



CSIRO Submission 14/492

Development of Northern Australia

Joint Select Committee on Northern Australia

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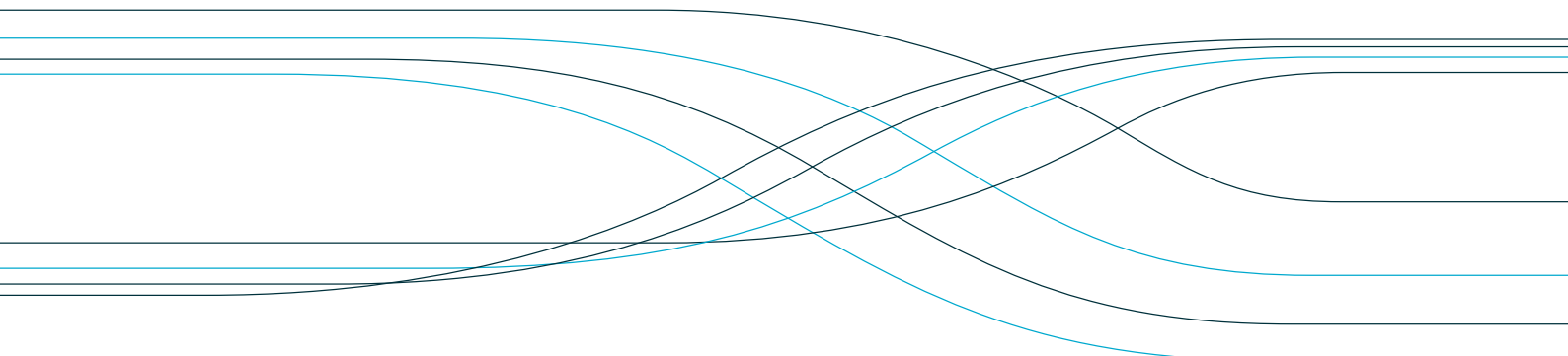


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Executive Summary

CSIRO welcomes the opportunity to provide input to this inquiry, based on its relevant research to support sustainable development of industries.

Potential for Industry development

A number of sectors and industries present potential for sustainable growth in Northern Australia.

Mining has a role to play in the development and its growth will depend on global demand, financial markets and local factors including water availability, energy supply, available skills, transport and infrastructure development, relationships with Indigenous communities, access to land and government policy and incentives.

For the oil and gas industry, success depends on effective and sustainable exploration and efficient extraction and processing, while uncertainty around the socio-economic and environmental impacts of the unconventional gas industry is an issue for the rate of its development.

Increased tourism and recreation in northern Australia depends on improvements to current facilities and access to an appropriately skilled workforce for operators.

The volume and value of infrastructure in the north could be increased by establishing clearer links between military and civilian infrastructure needs and benefits.

There is potential for productivity gains in the beef industry of 40-50% by deploying technological innovations that simultaneously improve reproductive performance, genetic gains, forage quality, nutrition and growth. Tools developed by CSIRO have also been used to focus infrastructure investment priorities for potential industry benefit. Recent studies indicate that establishing irrigation on beef properties is unlikely to provide the most cost-effective method for enhancing beef production.

Opportunities for development of a number of cropping industries have been explored in recent years and, as for the pastoral industry success would require matching suitable genotypes (or breeds) with appropriate management strategies to maximise production and economic returns. The Flinders and Gilbert Agricultural Resource Assessment recently delivered a comprehensive assessment of sustainable water resource development and the potential for new irrigated agriculture in those catchments, while the Food and Fibre Value Chains project will provide in mid 2014 an indication of medium and longer term opportunities and practical improvements that could be made across supply chains to improve longer term prospects for agricultural commodities. Initial historical analysis indicates that public investment in infrastructure has been a key factor in the success of irrigation ventures in the North.

Northern Australia's wild fisheries appear to be managed sustainably, and the 2009 Northern Australia Land and Water Science review indicated little potential to increase yield. There is a risk that harvests may decline if river flows are reduced due to water allocation changes and this issue is under active investigation by CSIRO and partners.

Advances in tropical aquaculture technology, together with emerging commercial interest in large-scale prawn farming, indicate a strong trajectory for the growth of tropical aquaculture in northern Australia, as long as discharge water quality standards can be met to ensure the health of ecosystems important to Indigenous communities, tourists, commercial fishers, and recreational users of waterways for recreation.

There is significant potential economic opportunity from emissions abatement in the North - in the order of hundreds of millions of dollars per annum once enabled. Issues around this are complex and our knowledge is incomplete, with new technologies and methodologies needed.

Impediments to growth

In realising the potential for development of Northern Australia, current and potential impediments need to be considered and avoided or addressed.

Land tenure arrangements are currently complex and present barriers across sectors and interests. There is an opportunity to increase consistency and reduce complexity through improved tenure arrangements, improve development assessment processes and improve landscape-scale planning to facilitate sustainable development.

Recently developed tools are able to identify and assess investments with potential to reduce costs and increase profits for industry, with a view to overcoming logistical barriers in northern supply chains. The tools have identified a number of initiatives with potential for the beef industry and can be configured to address other primary industries and sectors.

Growth of agricultural industries in northern Australia could generate biosecurity risks through direct exposure to local or exotic pests and diseases impacting on the productivity and sustainability of the new and existing primary industries and by providing a new bridging environment to support exotic organisms with consequences in established agricultural systems in southern Australia. Both these risks can be anticipated and mitigated through an integrated biosecurity strategy comprising technologies and social approaches.

Critical economic and social infrastructure

Physical infrastructure is identified as a requirement for development in a number of industries, and access to social infrastructure is also an important issue for northern Australian development, given many areas are remote. In many cases those enterprises and individuals that would benefit from infrastructure investment are not in a position to make that investment themselves. Hence there is a role for policy makers in determining where and how infrastructure investment might be best deployed to catalyse sustainable development. There is a particular role for remote service delivery in development of Northern Australia given its often remote geography.

CSIRO recognises the currency of interest in northern Australia and has identified a number of potential sustainable development pathways, particularly in the agricultural, mining and energy sectors, as well as potential impediments which can be overcome. CSIRO would be happy to provide further detail on any of the areas outlined in our response to the Terms of Reference or speak to the committee if required.

Introduction

CSIRO welcomes the opportunity to provide input to the Joint Select Committee inquiry into Development of Northern Australia.

CSIRO, as the national research agency, has been supporting development in northern Australia for half the time of its European settlement. Agricultural research commencing in the 1940s, and continuing to the present, identified the opportunity for the Ord River scheme, introduced tick-resistant *Bos indicus* cattle and dung beetles and developed tropically adapted insect-resistant cotton.

Since then CSIRO's research has expanded to include work supporting development of northern Australia's minerals and energy, tourism, defence and fisheries industries and the potential carbon economy. It has worked by directly supporting these sectors, as well as providing science that underpins the establishment and growth of industries and communities in the North more generally. This has included initiatives to improve northern Australia's hard and soft infrastructure, economic value chains, public health, land and water management and understanding of northern Australia's environment.

Much of this work is relevant to the Joint Select Committee Terms of Reference, as detailed below. This submission provides input on all Terms of Reference for this Inquiry, although CSIRO is limited in its capacity to respond to the second ToR given its role as national science agency which informs but does not directly advise on matters of policy.

It is important to note that the meaning of the term "Northern Australia" varies over time and according to the issues being addressed. Much of CSIRO's Northern Australia work in recent years relates to northern draining catchments (Figure 1), whereas the area north of the Tropic of Capricorn is also often referred to as Northern Australia (Figure 2). Given that the area of northern draining catchments is around 20% of that north of the Tropic of Capricorn, care needs to be taken in interpreting facts and figures for "Northern Australia".

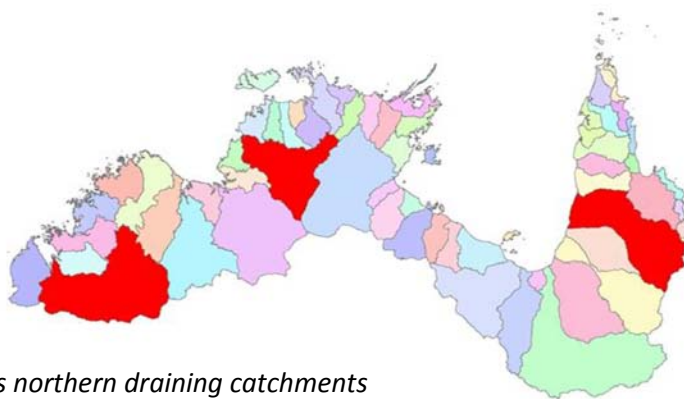


Figure 1 Australia's northern draining catchments



Figure 2 Australia north of the Tropic of Capricorn

CSIRO response to the Terms of Reference (ToR)

ToR 1 - Potential for development of the region's mineral, energy, agricultural, tourism, defence and other industries

CSIRO's work has examined a number of industries in northern Australia and their potential for development.

The mining, energy, tourism, defence, agriculture and fisheries industries are all well-established in northern Australia. Together they contribute tens of billions of dollars to the regional and national economies. They are efficient industries in the sense that northern Australia accrues GDP at approximately twice the per capita rate of the rest of Australia.

CSIRO examined in detail the potential for development of northern Australia industry in 2009, in the *Northern Australia Land and Water Science Review 2009*¹.

This study and subsequent work have identified significant growth prospects for major industries, as well as attendant impediments and enablers, as summarised below.

Mining (including coal for energy)

Mining has a substantial role to play in developing northern Australia and needs to be considered in the mix of future development activities. Mining can have significant positive and negative impacts on the wellbeing of regional and remote communities and on the environment. The mining industry can manage these impacts by working with governments, Indigenous people, pastoralists and others, through the whole mining lifecycle from exploration through to mine closure.

Northern Australia hosts Australia's two largest mineral developments (Pilbara iron and Bowen Basin black coal) and over 100 operating mines in the region export more than \$80 billion and employ over 24,000 people, or approximately 6% of northern Australia's workforce.

Value-adding operations are limited compared with large-scale mining of minerals that are exported almost entirely as unprocessed products. Of the 63 major minerals processing plants in Australia in 2008, only seven were located in northern Australia.

Northern Australia's mining operations occupy less than 0.1% of the northern Australia landscape, so have minimal direct impact on the broader landscape.

Water is involved in all mining operations and in almost every stage of production. Despite this, mining accounts for only around 2% of water use in Australia's northern draining catchments. Most of this is derived from groundwater, as there are only three surface water supply schemes servicing mining in northern Australia - Julius, Moondarra and Argyle dams. (Nationally, mining accounts for 3.5% of water use.)

Availability of water is not currently a major constraint to development, but may become so as mining operations expand. Greater understanding of cumulative impacts of groundwater extraction will be required to sustain mining where there are several mining operations in one area.

Mining growth will depend on global demand, financial markets and a range of local factors that include water availability, energy supply, available skills, transport and infrastructure development, relationships with Indigenous communities, access to land and government policy and incentives.

Energy

Oil and Gas

Australia's north-west could create billions in export earnings from oil and gas. Success depends on effective and sustainable exploration and efficient extraction and processing - currently a focus of CSIRO's work with industry.

Unconventional gas

Australia's unconventional gas resource comprises coal seam gas and shale gas. Industry potential is in the order of 900tcf (equivalent to 35% of current known energy reserves) and much of the known shale resource is located north of the Tropic of Capricorn. If unconstrained, the national resource potential could support LNG production of up to 150mtpa for 100 years, benefitting Australia through foreign direct investment of up to \$450 billion during the investment phase and export earnings of US\$75b per year (~5% of current GDP) during the operational phase. In addition, the exported gas would displace coal in electricity generation in parts of the world that are heavy and growing CO₂ emitters.

A more modest scenario would see development of the gas resources to supply Australia's domestic requirements. In this scenario, exploitation would provide low-cost secure energy while reducing greenhouse gas emissions by replacing coal fired electricity generation (converting all coal fired electricity generation to gas firing has the potential to reduce GHG by 75mtpa or ~13% of Australia's emissions in 2000).

Uncertainty around the socio-economic and environmental impacts of the natural gas industry is an issue for the rate of its development. To this end CSIRO and Australia Pacific LNG established the Gas Industry Social and Economic Research Alliance (GISERA) to provide publicly available research about these impacts for the community and decision makers. QGC has subsequently joined GISERAⁱⁱ.

Distributed Energy

Opportunities exist for cost competitive, alternative reliable and distributed energy solutions for rural communities and remote mine sites. While the economic return of these solutions in themselves is currently unclear, they have great potential as catalysts for other industries and remote developments.

Tourism:

Tourism generates a significant proportion of Northern Australia's regional income and employment and Northern Australia is a vitally important tourism destination. In 2009 it comprised 36% (1.6 million) of international overnight stays and 5% (5.5 million) of domestic overnight stays occurring in Australia. 60-70% of these occurred in north and especially Far North Queensland. Over 7 million visitors to Northern Australia spent almost \$6.5 billion dollars in the region, with the majority of expenditure (\$4.8 billion) made by domestic visitors.

Much of northern Australia's tourism and recreation is based on the natural environment: fishing, good weather, wildlife, seafood and the relatively unmodified landscape. Domestic self-drive travellers aged in their forties to sixties comprise a growing proportion of visitors in parts of northern Australia.

The high ratio of tourists to residents in northern Australia places a significant load on usually sparse civic infrastructure; however visitors are willing to make monetary contributions to maintaining enhanced tourism infrastructureⁱⁱⁱ.

Increased tourism and recreation in northern Australia depends on improvements to current facilities such as:

- road upgrades to improve access to sites currently inaccessible during the wet season;
- increased, improved and diversified camping and accommodation facilities;
- improved directional and interpretive signage;
- Indigenous art interpretive centres;
- increased and improved fuel and food outlets;
- increased parking at popular sites; and improved waste disposal facilities.

In addition, tourism operators need to be able to source an appropriately skilled, reliable and trustworthy workforce.

Defence

The Australian Defence Force (ADF) is one of the major investors, landholders and employers in Northern Australia, particularly in the Northern Territory. They influence economic growth and development of infrastructure in the region, and manage their land with high environmental standards.

In the Northern Territory, for example, the ADF employs approximately 6% of the population and directly contributes over 8% of the Northern Territory's GDP through spending on wages of defence personnel and operational items such as transport, catering, office supplies and cleaning.

The direct contribution of defence to the Northern Territory economy is greater than 16% when indirect spending within the regional economy is included, such as that by resident defence families.

Defence spending in northern Australia increased by 11% per year in the 14 years from 1995-2009. In addition to the defence of Australia, military presence in northern Australia enables the ADF to rapidly and continuously contribute to humanitarian relief, evacuations, peace-keeping and peace enforcement in south-east Asia.

Northern Australia's remoteness from supporting infrastructure and exposure to extreme events such as cyclones and floods makes it more reliant than the rest of Australia on the assistance provided by Defence. The ADF routinely supports the civilian community by loaning equipment, expertise and manpower, particularly in response to natural disasters.

The ADF primarily sees itself as a user, rather than co-developer, of civilian infrastructure such as roads, pipelines, railroads and ports. The ADF owns significant tracts of land in Northern Australia and CSIRO has undertaken a range of research projects in recent decades regarding their management and conservation values.

Establishing clearer links between military and civilian infrastructure needs and benefits would help to create significantly greater efficiency in infrastructure planning, investment and use. This, in turn, is likely to increase the volume and value of infrastructure in northern Australia. Coordination could be improved if civil developments were submitted to Defence for assessment of their military impacts in much the same way as they are already assessed for environmental impact. Conversely, subject to security constraints, Defence development plans should be canvassed with civil authorities.

Pastoral

Northern Australian agriculture is dominated by the beef industry. Australia is the world's second largest beef exporter, and its export industry is worth approximately \$6.6b pa, comprising \$5b beef and veal and \$590m live exports. The beef industry is the nation's second largest agricultural industry, and 45% (12.5 million) of the nation's approximately 28 million cattle are in northern Australia. 90% (over 690,000 head) of live cattle exports are from northern Australia.

The cattle industry provides 5% of the jobs in the north and covers 95% of the agricultural land area. It provides 75% of the value of Northern Territory's agricultural production.

The northern beef industry is currently in its worst state since the beef slump of the 1970s. Average return on assets is low, between 0.3 to 2%, as a result of rising land prices (250% in the last decade), a run of poor seasons, declining beef prices and modest productivity growth (1% pa). Interruption to the live export market also perturbed the industry.

A recently completed study by CSIRO and Meat and Livestock Australia of potential productivity gains for the northern beef industry concluded that by deploying technological innovations that simultaneously aim to improve reproductive performance, genetic gains, forage quality, nutrition and growth could result in productivity gains of 40-50%. These projected gains were achieved while maintaining overall grazing pressure at safe levels in terms of maintaining the resource base and minimising soil erosion.

Genetic gains have been an area of focus for CSIRO and partners for some decades, particularly through CRCs. There are three outputs from this work with particular significance for the sustainability of the northern beef sector:

- Science that underpins the national Meat Standards Australia grading scheme, which now accommodates animals with high-percentage *Bos Indicus* content - breeds favoured in the north for their heat tolerance and environmental resilience.
- Introduction of new traits into BREEDPLAN, the standardised national cattle breeding scheme. Traits such as "days to first calving" will be focal points for breeding.
- A commercial test was developed that will enable reliable selection of animals that are polled. When applied broadly, this will have productivity, animal welfare, and worker health and safety outcomes.

Transport is a major cost for the northern beef industry. Nearly 50% of the cattle in the Northern Territory travel upwards of 1000 km from farm gate to abattoir or port. Transport costs exceed \$150 per head, or up to 35% of the average market price. Supported by the Office of Northern Australia and the Queensland, WA and NT governments, CSIRO developed tools to analyse small and large scale investment in the supply chain for northern livestock logistics to reduce costs and increase profits for industry^{iv}. The tools have been used to help focus priorities for future investment in infrastructure and have identified a number of initiatives with potential industry benefit:

- Upgrade of the highway between Clermont and Roma to allow large road trains to use this north-south inland route and decrease the number of heavy vehicles using the Bruce Highway, substantially decreasing transport costs;
- Upgrade of selected minor roads and stocking routes in the NT to improve wet season accessibility;
- Location of a new spelling yard in the NT;
- A new Darwin abattoir which could reduce the average transport distance for seven NT beef producers from over 2000km to 835km with potential savings to property owners of \$13.2million annually (based on 120,000 head of cattle).

The tools can also be configured to address other industries and sectors.

The potential for mosaic irrigation for the beef industry has been mooted as a development option in recent years. Recent studies indicate that establishing irrigation on beef properties is unlikely to provide the most cost-effective method for enhancing beef production. The *Mosaic agriculture in northern Australia: assessment of sustainability and prospectivity* project^v was commissioned to provide a comprehensive and practical guide to the establishment of mosaic irrigation for the northern Australian beef industry. The project has worked with key industry stakeholders and the WA, NT and Qld governments to identify the range of prospects for irrigation mosaics across northern Australia, based on analysis of existing enablers and impediments. This project is complete and release of the report is imminent.

Cropping

There is currently 135,000 ha of irrigated agriculture in northern Australia, and the abundance of soil (at least 17 million ha is suitable for agriculture) and availability of water suggests that a much greater area is physically possible. Knowledge of the location of these resources and their potential to support agricultural production is far from complete. CSIRO is engaged in a suite of ongoing and recently completed projects exploring this potential.

As is the case with the pastoral industry, sustainable cropping development in Northern Australia requires matching suitable genotypes with appropriate management strategies to maximise production and economic returns. To date there has been relatively little research focus on optimising agricultural productivity in northern regions

Twenty-one catchments (of 66) north of latitude 21°S have been identified which could grow cotton based on soil and climate^{vi}. The potential irrigable land suited to cotton is very roughly 600kha. CSIRO contributed as a partner in successive Cotton CRC's, to guides for sustainable and profitable production of cotton in the Burdekin and Ord regions^{vii}.

There are also significant opportunities for the development of grain and pasture legumes in the tropics to supply Indonesian markets especially soybean and development of tropically adapted varieties could dramatically increase yield expectations. Soybeans have also been shown to have strong rotational benefits in sugarcane rotations.

Sugarcane is well adapted to tropical climates with high annual moisture levels. A 2007 report commissioned for WA and NT government agencies concluded that the expansion of the sugarcane industry, both for sugar and for ethanol, could be re-established and expanded in Northern Australia^{viii}.

Similarly, a 2010 DAFFQ/GRDC – supported project demonstrated that high yields were possible for wheat in non-traditional Northern Australia sites when grown with adequate moisture.

The 2020 vision developed for the Australian forestry industry^{ix} clearly identified significant opportunities for expansion of the forestry industry in Northern Australia. The report highlighted the need to expand the industry to meet both domestic and export demand given the phased reduction in logging of native forests, combined with increased export opportunities, and commented on the suitability of expansion of the industry in Northern Australia citing lower land costs.

CSIRO recently completed the Flinders and Gilbert Agricultural Resource Assessment for the Office of Northern Australia^x. The assessment investigated the opportunities for water and agricultural development in two large catchments in north Queensland; the catchments of the Flinders and Gilbert Rivers. The project delivered a comprehensive assessment of sustainable water resource development and the potential for new irrigated agriculture in north Queensland, and also developed a methodology which could be applied elsewhere to ascertain development potential.

The project found:

- The Flinders and Gilbert catchments differ significantly in their physical characteristics and, as a consequence, the extent to and methods by which agricultural development might occur.
- In the Flinders catchment, farm dams could support 10,000 to 20,000 ha of irrigation in 70 to 80% of years; irrigation may not be possible in very dry years. The precise area under irrigation will, in any year, vary depending on factors such as irrigation efficiency, water availability, crop choice and risk appetite.

- In the Gilbert catchment, large in-stream dams could support 20,000 to 30,000 ha of irrigation in 85% of years. Again, the precise area under irrigation will, in any year, vary depending on factors such as irrigation efficiency, water availability, crop choice and risk appetite.
- In-stream dams enable more reliable irrigated production than farm dams, because they can more easily carry water from one year to the next.
- Significant water use would, in the downstream environment, amplify the environmental and social challenges associated with dry years and would have impacts on commercial and recreational fishing catches that have not been quantified.

The Food and Fibre Value Chains project^{xi} is a collaborative initiative sponsored by the federal, WA, NT and Qld governments, RIRDC and RDA Pilbara; being undertaken jointly by ABARES and CSIRO. The project has three main aims:

- to provide a clear indication of medium and longer term opportunities for agricultural production across northern Australia, and critical supply chain and infrastructure investment issues that may help to foster those opportunities;
- to analyse the long term outlook for relevant agricultural commodities; both large volume commodity production industries (such as beef, grains, sugar, cotton, pulses) and high value small volume and emerging production industries (such as tropical fruits, aquaculture, Asian vegetables, chia, guar and cocoa). Broad market opportunities, risks and options that are likely to foster longer term growth will be described, as will the operational and infrastructure elements of the supply chain required to support them;
- to identify strategic investments or practical improvements that could be made across supply chains, to improve longer term prospects. An independent assessment of this type can underpin the planning by government and individuals required to unlock potential government and private investment.

The project is due for completion in mid 2014. An initial historical analysis of 12 past and current efforts to develop irrigated agriculture in Northern Australia found only four of these remain operating at a significant scale (over 10,000 ha)– the Ord River Irrigation Area, the Burdekin River Irrigation Area, the Emerald Irrigation Area and the Mareeba Dimbulah Irrigation Area. These schemes have all received significant government investment (hundreds of millions of dollars each in core dam infrastructure alone) with a mixture of State and Commonwealth Government funds supporting the construction of the dams and associated channel infrastructure. This has leveraged significant private sector investment.

Fisheries

Fisheries and aquaculture provided 781 jobs and \$232 million to the northern Australian economy in 2006/07.

Wild fisheries appear to be managed sustainably, and the 2009 Northern Australia Land and Water Science review indicated little potential to increase yield. There is a risk that harvests may decline if river flows are reduced due to water allocation changes.

Fisheries productivity is linked to land and freshwater management practice. Changes in flow patterns in the Ord River Irrigation Area, for example, have affected commercial species such as banana prawns, and possibly other species which are unable to grow and breed in the Ord estuary because increased fresh water flows in the dry season reduce water salinity levels. In other areas in the north, irrigated agriculture does not currently appear to be affecting fisheries, but an increase in irrigated agriculture or mining, or

disturbance to natural flows caused by dams or weirs could change river flow patterns and impact fish numbers.

Fish harvests increase with increases in freshwater flows from rivers, especially for mud crabs, banana prawns, barramundi, grunter, mackerels and sharks. Animals that are prey for these fish also depend upon these flows. Dams and weirs that block river flows stop fish from moving up and down rivers, and prevent nutrients and sediments from reaching the estuaries, which are important feeding grounds for juvenile fish. Commercially important species such as barramundi and grunter need freshwater flows from rivers to breed and grow. Dams change the natural seasonality of flows in the rivers, which fish have adapted to over thousands of years. Under the National Water Initiative, these factors must be considered when planning any new dam, weir or irrigation development.

Thus, a key challenge is to bridge the divide which exists in NRM agencies and research organisations between marine, coastal and terrestrial environments so that “whole-system catchment-to-sea” approaches can address critical connectivity issues. For example estuaries and shallow marine ecosystems in the Gulf of Carpentaria have supported finfish and prawn fisheries valued at over \$80m pa for the last 50 years. Overall the estuaries of Australia’s tropical rivers support commercial fisheries worth over \$200m pa, much of which depends on seasonal freshwater flows from relatively undeveloped catchments. As demand for irrigated agriculture rapidly increases, so does competition for water and the ecological, cultural and social and economic tradeoffs between natural river flows supporting fisheries and other values vs reallocation of water to support irrigated agriculture is required. CSIRO is working to complete by mid-year a study on impacts on Gulf fisheries of agricultural development, including changes to existing river flows.

Recreational fishing is a popular tourist activity, and is likely to increase. The relative benefits and social impacts of recreational and commercial fishing should be considered together.

Aquaculture

Aquaculture has the potential to expand, but needs to meet very strict Australian discharge water quality standards. This will ensure that an effective balance is achieved between achieving economic benefits and conserving the health of adjacent aquatic ecosystems, which are valuable to Indigenous communities, tourists, commercial fishers, and people who use waterways for recreation.

Aquaculture is significant to the economy of northern Australia, providing income of around \$66 million and 411 full-time-equivalent jobs in 2006/07 .In the Northern Territory, the most important farmed species are barramundi, mud crabs, pearl oysters and prawns. In Queensland, prawns and barramundi are the most important farmed species, and a significant proportion of the State’s aquaculture is based in the North. The Western Australian Government has identified many opportunities for developing aquaculture in the north of the state. These opportunities include barramundi, prawns and black pearl oysters.

Aquaculture production across northern Australia has grown by around 14% over the last five years, and several new sites are planned across the region. New sites need:

- electricity
- easy access to all-weather roads
- access to domestic and international transport routes .

Recent CSIRO advances in tropical aquaculture technology, together with emerging commercial interest in large-scale prawn farming (~\$1 billion potential production value) indicate a strong trajectory for the growth of tropical aquaculture in northern Australia. Research has identified significant potential for the development of large-scale, saltwater pond aquaculture coastal regions of northern Australia, (about 528,000 ha in NT, 594,000 ha in Qld and 516,000 ha in WA). Research has also shown that significant advances in environmental management technology have reached a point where socially, economically and

environmentally sustainable marine (saltwater) aquaculture in northern Australia could play a much more significant role in responding to the huge demand for high quality seafood from Asian markets.

Carbon

The scale of opportunity for emissions abatement from the North is potentially very significant with potential in the order of hundreds of millions of dollars per annum once enabled. Issues around this are complex and our knowledge is incomplete, and new technologies and methodologies are needed^{xii}.

Work conducted for the Northern Australia Ministerial Forum in 2013 indicates that three strong prospects exist:

1. Reduced emissions from fire and livestock that could generate tens of millions of dollars per year if only partially realised;
2. Increased biosequestration in soils and vegetations that has been shown if fully realised through improved fire management to be worth in excess of \$2 million per year on the Tiwi Islands alone;
3. Growing feed-stocks for biofuel production is an emerging opportunity that could generate up to 5% of Australia's airline fuel needs.

There are some current activities underway. For example in the Northern Territory the potential of fire management for Greenhouse Gas Abatement is being harnessed to provide livelihood opportunities^{xiii}.

ToR 2 - Recommendations to enhance trade and other investment links with the Asia-Pacific, establish a conducive regulatory taxation and economic environment, address impediments to growth and set conditions for private investment and innovation

CSIRO is limited in its capacity to respond to this ToR given its role as national science agency which informs but does not directly advise policy. Notwithstanding we make the following observation and suggestions as informed by our research.

Land tenure

Complex land tenure has been recognised as an impediment to development of northern Australia and CSIRO and JCU prepared a report for the Northern Australia ministerial Forum on this issue^{xiv}.

This study found that different sectors or interests face distinct investment issues. However, there are common barriers to investment that include:

- deficiencies in specific aspects of the tenure information base including registration of interests and accessibility of this information to investors;
- diversity of tenures and land and water entitlements including the different conditions of use on similar tenures across jurisdictions;
- inefficiencies in development assessment processes, particularly for major projects, exacerbates tenure-related problems;
- under-resourced negotiation and tenure-resolution mechanisms; and
- legal and other conditions that limit Indigenous and other land owners' ability to leverage their land assets for capital and development purposes without affecting existing rights.

The study worked with stakeholders who encouraged governments to:

- increase consistency and reduce complexity through improved tenure arrangements;
- Improve development assessment; and
- Improve landscape-scale planning.

Biosecurity

The development potential of northern Australia is considerable, but the diversity and scale of the proposed expansions poses challenges and potential new external risks to the delivery of biosecurity. New agricultural developments in northern Australia could generate biosecurity risks in two ways:

- through direct exposure to local or exotic pests and diseases impacting on the productivity and sustainability of the new and existing primary industries;
- through northern agricultural systems providing a new bridging environment to support the entry, establishment and spread of exotic organisms to then have more severe consequences in established agricultural systems in southern Australia.

Both these risks can be anticipated and mitigated.

Population growth in northern Australia will also need to anticipate greater impacts from emerging infectious diseases (EIDs) such as Dengue and Chikungunya virus, given the increasing distribution of mosquito vectors, growing population centres and the growth in exchange of travellers between northern Australia and SE Asia. Addressing these human health threats through the integration of medical, veterinary and environmental sciences (a so-called One Health approach), will assist in preventing and combating these serious EIDs.

CSIRO suggest that an integrated biosecurity strategy comprising technologies and social approaches that have been proven elsewhere can be adapted and deployed early in the development phase. Five streams of activity are proposed:

- *Strategic Framework for integrated surveillance system* – Undertake a strategic assessment of the optimal deployment of an integrated surveillance system for Northern Australia for the next twenty years. It will characterise the current and expected developments in the north within a regional context, the biosecurity challenges that this will entail, and will provide both technological and social management options.
- *The Tool for Assessing Pest and Pathogen Airborne Spread (TAPPAS)* – A web-based user-friendly interface currently being developed by CSIRO, Bureau of Meteorology and Department of Agriculture to allow end-users (State & Federal Governments and industry partners) to appreciate new biosecurity threats posed by wind dispersal to guide surveillance, preparedness, incursion response, and resource prioritisation.
- *Autonomous systems* – Autonomous systems, next-generation sensors, robotic platforms and fixed devices, and automated networks that do not rely on human operators, can strengthen surveillance and response activities in real time. CSIRO is already investigating how they can be combined with traditional approaches to reduce costs and risks from large-scale biosecurity surveillance in both terrestrial and marine contexts. Three current examples are:
 - Autonomous surveillance – An automated surveillance system incorporating automated image analysis of insect pests and other biosecurity risk agents with concurrent communication to end-users.
 - Livestock health surveillance – Adapting the Digital Homestead project using wireless sensor networks for real-time monitoring of livestock. Different sensors can be used in real time using a web-based, 3G or satellite links interface into a 'dashboard' that enables interrogation and processing of the data streams.
 - Autonomous vehicles – CSIRO is developing autonomous vehicles (submarine for underwater surveillance and helicopters for aerial surveys) for specific targets. These vehicles can be used for both search and search and destroy missions. The vehicles can be adapted to a range of biosecurity applications where their autonomy provides advantages in terms of speed, access, coverage and safety.
- *Engaging individuals, communities, industry and regulators in biosecurity surveillance* – Low population density across Northern Australia will continue to challenge human resources available for biosecurity. New technologies for surveillance and response may only partly overcome this limitation as, individuals, communities, regulators and industry need to develop trust and willingness to use them. CSIRO suggest three elements will be necessary:
 - Citizen Science – Working with remote communities to train and engage in delivering best practice in biosecurity and monitor impact. It will produce an assessment framework for government and community stakeholders to determine how best to engage different sectors in biosecurity surveillance.
 - Changing bad behaviours and reinforcing good ones – The behavioural change approach seeks to develop interventions aimed at changing poor biosecurity behaviours and reinforcing good ones by defining and achieving 'best practice'. A key to this is to understand how individuals think about, and behave around biosecurity.

- How do we bring new technology into biosecurity practice? Technology meets people – rather than just focussing on how technologies can assist in biosecurity, success depends on how people adopt the technologies and how the technologies can be improved to meet local needs and contexts.
- *Using social media for biosecurity intelligence and situational awareness* – The objective is to improve biosecurity agency capabilities by strengthening existing intelligence and communication components with analysis, surveillance and detection elements of CSIRO’s social media platform tuned for Australia’s biosecurity threats, risks and pathways. CSIRO has capacity to extend social media monitoring to sources beyond Australia, targeting regional social, economic, environmental events and pathways likely to impact Northern Australia’s biosecurity.

While the focus above is on significant external threats it is important to also consider locally generated biosecurity threats which may emerge in response to changed land management practices and production systems. Crops in new areas and novel crops will have novel suites of pests, weeds and diseases that will impact pest management systems in them and neighbouring cropping areas. Given that northern development may involve cultivation in landscapes where cropping has not previously been the norm, it is critical that pest problems are anticipated and managed through well researched and sustainable pest management systems which protect the wider environment and existing cropping systems elsewhere in Australia.

Existing regulatory risk assessment approaches for new agricultural activities provide a basis for assessing the likely post border biosecurity risks from new cropping systems in Northern Australia particularly if crops new to the region are being considered. Such risk assessment should include:

- direct risks of new crops becoming invasive;
- potential for local pests and diseases to limit production viability;
- risks of pest or disease using new crops in new areas as stepping stones to established agricultural regions.

ToR 3 - identify the critical economic and social infrastructure needed to support the long term growth of the region and ways to support planning and investment in that infrastructure

Across a number of sectors and studies identified in the response to ToR 1, investment in physical infrastructure is identified as a potential impediment to growth. In many cases those enterprises and individuals that would benefit from infrastructure investment are not in a position to make that investment themselves. Hence there is a role for policy makers in determining where and how infrastructure investment might be best deployed to catalyse sustainable development.

The livestock industry logistic work referred to above addresses a number of supply challenges in the north^{xv}:

- Road access is highly variable and costs are high – up to 35% of the market price;
- Cattle can be stranded in floods with roads blocked while alternative markets can be too costly to reach, reducing value and increasing cost;
- Parts of the country are tick infested requiring cattle to be dipped – adding time and expense;
- Growth in the North will continue to put pressure on the existing road and rail infrastructure.

Tools developed to analyse small and large scale infrastructure investments in the supply chain for all northern livestock logistics have been used to help focus priorities for future investment and identified key initiatives with potential industry benefit, including:

- Upgrade of highway between Clermont and Roma to allow large road trains to use this north-south inland route and decrease the number of heavy vehicles using the Bruce Highway, substantially reducing transport costs;
- Upgrade of selected minor roads and stocking routes in the NT to improve accessibility early in the wet season;
- Location of a new spelling yard in the NT, if there are changes to animal welfare or drive fatigue guidelines;
- Implications on road traffic for increasing or reducing the utilisation of rail transport for moving cattle in Queensland;
- Transport implications of a new abattoir and mosaic irrigation in the Kimberley region including the influence of property location.

The Livestock Logistics Tools will be instrumental in recommending actions to address these scenarios and can also be configured to address other primary industries and sectors. Release of the final report for this work is imminent.

Access to social infrastructure is also an important issue for northern Australian development, given many areas are remote. Work is underway in CSIRO to boost telecommunication and remote service delivery, including:

- Extending mobile phone coverage and eliminating “black spots” in northern Australia critical for business and the community,
- Developing “smart” radio technologies allowing the use of small, efficient and inexpensive towers to provide better coverage,
- Deploying our Remote-I solution in northern WA, Queensland and the Torres Strait to close the gap in eye care services,
- Developing new service delivery models based around NGARA telecommunications technology, targeting remote aboriginal communities, and focused on health, education, training, employment and business development.

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- iv CSIRO Livestock Logistics available at www.regional.gov.au/regional/ona/files/SAF_LivestockLogisticsFlyer-AH2013-05.pdf
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