

SCIENCE AND RESEARCH TO SUPPORT PLANNING AND MANAGEMENT IN NORTHERN AUSTRALIA

1. INTRODUCTION

In most sectors of the economy, for example, agriculture, industry, defence, sport and the arts, innovation has increasingly been recognised as an essential ingredient for solving problems, exploiting opportunities, maintaining competitiveness and continuing to grow both social and economic prosperity. Benefit-cost evaluations of innovation in the rural research and development (R&D) sector indicate high returns on investment – averaging eleven to one – were attained over a range of projects.

Hence investment in research, development and innovation in northern Australia can be expected to be highly beneficial.

This paper is a contribution to the Australia21 (A21) submission to the Land and Water Task Force. It focuses on the need

for innovation across many sectors and topics and thus will overlap with other submissions. It presents the combined perspectives of an independent group of people with experience in the north, drawing as appropriate on material from previous reviews and analyses. It suggests priority actions, outlines a strategic plan for northern science and research and, in an appendix, identifies various topics and opportunities that we consider deserve increased attention.

Investment in research, development and innovation in northern Australia is critical to informing policy aimed at both sustaining and enhancing social and economic development.

Southern-dominance

Discussion on the current state of development of northern Australia often refers to a dependence on policy and investment decisions by southern political institutions.

Southern-dominance in current research decision-making reduces the prospects of northern-specific research being funded. Establishment of the Office of Northern Australia (ONA), designed to provide policy advice to the Government on sustainable development issues in, or affecting, northern Australia, is expected to overcome some of these issues. There is a need to target research to local and regionally identified needs and priorities.

For a variety of reasons, policy and investment in the north is overly constrained by the perceptions and needs of people and institutions in the south, which unless managed in an enlightened way can both slow and constrain economic and social development in the north.

A research focus for northern Australia, can serve northern expectations while also fitting within Australia-wide priorities and research frameworks including:

1. Australia's National Research Priorities:
 - An Environmentally Sustainable Australia.
 - Promoting and Maintaining Good Health.
 - Frontier Technologies for Building and Transforming Australian Industries.
 - Safeguarding Australia.
2. Northern (WA, NT and QLD) State Research priorities.
3. Australia's commitment to the international Millennium Development Goals.

Knowledge vacuum in policy development

Despite the north, with its small population size, having a similar raft of development problems to the south, research on those problems, which generates new knowledge, is relatively constrained. It argues for a stronger per capita commitment to research, development and innovation if equity is to be achieved in social and economic development, which has wide-ranging benefits to the north and south.

Parliamentary Secretary for Western and Northern Australia, the Hon Gary Gray AO MP (the minister responsible for the ONA) (2009) identified that the data base on northern Australia was often inadequate for getting an adequate picture of problems, and hence did not provide the evidence-based policy needed for deriving solutions. This lack of data is affecting economic statistics as well as natural resource decision making. Similarly in his paper "Development of Northern Australia" (2008), Stephen Garnett concluded that the degree to which research currently is informing northern policy was patchy, varying with discipline, geography and available resources for study. Science can better inform policy and its impact and influence on the drivers change.

A more targeted and coordinated approach to research is needed to facilitate sustainable development of northern Australia and to help fill a knowledge vacuum on many subjects.

Boosting research, development and innovation in the north does not need to be at the expense of the south, indeed the opposite should be expected. Researchers in the south will generally benefit greatly from exposure to solving problems in the north, in collaboration with research and policy institutions, in terms of their problem-solving expertise at national and international levels.

Indigenous issues

Of the Australians who live in northern Australia, and who must ultimately benefit from social and economic development, a high proportion are indigenous people, many of whom reside on traditional lands for social and cultural reasons, rather than because the lands and waterways are highly productive and well-suited for economic development through conventional land-use practices in agriculture, fisheries, aquaculture or timber production.

This is not an "alternative lifestyle" choice, as may occur in the south, but rather a fundamental right and cultural reality respected in global agreements on the rights of indigenous people. The policy requirements associated with this reality are immensely complex, for Indigenous and non-Indigenous Australians, and there is an unequivocal need for innovative new policies to be based on research and testing, involving both Indigenous knowledge and science.

Indigenous issues are a critical focus in northern Australia for all considerations of economic and social development.

2. ISSUES AND PRIORITY ACTIONS FROM A21

With such a diverse array of problems confronting the north, it is important to prioritise required actions at a high level of resolution, and identify spheres of problems where the north is uniquely positioned relative to the south.

At meetings in Darwin in April and in August 2009, A21 members discussed a wide range of issues and options about northern Australia, including priority actions for science and research, and the role of science, research and innovation in planning and management in northern Australia.

Improve science capacity and capability

Science capability and capacity is limited in the north because of the low population. Yet the scale and diversity of opportunities, problems and issues to be addressed is as wide as those in the South. Appendix 1 contains examples. There are few universities and although CSIRO and State departments have a research capability, their numbers are low. Keeping scientists in the north is often problematic. Research funding agencies and investors ask the question: "Why do science in the north rather than in the south where the infrastructure and scientific resources are currently located?"

Funding has declined for agricultural R&D over recent years. This is noticeably linked to State governments having reduced

There is a need to get in clear focus the social and economic constraints acting on research and science capacity and capability in the north, with a view to deriving innovative new solutions tailored to the realities of social and economic development in the north.

departmental funding, and tending to give "research" a lower priority than perhaps it merits. Historically, research was a very active sector in the north, particularly commensurate with the new view that new ways of agricultural production were needed to suit the tropical environments. Even where agricultural R&D has not been greatly reduced, there has been a large diversion of available funds away from production research to issues such as greenhouse gas emission mitigation. Governments need to increase funding for emissions research, rather than divert funds from core research goals. With reduced budgets has come increased rationalisation of research priorities, which has tended to favour core industry needs at the expense of truly innovation breakthrough discoveries. The best predictor of a research questions budgeted for any one year is what was funded the previous year, suggesting that "new initiatives", no matter how compelling, may be much more difficult to initiate than ones that have a history of political acceptance.

The southern-dominance in decision-making about funding research further reduces the prospects of northern perspective being influential. There has been a significant increase in the extent of Commonwealth funding of research in the north, particularly in environmental issues, but it has come at a cost. The funding is more likely to be tailored to southern priorities and problems, rather than to strategic priorities in north.

Maintain and enhance resilience in socio-ecological systems

The resilience of socio-ecological systems (i.e., the ability to maintain human functions during periods of environmental stress and change) depends largely on recognising and accounting for the underlying, slowly changing and interacting variables, such as climate, land use, nutrient stocks, human values, education and policies. Resilience can be degraded by a large variety of factors including loss of biodiversity, toxic pollution, inflexible and closed institutions, perverse subsidies that encourage unsustainable use of resources and a focus on production and increased efficiencies that leads to a loss of redundancy.

Undisturbed natural systems are inherently resilient but just as their capacity to cope with disturbance can be degraded, so can it be enhanced. The key to resilience in social-ecological systems is diversity interactions – ecological, social and economic. Biodiversity plays a crucial role by providing functional redundancy. For example, in a grassland ecosystem, several different species will commonly perform nitrogen fixation, but each species may respond differently to climatic events, thus ensuring that even though some species may be lost, the process of nitrogen fixation within the grassland ecosystem will continue. Similarly, when the management of a resource is shared by a diverse

Active adaptive management is needed whereby management actions are designed as experiments that encourage learning and novelty, thus increasing resilience in social-ecological systems.

group of stakeholders (e.g., local resource users, research scientists, community members with traditional knowledge, government representatives, etc.), decision-making is better informed and more options exist for testing policies.

Focus on multiple enterprises from a resource or region and avoid over specialisation

Development and utilisation of natural resources has a tendency to focus on single products and enterprises. For example, fishing and fishery development and management focus on either recreational or commercial aspects, whereas the approach should be to integrate both and also incorporate Indigenous subsistence resource use and education.

Innovation and invention in them should be supported. Products should be linked, including with tourism. There is a need for harder science in tourism – operators have had a tendency to have a short-term focus. Their products would benefit from innovation and R&D investment.

Avoiding over specialisation will reduce the tendency for some innovative initiatives to fall between sectors and silos / departments.

In developing northern enterprises it is prudent to focus on those for which the north has a comparative advantage. A resource inventory of the natural assets of northern Australia is needed but would be vast and an expensive exercise. An interim measure would be to identify more precisely resources which already have markets or potential markets and are therefore likely to produce an economic return. What this suggests is that the approach to niche resource development in remote areas may need to work from the top down (market to production) rather than the bottom up (researching a product then trying to find markets).

The process could benefit Indigenous communities in terms of economic returns that may start small and grow, rather than having a massive research cost ending in a failed market. Information on potential resources gathered could be added to a website, and a wide range of skilled and unskilled Indigenous people could be engaged in such a process.

Support for Indigenous innovation

Innovation is recognised as an important component of Australia's overseas aid program. Through the application of science and R&D, the Australian Centre for International Agricultural Research (ACIAR) contributes deliberately to poverty reduction and sustainable development overseas. There are large investments being made to address health, social and legal problems affecting Indigenous Australians, which are

Conduct a resource inventory

Innovation targeted at Indigenous Australia, lacks a dedicated research funding program.

arguably the symptoms of a social system under extreme stress, yet limited interest in bold new approaches to overcoming that stress.

Commonwealth, State and Territory Government are committed to 'closing the gap' between Indigenous and non-Indigenous Australians. Arguably they are using conventional approaches which in the past have a long track-record of not working rather than truly new and innovative models (Altman 2009).

There is currently a 'market gap' and an unmet need for the funding, development and delivery of rural and regional R&D that involves Indigenous Australians (Australian Rural Leadership Foundation 2008). This poses as a particular issue for northern Australia as it is the hearth for Indigenous people. It is the location where the true potential and self-realisation of Indigenous Australians is being achieved, but where the real work needs to be done to deliver equality (NAEDF (North Australia Economic Development Forum) 2008).

There is a focus on meeting housing needs and improving rates of home ownership in Indigenous communities, but for this to occur, there needs to be an expansion of employment opportunities, income generating jobs and substantial social reform. Although there is clearly a role to continue many conventional forms of development, the case for testing innovation and new approaches is unequivocally compelling.

The national and international marketing of Indigenous art is a high profile example of a greatly successful innovation. It involved both Indigenous and non-Indigenous people bridging the gap between the long history of traditional art and its effective marketing. Research and testing may well be able to expand this established industry to a wider diversity of formats, including digital media, and could perhaps be applied to new forms of Aboriginal culture and tradition. The income earning capacity of Indigenous art and culture needs to be fostered and developed, both as a means of sustaining culture in a world increasingly dominated by economic forces, and cultural homogenisation. The successes of Indigenous art and music should be built on and used more extensively as an iconic symbol for northern Australia, and a guide for what types of economic development are likely to work in the context of Indigenous livelihoods in remote areas.

The Indigenous product is a strong marketing tool if used wisely and innovatively, with the best marketing skills the country has to offer.

Improve governance and management

Governance and management including management of research, are potential key issues needing scientific investigation to aid planning and resource management in their own right. Institutional and structural arrangements for governance of both Indigenous and non-Indigenous communities are changing, almost continuously,

without learning from the past through rigorous scientific analysis and consideration of options.

Partnerships between the private and public sectors in R&D such as has been the basis of agricultural R&D could be extended to other sectors, including tourism and Indigenous land and resource management. Under these models, governments contribute to R&D on behalf of all Australians and industries and sectors who benefit, also contribute. However, such approaches need to be funded in a way that truly recognises the financial risks involved in developing novel industries, otherwise there will be no private investment.

Research is needed on the most effective incentives and stimulatory mechanisms that encourage private sector investment in R&D. Improving the effectiveness of contributions to research will enable better returns on investment for both the government and private sector.

Enable better returns on investment by both government and private sector through research on governance and management

Acknowledge existing northern research activity

While identifying the need for much more northern research, it is important to acknowledge the research that is being done with a focus on northern Australia. It comes from both national organisations and northern organisations:

National organisations

National agencies and organisations including the Department of Agriculture, Forestry & Fisheries (DAFF), Rural Industries R&D Corporation (RIRDC), Fisheries R&D Corporation (FRDC), Australian Bureau of Statistics (ABS), ACIAR, Commonwealth Environment Research Facilities (CERF) program, the Australian Research Council (ARC) and CSIRO and others, undertake a proportion of their research related to northern Australia.

Industries such as mining, tourism and the various arms of agriculture also play significant roles in funding research in their respective fields in northern Australia.

Northern organisations

There are a number of government research organisations and Institutions that are more dedicated to northern Australian issues. These include research organisations such as Charles Darwin University and James Cook University, the North Australian Indigenous Land and Sea Management Alliance (NALSMA), Cooperative Research Centres (CRCs) such as Aboriginal Health and Tropical Savannahs, and the proposed Northern Ventures CRC, CRC for Remote Economic Participation (CRC-REP) and the Menzies School of Health Research. There are also State and Territory Government departments and agencies such as the Northern Territory Research Innovation Fund and Arafura Timor Research Facility.

Northern Australia Research Unit (NARU) facilitates the work of Australian National University researchers, and those who wish to collaborate with them, on research topics of relevance to north Australia and the adjacent region.

Industry collaborations

Industry collaborations undertake research, for example, the Centre for Social Responsibility in Mining at the University of Queensland is part of the Sustainable Minerals Institute. It conducts research on social issues relevant to the industry and helps build the capacity of the industry to manage these issues more effectively. It has conducted a number of projects on Indigenous issues and the connection to the mining industry. The great majority of research projects by the Sustainable Minerals Institute (SMI) are industry funded, either by groups or individual companies.

What is noticeably lacking is the role of small, private business in collaborative research and innovation with Indigenous people, which to a large degree reflects the very real commercial risks involved.

Coordinate science and innovation

It is essential that northern research has structures that facilitate coordination. There has been growth in joint projects and alliances and research institutions in the north for example NAILSMA. The Cooperative Framework on Tropical Science, Knowledge and Innovation (SKI) is another example of this collaboration and recognition of the importance of research. If successful, the proposed Northern Ventures CRC will also provide a collaborative mechanism for social and economic development across northern Australia, particularly in regional and remote areas.

Using the SKI model, collaboration between research bodies is one way of ensuring the establishment and maintenance of viable research stations in smaller centres, well as building capacity in larger regional centres such as Darwin and Townsville, and in metropolitan cities. Apart from CRCs, forms of collaboration could include: joint centres with nodes in different locations (and jurisdictions); co-location of research units; joint programs; and degree courses. The ONA should also provide a level of research coordination.

Continuation and enhancement of coordination activities is essential, together with the creation of new investments matched by the private sector to support innovation and research into planning and management of northern Australia. In particular, A21 advocates the establishment of an innovation fund to support Indigenous enterprises and communities, and sustainable land and sea management.

3. SCOPE OF INTEGRATED RESEARCH AND DEVELOPMENT

A program of research and innovation covering northern Australia would be very broad and complex covering many sectors. As an aid to further discussion, A21 offers the following goals, objectives and outcomes which might inform the development of a strategic plan (Figure 1).

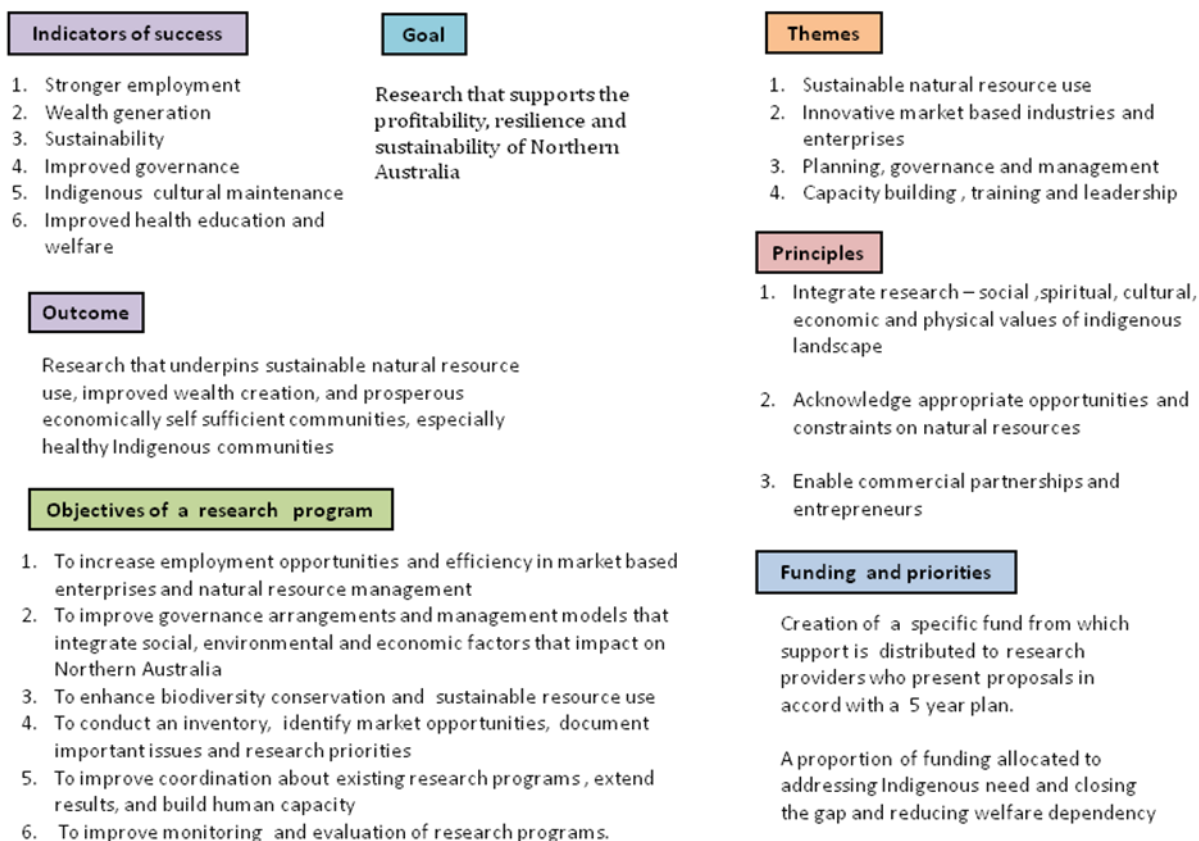


Figure 1 Research and innovation in northern Australia – goals, objectives and outcomes

Issues and challenges by sector

A strategic R&D plan for the north would cover many sectors. Appendix 1 considers some of the topics and drivers which form some of the issues and challenges to be faced by research and innovation. These draw heavily on the Tropical Futures Forum and North Australian Economic Development Forum research categories.

4. CONCLUSION

Northern Australia is a heterogeneous region including deserts, tropical rainforests, untamed rivers and vast open spaces, and only a few major population centres. It also has vast potential for development supported by targeted scientific research and innovation. To meet the R&D needs of northern Australia, a coordinated and planned approach is required.

The Government is committed to a number of northern projects across infrastructure and the environment, transport, health, education, community safety, defence and Indigenous health and economic development. Significant developments include:

- Northern Australia Land and Water Taskforce
- East Kimberly Development Package.

A R&D component to underpin these developments and support wider planning and management in northern Australia is essential.

The development of a northern Australia Research Program would have many facets and this paper has outlined some. It would have regional priorities and, in particular, support innovation in Indigenous Australia.

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APPENDIX 1

ISSUES AND CHALLENGES BY SECTOR

A strategic R&D plan for the north would cover many sectors. The following lists topics and drivers which make up issues and challenges to be addressed by research and innovation. They draw heavily on the Tropical Futures Forum and North Australian Economic Development Forum research categories.

Agriculture

The potential of northern Australia agriculture is increasing, especially due to water availability and a drying of southern agricultural areas. Previous agricultural failures across the north show that adaptation and innovation are important to success and viability. Key areas for innovation and R&D include:

- R & D to maintain Australia's position as a major net agricultural exporter of competitively priced food, and its role maintaining future global food security. Australian systems are competitive because they are relatively low-input.
- Research into effective identification and management of biosecurity threats to agricultural production and productivity.
- Beef will continue be the major agricultural product in northern Australia and hence continuing R&D investments in cattle breeding and systems is needed.
- Mosaic style development will be needed because there is limited good quality land suitable for agriculture.
- To deliver best production systems that are profitable and sustainable, future development of new agricultural land will need integrated research on:
 - geohydrological
 - soil surveys
 - sustainable production systems
 - ecological impact and reducing that impact
 - water licensing
 - infrastructure studies
 - whole scheme economic and social analysis.
- In the opening of new irrigation areas, improved farm production technology for handling, storage and transport options, including air transport is important.
- New technologies can change the prospects of previously failed agriculture and they can be developed to be sensitive to environmental concerns.

- New technologies and methods are needed to limit fisheries by-catch in tropical waters e.g. turtles, dugongs.
- Maintaining sustainable production systems and products will need research to address:
 - diversification of land use, including sustainable use of native species (plants and animals)
 - current pressure on wild fisheries from overfishing or fishing to maximum limits
 - requirements of sustainable freshwater and marine aquaculture with a focus on high quality product like barramundi
 - understanding the dynamics of climate change, ocean warming, marine food sources change on fisheries
 - water management including groundwater
 - improved sustainability practices for existing industries (e.g. beef, sugar and tropical fruits)
 - sustainable development of new tropical food industries like crocodile, water buffalo, cashews, coffee, culinary bamboo, mung beans, and various tropical fruits (in the Asia- Pacific region, the market for tropical fruits alone is estimated to be \$US 200 billion)
 - development of systems and technologies for stabilising tropical food products and maximising shelf life
 - producing higher yield products to compete with lower cost products from Asia-Pacific
 - predicting and managing the impact of climate change on agriculture, including increased heat stress on beef and dairy cattle, reduced areas for arable land, new pests and diseases
 - developing management systems that recognise and maintain the customary economy and other indigenous interests
 - initiatives designed to benefit and engage indigenous peoples and remote communities generally at a range of levels
 - opportunities and threats of the possible inclusion of northern agricultural carbon fluxes in the Carbon Pollution Reduction Scheme (CPRS) and emission trading schemes
 - emerging carbon market and environmental consciousness and the potential for a boom in sales of 'green' products from tropical Australia and voluntary carbon trading

- the role of genetically modified plants that require less water and thrive in hot and humid environments and are resistant to insects and need only small amounts of fertiliser and no chemicals – available by 2020
- consideration to use salt tolerant plants for managing salinity and remediation of blighted areas in Western Australia and Queensland.

Mining and energy

Northern Australia is the focus of much of Australia's mineral wealth, and it is only partially tapped and identified. Innovation and R&D is needed in the following areas:

Exploration:

- minimising the impact of exploration specific to northern Australian environments
- innovation in tropical regolith mapping
- innovation in satellite imaging/interpretation in areas of intense vegetation cover and deep weathering

Mining and processing:

- innovation in mine and processing plant technologies such as increased processing efficiency of lower grade ore and minerals
- innovation and new technologies specific to tropical/monsoon/high rainfall areas
- value adding through processing and producing high value / quality products
- R&D for reducing the mining footprint and impact on environment
- improved techniques for mine rehabilitation and waste management in high rainfall situations
- research into reducing offsite effects such as acid mine drainage

Mining towns and jobs:

- research for a range of social factors in development of mines and mining towns such as impacts on house prices; local economies and people; town depression/closure at the end of the mine life; infrastructure investments etc.
- research into the impact and opportunities of mines on Indigenous lands: Indigenous land use agreements; royalties; agreements for improved facilities and infrastructure; jobs for Indigenous locals etc.

The energy sector is also in a state of change. Future priorities for R&D into energy in northern Australia include:

- greater need for development of cleaner energy systems and renewable energy sources, and provide access to green energy technologies in remote areas
- the impact and opportunities of the Carbon Pollution Reduction Scheme and emissions trading on northern Australian power generation, delivery and usage, including remote areas
- consideration of the large scale production of biodiesel and biofuels for electricity generation, for example, growing *Pongamia (Pongamia pinnata)*.

Tourism

The potential for increased tourism in northern Australia is considerable based on the unique and diverse wilderness, wildlife, marine life and cultural resources, increased global travel and rising disposable incomes. The following are R&D considerations to ensure increased tourism is ecologically and culturally friendly and thus sustainable and viable long-term:

- R&D programs that have a greater focus on ecological and cultural education by tour guides and reduced impact on the environment
- greater coordinated approaches and investment are needed from both the public and private sector as the industry has been largely ad hoc to date
- greater understanding and meeting demands for indigenous tourism opportunities are also needed.

Infrastructure & services

There is little substantial infrastructure outside of major centres, especially for transport and power and other essential services in northern Australia. Lack of investment in infrastructure in regional areas has impeded business development across the north and discouraged people from settling in regional and remote areas. There is no labour force and hence, no incentive for governments to invest in infrastructure. Key issues include:

- poor roads and limited power supplies
- access to education
- health and community services
- housing affordability
- distance from market
- availability of skilled and unskilled labour.

For the future development of any aspect of northern Australia, research needs to be directed to how and where regional infrastructure and service provision will be

successful. This would need to be in close association with business R&D and investment and creation of jobs.

Frontier technologies

A specific focus is needed on the opportunities and benefits of innovation, development and application of new technologies:

- improving agricultural productivity through biotechnology, including increased resistance to drought, heat, pests and disease
- using biotechnology and nanotechnology to develop diagnostic tools, vaccines and drugs to combat tropical diseases
- bioprospecting of plants, marine organisms and other biodiversity for new drugs, biopesticides etc
- alternative energy generation using biomass, wind, solar and tidal sources
- improved waste management systems and technologies (e.g. recycled waste water)
- developing and applying remote sensing technologies to conservation and management of natural resources
- development of technologies for minerals exploration in remote, inaccessible areas (including oceans) such as airborne gravity, airborne scans of hyperspectral data and remote sensing
- new materials, design approaches and energy systems to create energy efficient built environments
- providing new or improved information and telecommunications technologies for rural and remote regions in the tropics.

Health

Key priority areas for health research and innovation include:

- detection, monitoring, prevention and management of vector borne diseases, including diseases spread by global travel
- exposure to dangerous creatures including crocodiles, sand flies, and jellyfish, a concern for established populations and for the growing tourist industry
- impact of climate change on human health including increase in vector borne diseases, cancer and food poisoning plus stress associated with drought and bushfire
- chronic health and social problems among indigenous communities, coupled with isolation of communities from mainstream health and community services

- innovation in land and resource management to generate opportunities for indigenous people that reduce welfare dependence and its social and health consequences.

Biosecurity

Biosecurity programs and management are important for minimising the risk of the entry, establishment and spread of exotic pests and diseases that could harm people, agriculture or the environment (Beale *et al.* 2008). Biosecurity protects the Australian people, economy and environment from significant damage. Key priority areas for northern Australia include:

- prevention, control and management of exotic plants, pests and diseases and their adverse impact on natural ecosystems, including biosecurity threats from adjacent areas of Asia and the Pacific through increased awareness and education and quarantine measures
- engagement of regional and remote communities in prevention and monitoring of exotic pests and diseases entering northern Australia
- the need for R&D for greater reliance on ecological friendly control mechanisms and reduced dependence on toxic chemicals.

Education

Northern Australia is an entry point to Southeast Asia. There will be both local and export benefits from building educational and research hubs in the north that are focused on sustainable environmental management, global health and bio-security. There are also opportunities for:

- improved science capacity and capability
- R&D and investment in new technologies for improving remote education.

Sustainable environments

It is essential that northern Australia's environments remain stable and sustainable. The following are key areas for future R&D and innovation and need for increased resources and actions to reverse degradation and maintain sustainable environments:

- regional climatic patterns are highly variable, with rainfall patterns and intensity varying markedly from year to year – climate and water use data needs to be gathered over a sufficient length of time in order to better understand the short-term effects of individually abnormally dry or wet years
- changing climatic conditions associated with global warming and the consequent impacts on fragile tropical marine and terrestrial ecosystems

- inadequate mapping and understanding of the rich biodiversity and resources of tropical regions across huge areas of land and ocean
- loss of biodiversity from vegetation clearing (e.g. from the use of farming systems adopted from temperate zones), marine pollution, fishing and other human activities
- changes in fire regimes and impact on vegetation and wildlife as a consequence of altered land use/management practices
- accelerated rates of soil degradation, often in areas already characterised by poor tropical soils
- pollution and degradation of marine catchment areas and the Great Barrier Reef e.g. from agricultural run-off
- pressure on water supplies from over allocation and the need for adequate, clean and renewable water supplies for future population growth and sustainable development; surface and groundwater
- environmental consequences of harvesting water, especially for riparian life forms
- impact and control of exotic plants, pests and diseases on natural ecosystems, including biosecurity threats from adjacent areas of Asia and the Pacific; depopulation of remote lands that require active management of invasive species and threats to biosecurity
- undisturbed and intact ecosystems are valuable mechanisms for biosequestration and in carbon emission trading – need is to understanding of carbon fluxes in these systems
- engagement, consultation and corroboration with Indigenous groups about best practice environmental management, combining traditional ecological knowledge with science, building Indigenous capacity to apply their knowledge and maintain generational passage; maintenance of traditional law to ensure sustainable wildlife and land use
- opportunities for greater involvement of indigenous people in sustainable land and wildlife management.