated into the Foreign Affairs and Trade portfolio. It has been a key part of the Government's foreign policy effort due to the enduring relationships it has developed through its in-depth partnerships in the region. ACIAR plays a central role in implementation of the Government's development policy, which includes agriculture as a priority area, and as an integral part of the Government's economic diplomacy strategy in the Indo-Pacific region.

ACIAR works with the brightest minds in Australia and around the world to find practical solutions to agricultural development problems. ACIAR commissions expert Australian research groups and institutes, and selected international agricultural research centres, to carry out research projects in partnership with counterparts in developing countries. ACIAR is also increasingly engaging with the private sector on collaborative research. ACIAR's results-driven research makes developing countries more self-reliant, leading to better health outcomes and, higher incomes.

ACIAR's innovation and impact

ACIAR puts Australia's agricultural innovation system to work to reduce poverty and contribute to the long-term economic prosperity of developing countries. This work contributes to stronger economies and to poverty alleviation, which is central to Australia's aid agenda. There are significant spillover over benefits to Australia derived through these activities.

Stronger economies in our region assist Australian exporters and investors to access and profit from foreign markets. Support for more-productive, market-led agricultural systems that engage smallholders encourages developing countries to effectively tap into new opportunities. In these ways, ACIAR works towards a future of shared prosperity.

Through partnerships in science and technology, ACIAR fosters closer ties between Australia and the region and develops stronger people-to-people links. These are some of the most effective ways of assisting other nations, and of creating real bridges between Australia and our counterparts.

ACIAR concentrates efforts in developing countries of Asia and the Pacific, while also engaging in high-payoff partnerships in other regions in support of Australia's foreign policy objectives. We work through both bilateral (at least 70%) and multilateral (up to 30%) modalities.

ACIAR generates new technologies, new knowledge, greater capability and better decision-making from our research partnerships. By focusing on impact pathways, ACIAR will deliver more-productive and sustainable agriculture for the benefit of farmers and consumers in developing countries and Australia.

ACIAR is driven by a focus on impacts. ACIAR continues to strive to understand the needs of next and end users of our research and to develop impact pathways that continually respond to the changing circumstances in which the outputs of research can best be utilised. We will place emphasis on

building partnerships and processes that maximise the likelihood of impact, primarily to deliver development benefit of the Australian aid program, which also benefits the Australian agricultural systems.

Independent assessment conclude:

- Australian aid well serves our national interests of regional peace and security by alleviating poverty and by enhancing food security and economic growth in developing countries.
- Agricultural R&D is an effective way to meet these national interests. It is delivered by ACIAR, which, in turn, relies on cooperation with other Australian agricultural research institutions, including State and Federal agencies. Their willingness to cooperate reflects a view that international agricultural research also serves their institutional objectives.
- A review of ACIAR's bilateral research program (about 70% of its budget) found that the rate of return on investment by ACIAR and its Australian and developing country partners – from a limited sample of projects (about 10% of the total bilateral program) – was between 50:1 and 70:1, depending on whether benefits judged to be convincing or plausible are included. This return greatly exceeds total investment in bilateral research since ACIAR's inception 31 years ago. The return is mostly in the form of increased farm incomes in developing countries.
- There are spill over benefits that support Australia's agricultural systems through improved productivity and enhanced biosecurity