Q9. If research is to be organised around cluster groups, what other stakeholder groups would be good to include in your cluster?

Torres Strait Regional Authority

1	Indigenous stakeholders

Cape York NRM

1	RDAs
2	Industry
3	Interest groups alliances (e.g. FNQ-ROC)

Notes: Research should be organised around themes, rather than just geographic groupings, with opportunities for participation across geographic areas. i.e. project involvement should not be limited by geographic boundaries but by relevance (e.g. CYNRM and other regions have interest in cat control).

Southern Gulf Catchments

1	Gulf Savanna
2	RDAs
3	Mount Isa Economic Zone
4	Beef Crisis /SGC Catchments Limited Pastoral Industry Advisory Group/AgForce/ National Farmers' Federation
5	Rangelands NRM Alliance
6	Traditional Owners

Notes: Depends on level of project

Northern Gulf Resource Management Group

1	Indigenous groups (e.g. Traditional Owner groups, Land Councils)
2	RDAs
3	LGAs
4	Industry groups (e.g. Northern Gulf Graziers Group, Gulf of Carpentaria Commercial Fishing Association, Mareeba-Dimbulah Vegetable Growers Association)
5	Local researchers (e.g. consultants, State Government agencies, JCU, CDU)

Notes: NGRMG works constructively with the region's Indigenous groups and LGAs

Terrain NRM

1	NRM groups (engaging with their stakeholder base)
2	Industry representative groups (e.g. agriculture, tourism)
3	Stage/federal agencies
4	Traditional Owners
5	LGAs

Notes: Selection of stakeholders will depend on the issue being addressed

NQ Dry Tropics

1	All decision makers and managers of natural resources (including other NRMs)
2	LGAs
3	State government
4	GBRMPA
5	Indigenous communities

Notes: NRM bodies can engage with smaller organisations with less capacity

Reef Catchments

1	NRM bodies, especially Fitzroy/Burdekin
2	Port/infrastructure developers and managers
3	RoCs
4	RIRDC
5	TOs – with local engagement essential (direct or through NRM)

Notes: NRM bodies are in a good position to provide a coordinating role to ensure two-way engagement with these groups. So it is not necessary to have all players at the NERP table, but to engage NRMs/RDAs to provided communication and engagement. Engagement processes should be theme dependent

Fitzroy Basin Association

1	Reef alliance (5 major reef catchments with industry linkages)
2	Industry groups (QFF, AgForce etc.)
3	Where biodiversity is the focus then NRM groups across bioregion (FBA, NQDT and BMRG)

Notes: Makeup of stakeholder groups will depend on research focus and the desired outcome of the engagement process (e.g. guidance or information dissemination).

Territory NRM

1	RDA
2	Industry Groups (e.g. NT Cattlemen's Association, NT Agricultural Association, NT Horticultural Association)
3	TO representation
4	NT and Federal Governments, specifically PWCNT

Notes: Representation will vary with research focus
Need to make sure stakeholder rep groups really represent stakeholder base
Alignment across NRM regions is ideal, but often impractical and requires institutional support

Rangelands WA

1	Indigenous (e.g. Kimberley Land Council, Yawoorroong Miriuwung Gajerrong Yirrgeb Noong Dawang Aboriginal Corporation, and site specific corporations)
2	Pastoral (e.g. Land Care District Committees, Kimberley Cattlemen's Association, Pastoralists and Graziers Association of Western Australia)
3	Biosecurity (Kimberley Rangelands Biosecurity Association)
4	Environmental (Environs Kimberley, AWC, WWF, etc.)
5	Government (local and state agencies)

RDA Far North Queensland and Torres Strait

1	Regional economic development groups e.g. Advance Cairns, Gulf Savannah Development, Cape York Peninsula Sustainable Futures
2	LGAs
3	Chambers of commerce
4	Industry bodies
5	Prescribed bodies corporate

RDA Townsville and North West

1	NRMs
2	LGAs, Remote Area Planning and Development Board, Regional Organisation of Councils, Regional Economic Development Sub-Committee of the North Queensland Regional Organisation of Councils
3	Chambers of Commerce, Townsville Enterprise, Mount Isa to Townsville Economic Development Zone, Gulf Savannah
4	QG Regional Managers' Coordination Network (channel for broader QG engagement)
5	Industry bodies – AgForce, MLA, Industry clusters, Qld Resources Council

Notes: Other than LGAs, who are important for on-ground delivery, these stakeholders take on big strategic issues

RDA Mackay-Isaac-Whitsunday

1	Whitsunday Regional Organisation of Councils
2	Mackay-Whitsunday Regional Economic Development Committee
3	Other RDAs
4	NRM groups

Notes: RDAs are in a good position to provide a coordinating role to ensure two-way engagement with these groups. So it is not necessary to have all players at the NERP table, but to engage RDAs to provided communication and engagement. Engagement processes should be theme dependent.

RDA Northern Territory

1	Northern RDA alliances
2	LGAs
3	Agricultural industry associations and agribusiness sector (to reach producers)
4	Kimberley to Cape Network
5	NT Government and advisory bodies

Notes: RDAs are in a good position to provide a coordinating role to ensure two-way engagement with these groups. So it is not necessary to have all players at the NERP table, but to engage RDAs to provided communication and engagement. Engagement processes should be theme dependent.

RDA Kimberley

1	LGAs
2	NRM groups
3	Traditional Owners

Additional comments

Northern Gulf Resource Management Group

How do we communicate information in a simple and informative manner to landholders and policy makers?

Reef Catchments

- Need to consider historical context and understand the constraints to development of NERP. Will the same structures and focus be in place, and how much room is there for new structures and foci? What are the engagement processes, and will they be the same as before?
- Reef Catchments was consulted in the program / project prioritisation of NERP TE, but there was little subsequent engagement. Projects were good, but would have been more useful with ongoing serious engagement.
- GBR project topics were relevant to Mackay-Whitsunday, but a low level investment and physical presence of researchers in this region (and further south) limited their applicability
- Reef Catchments would like to see invitations to co-invest in NERP to
    - Ensure that stakeholders needs are met
    - Stakeholders are committed and can justify a reasonable level of involvement
    - NRM groups can help leverage more fund through relationships with industry and other partners
- However, there would need to be a process for recognition of funds that are derived from AG/QG as an investment (and statement of priorities) – rather than just dismissed as double-dipping
- Payment on delivery is essential, with project schedules clearly defining milestones with agreed outcomes, which can be a tranche of scientific enquiry (blue-sky) or a tangible deliverable
- While decisions about major projects are made at the regional level, environmental decisions are made at the state and national level. Need to address this disconnect

Fitzroy Basin Association

Some NERP project leaders have engaged well with NRM groups.

Paddock to Reef is a good example of research that is well integrated with end-users.

NRM groups are getting better at evaluation through annual processes and can share this information with research programs.

Rangelands WA

There is an opportunity for greater integration with NRM groups to facilitate development, delivery, communication and adoption of research initiatives.

RDA Far North Queensland and Torres Strait

From community engagement there are some micro research issues that have been identified:

- Accurate data on natural disasters
- Community capacity and engagement in NRM data – NRM info already exists for Land Managers but community scale (SLA or Catchment scale) data is required
- Community's attitudes and motivation about the environment
- Number of farms, landholders and other businesses/groups providing environmental offset services (and type of offset e.g. koala habitat or vegetation management offset)
- Number of businesses and households seeking to participate in voluntary carbon markets and extent of offset activity
- Average greenhouse gas emissions figures for peak period vehicle movements on roads
- Local government area or catchment scale data to support the National Water Initiative7

[7] http://www.nwc.gov.au/nwi

- Land management data – catchment scale data concerning grazing and agricultural land management practices e.g. fertilizer usage, fencing of riparian zones to exclude stock
- Nature based tourism activities – number and economic value
- Greenhouse gas emissions – quantity of gas emissions (little consistency at GIS in the percentage of green space available, with the latter, Local government area level data not available too)
- Endangered species – no region-wide list of endangered species available, also need mapping of concentrations and numbers and population projections (including issue of cyclones)

Synthesis of responses

Research priorities

Targeting investment

NRM groups and RDAs supported research being undertaken in all areas of NRM activity – from foundational ecological research through landscape planning and management to program delivery (Q3; Figure 3).

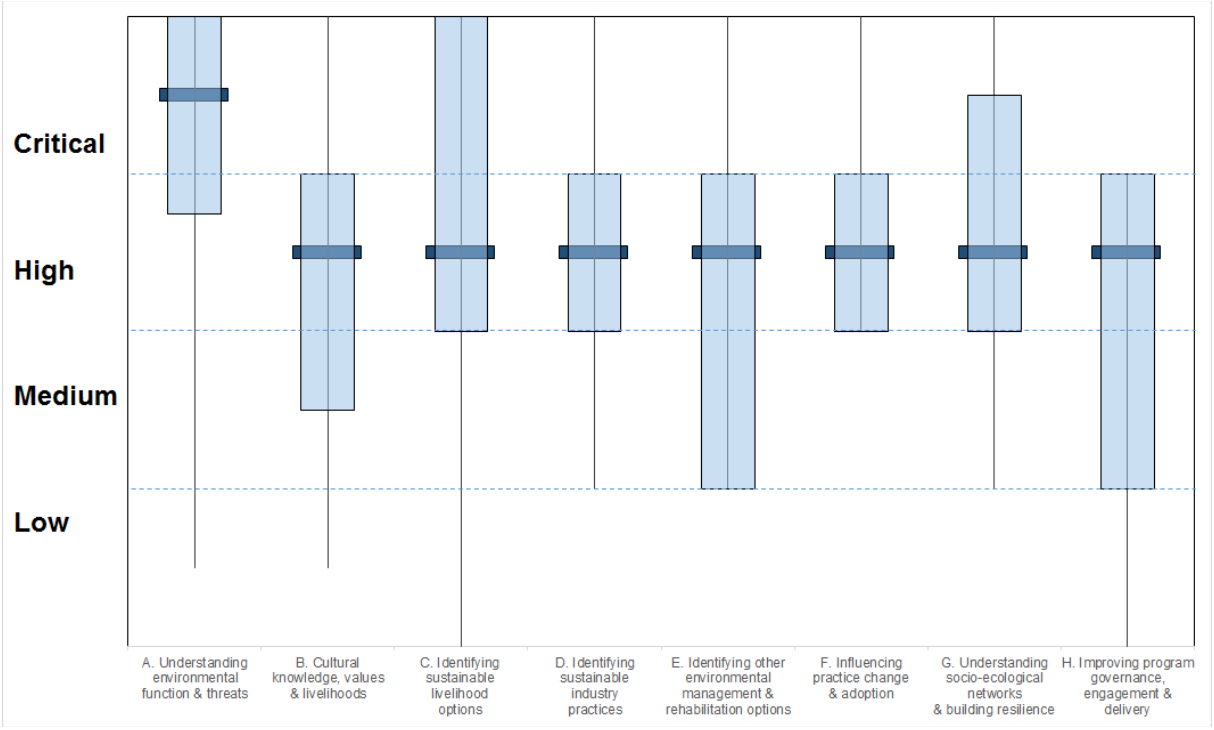

Figure 3: Priority areas for investment of research funding – NRM and RDA combined

The highest priority for investment jointly identified by both NRM groups and RDAs was research to improve understanding of environmental function and threats. Many groups stressed that research invested in this area should focus on informing management, rather than simply identifying values and threats.

The next highest priority across both sectors was identification of alternative sustainable livelihood options, particularly for Indigenous people. In more remote areas, identification of options outside the agricultural sector was emphasised, but in more intensely developed areas, there was greater interest in new agricultural crops.

NRM groups also emphasised the importance of improving understanding of socio-ecological networks and community resilience building (Figure 4). While there was recognition of the importance of effective and egalitarian policy and program governance, research was not necessarily seen as the solution to achieving this. Any interest shown in governance research was more likely to be focused on ensuring NRM policies and programs lead to enduring improvements in social and environmental outcomes. This situation may reflect the difficulties facing natural resource institutions integrating the governance and social sciences into their priorities and processes (see Dale, Taylor & Lane, 2002).

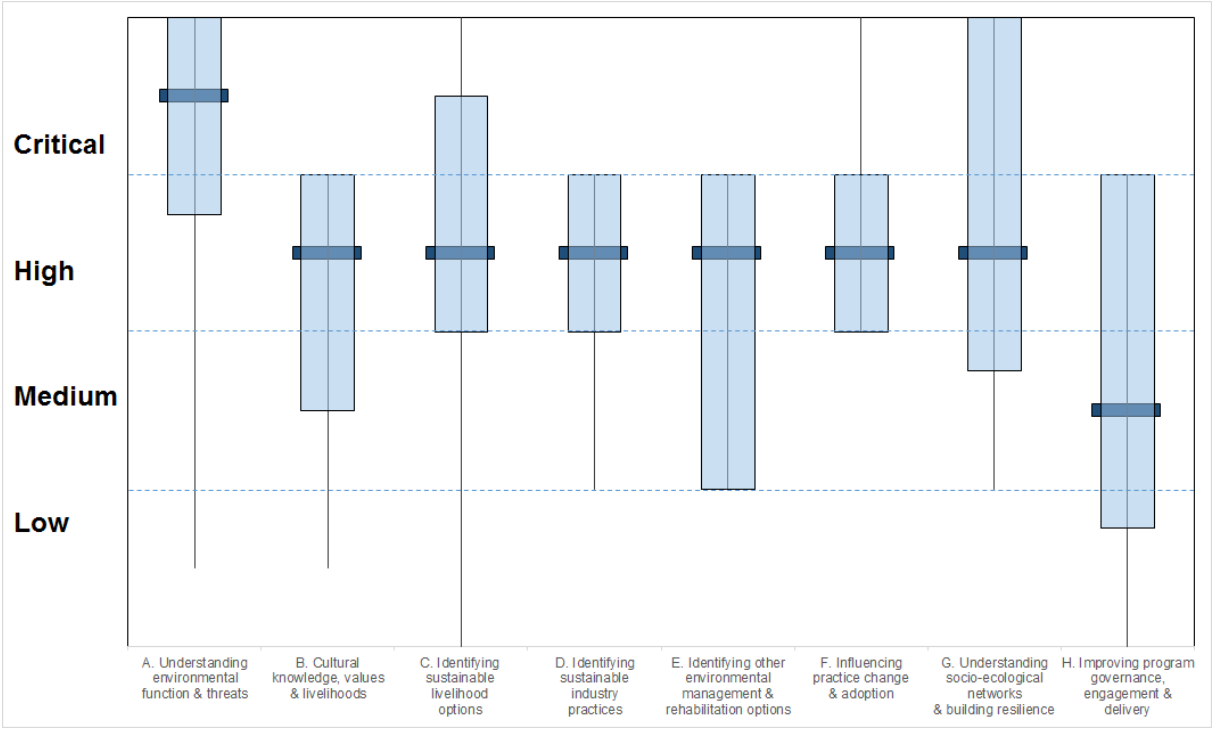

Figure 4: Priority areas for investment of research funding – NRM only

RDAs also emphasised the need for research to develop sustainable industry practices (Figure 5). Research into rehabilitation received low overall support, but was considered critical in regions with high mining activity.

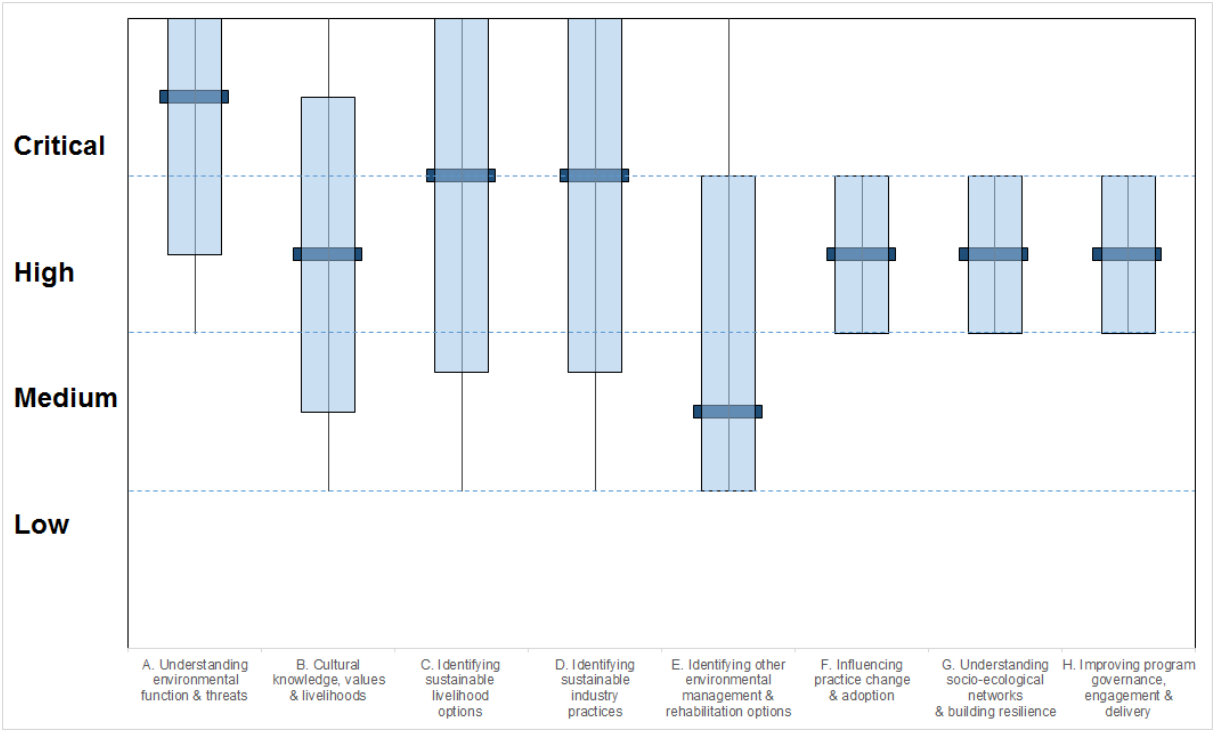

Figure 5: Priority areas for investment of research funding – RDA only

Framing research priorities

NRM groups and RDAs listed a number of factors that should be taken into consideration when framing national environmental research programs (Q5). There was broad consensus that any future environmental research program directions should be based on a clean-slate prioritisation, with identification and prioritisation of research gaps (NGRMG, Territory NRM, FNQ&TS, RDA Kimberley) through a combination of stakeholder (community and industry) and researcher input (NGRMG). Processes and systems would need to be put in place to ensure strategic investment to deliver regional-scale outcomes (RDA FNQ&TS).

Most NRM and RDAs have already run their own research prioritisation processes as part of developing their plans or roadmaps – as well as for their internal operations – and most have been part of wider prioritisation processes. They therefore saw the importance of aligning research prioritisation with existing plans and strategies, including: NRM plans and RDA roadmaps; Reef RD&E; Reef Rescue prioritisation; sustainable agriculture strategies; and water security (RC, FBA, Territory NRM, RDA FNQ&TS).

A fresh prioritisation approach was preferred over unquestioned continuation of investment in already well-researched areas, a process which was perceived to have led to the neglect of frontline environmental issues (NGRMG, NQDT, RC, Territory NRM). Readily identified gaps in the current NERP TE Hub program included:

- Exclusion of environments outside the GBR, Torres Strait and Wet Tropics, in particular, the dry tropics, where there is greatest development pressure (NQDT, RC)
- Low investment in ecosystems of the aquatic-marine interface of the GBR region (mangroves, coasts, estuaries, floodplains) (NQDT, FBA)

A robust prioritisation process, however, was also expected to identify a wider range of issues – including emerging or anticipated issues – worthy of research. These would include the research priorities identified by NRM groups and RDAs, as presented in the following sections. However, there was recognition that current programs deliver many valuable outputs. Hence, identification of new priorities should not necessarily mean the withdrawal of research funding from existing high quality research (NQDT).

Given the range of research programs available to address industry development (e.g. RIRDC, MLA, SRA, GRDC, HAL and potentially a northern agricultural CRC), baseline environmental research assessing ecosystems values and threats was considered the highest priority by some groups (see Targeting investment), with a balance between environmental consequences and economic impact (RDA MIW). As well as investing in biophysical research, research that improves understanding of the social context was considered essential to ensure applicability and environmental impact (Terrain, RC, FBA). This work needs to be more practical than much of the socio-economic research that has been undertaken historically by going beyond simply developing an understanding of motivations and barrier to adoption of better practices to identifying what can be done to ensure ongoing uptake and improvement in environmental outcomes (FBA). NRMs are in a good position to help focus social research in this regard (RC).

There was overwhelming support for an emphasis on research with applicable outcomes (NGRMG, Terrain, NQDT, RC, FBA, Territory NRM, Rangelands WA, RDA FNQ&TS, RDA NT, RDA Kimberley). To achieve this, the majority of research funding should be invested in projects to inform decisions about resource use and management and program investment. Some groups consented to a small percentage of funding (~10-20%) being allocated to blue-sky research (Terrain, RC). Useful research outputs identified included science synthesis; strategic management options; modelling/decision-making software; and policy advice (NQDT, RC, FBA, Territory NRM, RDA FNQ&TS). Such outputs can be delivered within the relatively short timeframes currently provided by NERP, while more in-depth research aimed at improving understanding of complex problems or processes may require longer funding cycles (Terrain).

There was a preference for research hubs to be established around themes or objectives, not geographic areas (FBA, CYNRM). In a theme-based program, distribution of research effort and stakeholder involvement should not be constrained to a small geographic area (TSRA, CYNRM, RC). Where it is based around a biome or bioregion (e.g. GBR, Brigalow Belt), effort and engagement should be equitably spread across the area (TSRA, RC, FBA). For example, investment in GBR and associated water quality research should be extended outside the area between Townsville and Cairns (TSRA, RC, FBA, BMRG). Some groups felt that research outcomes should be applicable across northern Australia and to a range of stakeholders, but with focal studies in agreed, representative locations where it is likely to achieve most impact (Territory NRM, RDA FNQ&TS, RDA Kimberley).

At the project selection level, it was considered that research proposals should stand up to cost/benefit and gap analysis (Terrain). Researchers seeking funds should be required to demonstrate public support for their research by forming partnerships with stakeholders who are prepared to invest in and apply their outputs (NGRMG, RC, Rangelands WA, RDA FNQ&TS, RDA NT).

Universities were viewed as a subset of stakeholders, and should not be treated as the primary stakeholder driving NERP investment (RC). However, there was recognition that different performance indicators drive priorities within research institutions and NRM groups or RDAs, and that program design would need to ensure mutually-beneficial outcomes (RDA FNQ&TS). It was also suggested that additional incentives may be required to attract researchers into applied research areas that are perceived as low-value or risky (NGRMG). While the importance of maintaining local research capacity was recognised, continuity of project funding for a researcher was deemed justified only where this met a prioritised knowledge need (Terrain, Territory NRM). If expertise in an identified area of research need is not available locally, then it was considered desirable that outside researcher organisations should be engaged, or outside researchers employed, seconded or hosted by northern institutions (Territory NRM).

Finally, it was considered important that operational efficiencies be achieved by dovetailing with existing projects, initiatives resources and networks to minimise duplication (Rangelands WA; RDA NT). RDA and NRM networks can support such efficiencies.

Research priorities extending across northern Australia

Research priorities identified by NRM groups and RDAs were drawn into 12 thematic areas (Figure 6, Table 2). The most highly ranked themes across northern Australia were water and landscape planning; alternative sustainable livelihood options and best practice management adoption.

Table 2: Research themes derived from NRM and RDA responses

THEME	
1	Influencing policy development
2	Water resource planning
3	Landscape planning
4	Sustainable livelihood and agricultural options
5	Achieving on-ground best practice
6	Intelligent condition and trend assessment
7	Water quality improvement
8	Efficient resource production and use to minimise footprint
9	Carbon abatement and sequestration options
10	Climate vulnerability and adaptation
11	Biodiversity values, threats and management responses
12	Coastal to freshwater wetland values, ecosystem services and management

The first four themes aim to ensure development of northern Australia is based on sound understanding of environmental, cultural and social values, economic opportunities – with intelligent management of trade-offs – and that the economic benefits of development are equitably shared. The remaining themes feed into one or more of these core themes by delving more deeply into understanding, monitoring and/or managing specific assets.

- Theme 1 examines how to achieve real and long-term improvement in the condition of northern Australia's environmental, cultural, social and economics assets through influencing the policies and programs of government, political parties and other interest groups
- Theme 2 considers water assets and needs and the relative merits of allocating water for different purposes
- Theme 3 identifies where in the landscape different land uses and management are most appropriate both individually and in an integrated matrix
- Theme 4 identifies sustainable economic and employment options that are sympathetic with the north's rich environmental and cultural values
- Theme 5 identifies best management practices to achieve desired outcomes and knowing how these are best implemented for long-term benefit
- Theme 6 develops tools for monitoring and evaluating impact of NRM on environmental, social, economic and cultural condition in order to demonstrate where the best return on investment can be gained

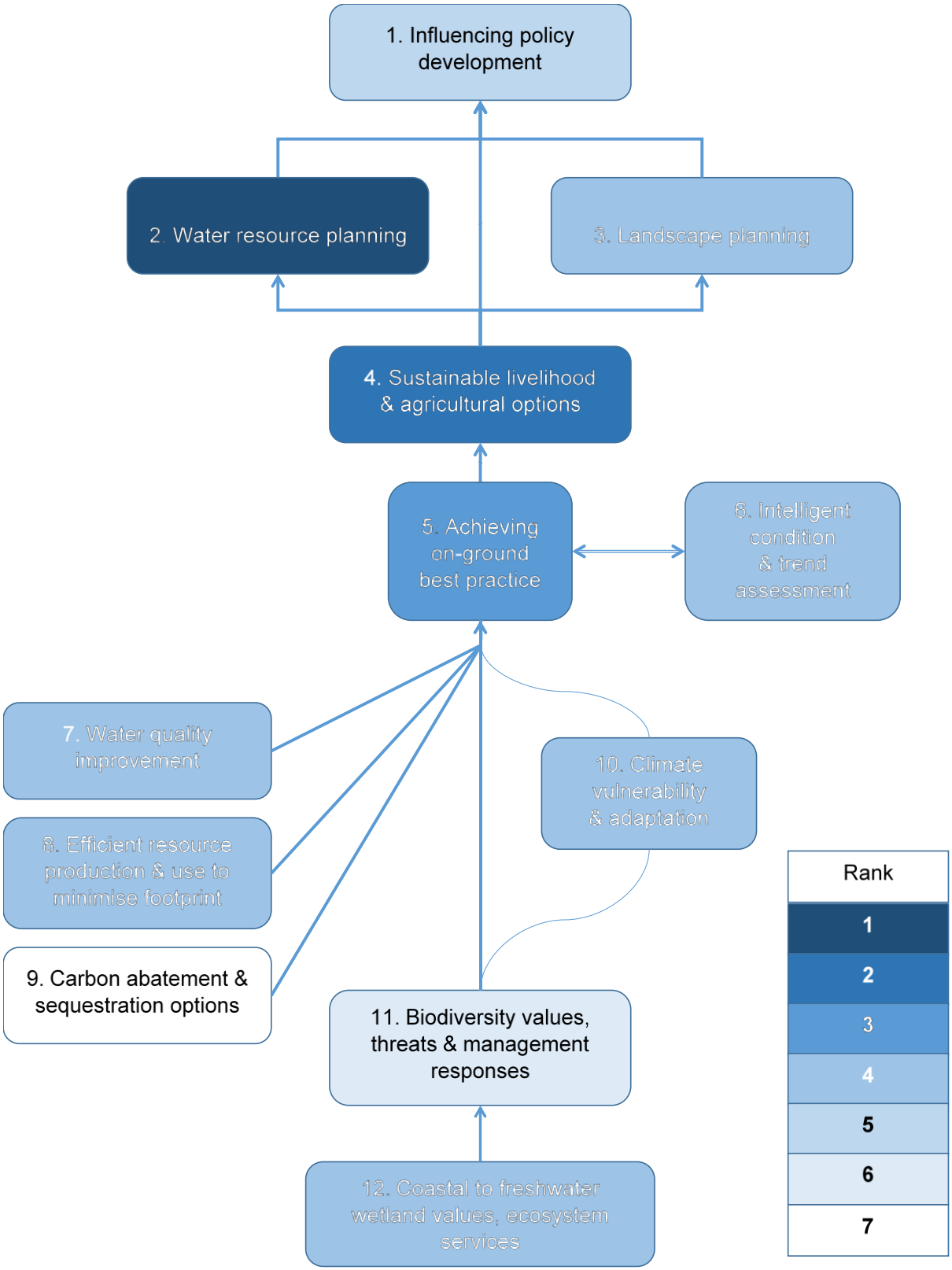

Figure 6: Relationship between and ranking of environmental research themes identified in this report

Subsequent themes provide a deeper understanding that will inform decisions made about resource use and management.

- Best practice management will be examined in finer detail for water quality improvement (Theme 7); minimising environmental footprints, particularly with regard to energy and water (Theme 8); and carbon stocks (Theme 9).
- Planning for environmental management, resource use and NRM jobs will be facilitated by a more comprehensive understanding of biodiversity values (especially ecosystem services), threats and appropriate management responses (Theme 11), particularly with regard to wetlands (Theme 12), and the impacts of climate variability and climate change (Theme 10)

These 12 themes aims to achieve real and long-term improvement in environmental conditions based on an improved knowledge base and its integration into policy and practice.

Emerging regional priorities across NERP TE regions

GBR health is still a major concern for organisations operating in the reef catchments. However, these groups require additional information about impacts of non-agricultural land use and best practice management to improve GBR water quality, especially regarding the building and maintenance of roads and other infrastructure (Theme 7). A shift in research focus from hillslope erosion to identifying contributions of gully and stream bank erosion was considered essential if Reef Plan targets (State of Queensland, 2013) are to be achieved. Such broadening will help in decisions about the best investments to reduce water pollution across the entire region. Groups at either end of the GBR also identified a need to intensify GBR research beyond the regions around Townsville and Cairns.

Understanding the options for economic diversification, with an emphasis on Indigenous employment in NRM is a high priority throughout north-east Queensland (Theme 4). This includes employment in monitoring and evaluation programs, as well as environmental management, and participation in the carbon economy (Theme 9). Emphasis on providing Indigenous people opportunities to maintain linkages with traditional estates while undertaking NRM was stressed in many responses. While much effort has already be invested into climate change research in the region, ongoing improvements in the climate change knowledge base was considered essential for future economic planning (Theme 10).

Emerging regional priorities across NERP NA regions

Understanding the options for improving Indigenous employment in NRM was considered equally important across the regions of current NERP NA research focus (Theme 4). Ensuring that development of northern Australia was based on an understanding of environmental values, economic opportunities and trade-offs was also highly rated (Theme 2 and Theme 3). How to achieve integrated NRM for multiple outcomes was seen as the next step, going beyond the simple mechanics of how to manage fire or kill weeds to how to make it happen on an ongoing basis and provide long-term environmental and employment benefits (Theme 5).

Gap filling in areas and ecosystems without a current NERP focus

Water (Theme 2) and landscape planning (Theme 3) based on an understanding of biodiversity values (Theme 11) were the highest priorities in regions not currently covered by a NERP research focus. These are the areas and ecosystems with the greatest development pressures from mining and agricultural development and associated infrastructure. The lack of research attention in these drier ecosystems hampers sustainable land use water resource planning.

Water quality issues and soil conservation were also identified as issues that extend beyond the GBR catchments (Theme 7). Management of hillslope, gully and stream bank erosion was considered an issue regardless of whether catchments flow into the GBR or other marine environments.

Theme profiles

A profile is provided for each research theme. These provide a summary; considerations; information on regional variation in responses; and maps indicating the organisations that identified elements in the theme as being either a *Moderate* or *High* priority. Emerging priorities are also summarised in the areas of current research focus by NERP TE and NERP NA, as well as for regions outside current intensive NERP investment. It should be noted that absence of a medium or high priority rating does not indicate lack of support for a research theme, only that it was not raised in responses to date. NRM groups and RDA boards will have the opportunity to refine their priorities and the list of themes before this report is finalised.

Theme 1 Influencing policy development

Summary

Efforts to improve environmental, social, cultural and economic outcomes will only be effective if they are supported at all levels from on-ground practice to policy development. This theme addresses the difficult task of ensuring environmental research and planning at the regional level have the attention of policy makers and other high level stakeholders. A recent review of NERP (Spencer, McVay, & Sheridan, 2014) showed that, while research outputs and advice were incorporated into some policy decisions made by Department of Environment, this was inconsistent and appeared to depend on personal relationships developed between researchers and bureaucrats. An assessment has yet to be done about how successful NRM plans and RDA roadmaps have been in influencing government programs and industry positions and what factors most favour higher levels of influence.

This theme will therefore assist and support NRM groups and RDAs to measure and enhance their influence on relevant policy and program design by all levels of government (and associated government budgetary processes), as well as on industry standards and sustainability initiatives. An assessment will also be undertaken of the extent to which policy makers have drawn on a good understanding of the issues and the relative advantages, disadvantages and trade-offs to develop evidence-based policy, and the contribution of other factors such as expediency under short time-frames or lobbying for development, conservation or other political agendas. It will identify which activities have had the most influence and how this insight can be used to effect greater improvements in social, cultural, environmental and economic outcomes.

Relationship to other themes

Theme 5 addresses mechanisms to increase on-ground best adoption.
Theme 6: This research will inform the type of monitoring and reporting required to influence particular policy development.
All other themes will provide a strong evidence-base to support policy development.

Theme 2 Water resource planning

Summary

Agricultural and mining expansion across northern Australia is placing increasing pressure on water resources and associated ecosystems. Current and projected demand requires construction of surface water storage or extraction of groundwater. Before water is committed to new developments, information is required on the availability of supply, rates of groundwater recharge, and impact of storage and extraction on cultural and environmental values and other dependent industries and communities.

Regional variation and considerations

- Mapping and monitoring of water resources to assess capacity, quality and environmental impact of capture and storage is needed to inform allocation. This includes likely impacts on fisheries; water-dependent ecosystems (especially springs); distribution of riparian weeds and pest animals; and sustainability of current and proposed agricultural land use
- CSIRO has undertaken a thorough water resource assessment for the proposed expansion of irrigated agriculture in the Flinders-Gilbert area of north Queensland[1], but similar assessments are required in other areas of proposed agricultural expansion or affected by extraction
- Impact of coal mining on groundwater quality and availability is a concern in the Fitzroy, Mackay-Whitsunday and Kimberley regions
- ANZECC water quality standards have been identified as inapplicable in the Northern Gulf
- Cultural values must be considered in any decision about water resource use
- Decision support based on social, environmental and economic assessment is required to identify best practice water management in each setting (e.g. off-stream storage versus in-stream storage versus aquifer recharge) as well as allocation
- Planning to improve water use efficiency is required at all levels down to the property scale
- Town water quality and security is a particular concern in the north-west Queensland

Relationship to other themes

Water storage, groundwater extraction and fracking have implications for water quality (Theme 7), wetland health (Theme 12) and biodiversity (Theme 11).
Theme 4: Planning for sustainable agricultural development will be dependent on an understanding of water resources.
Theme 10: Water resource planning needs to be cognisant of likely climate change impacts.
Theme 8: More efficient water use will help to reduce environmental footprints.

[1] www.csiro.au/Organisation-Structure/Flagships/Water-for-a-Healthy-Country-Flagship/Sustainable-Yields-Projects/Flinders-and-Gilbert-Agricultural-Resource-Assessment-overview.aspx

Theme 3 Landscape planning

Summary

Northern Australia's future development needs to be well planned to maintain the region's unique ecological and cultural values, and enhance its long-term economic viability and community resilience. This theme will therefore develop and populate planning decision-support tools through improved understanding of:

- Environmental, cultural and economic assets
- Landscape function and processes, including ecosystem services and connectivity
- Pressures, drivers and long-term economic outlooks (including population growth, development agendas, market forces and climate change)
- Benefits, impacts and trade-offs of current and potential land uses (including mining, agriculture, carbon sequestration, conservation) and associated infrastructure

Decision support tools supporting trade-off analysis should facilitate assessment of the relative environmental, cultural, social and economic costs and benefits of specific alternatives (e.g. reforestation for carbon sequestration versus growing fuel crops) as well as appropriateness of land uses in specific locations (e.g. restricting clearing to less erodible soils; siting of rail corridors to minimise impact on landscape connectivity).

Regional variation and considerations

- Greatest need is in areas of northern Australia ear-marked for agricultural or mining expansion, notably in areas of outside areas of current NERP focus
- Staging of research and timing of outputs need to be scheduled to inform decisions, planning and policy development

Relationship to other themes

Landscape planning should be based on understanding of biodiversity values, processes and management principles – such as protection of critical habitat and maintenance of connectivity (Theme 11); and how these are likely to be affected by climate change (Theme 10).

Landscape planning should also deliver real improvements in social, cultural, environmental and economic outcomes through sustainable and equitable water allocation (Theme 2) protection of GQAL to ensure regional food security (Theme 4) and protection of water quality (Theme 7). Effectiveness of landscape planning in this regard will depend on identification and uptake of best practices (Theme 5).

Theme 9: This theme will identify where carbon farming is most appropriate in the landscape.

Theme 4 Sustainable livelihood and agricultural options

Summary

Development of the north should be both sustainable and to the benefit of the whole community. This means identifying new economic opportunities that are compatible with the region's high ecological values and provide sustainable employment. Potential areas for investigation should include agricultural (e.g. food and tree crops; biofuels) and alternative livelihoods (e.g. eco- and cultural-tourism; sustainable wildlife, plant and seed harvesting; environmental mapping and monitoring; carbon farming; alternative fuel generation); as well as using offset schemes to transfer economic gains realised from development to support NRM. Feasibility assessments, including pilot programs, are required to determine whether new opportunities can provide long-term employment and economic solutions.

Regional variation and considerations

- Agricultural diversification is a higher priority in the more developed regions and Indigenous employment opportunities in NRM in more remote areas
- CYNRM has identified priority opportunities to pursue employment in ecosystem service delivery, but funding is required for feasibility assessment and start-up
- Local communities should have a role in determining which livelihood options should be pursued
- Innovative solutions – such as using weeds for biofuels or pest animals for compost – should be sought to address seemingly intractable problems
- Investment in new industries and employment opportunities should enhance community resilience and allow Indigenous communities to maintain relationships with traditional estates
- Indigenous training and skill development should be linked to real employment opportunities

Relationship to other themes

Theme 2 Sustainable agricultural development will depend on an understanding of water resources.
Theme 3 Assessment of new economic opportunities should be integrated with landscape planning and ensure protection of GQAL.
Theme 6 Identification of sustainable employment options in NRM will be facilitated by an improved understanding of the impact of NRM on environmental condition and trend.
Potential employment opportunities include sustainable use and management of wetlands (Theme 12); mapping environmental assets and monitoring environmental conditions (Theme 6); and carbon sequestration and emission abatement (Theme 9).
Theme 11 New crops and agricultural practices (e.g. biofuels) should not pose threats to biodiversity.

Theme 5 Achieving on-ground best practice

Summary

Many industries have developed Best Practice management options (BPs) to maximise economic returns and minimise environmental impact. In northern Australia, focus has been on improving soil conservation in the grazing industry and fertiliser and pesticide efficiency in the sugar and horticultural industries to the benefit of GBR water quality. BPs are required for a range of other regions, industries and practices (e.g. mine rehabilitation). Mechanisms for improving BP adoption (such as maintaining grazing land condition), should be developed by improving understanding of the NRM community and how to overcome barriers to adoption; improving producer understanding of issues, solutions and trade-offs; and bringing market forces into play. Where appropriate, BPs should be incorporated into industry guidelines.

BPs are also required for a range of NRM activities, such as governance and engagement and achieving integrated NRM across the landscape through combined cultural, fire and biodiversity management. BPs need to be regionally appropriate, taking into account the specific values and vulnerabilities of the areas being managed, as well as cultural knowledge, values and aspirations. Practical demonstration is also required of how BP adoption can be sustained to produce long-term benefits.

Regional variation and considerations

- BPs should include cradle-to-grave approaches, ranging from prevention to treatment; be integrated to avoid perverse outcomes; and be delivered through an adaptive management planning framework
- BPs should include innovative solutions, such as turning weeds into economic assets
- Engagement strategies are required to influence BP adoption by periurban communities and managers of small landholdings

Relationship to other themes

Theme 3: Effectiveness of landscape planning depends on identification and BP adoption.
Theme 7: Water quality improvement is dependent on the development of BPs for minimising sediment, nutrient and pesticide management.
Theme 11: BP implementation is required to maintain the integrity of the north's biodiversity values.
Theme 9: Development of carbon sequestration and abatement methodologies needs to be informed by local values and aspirations.

Theme 6 Intelligent condition and trend assessment

Summary

Monitoring to assess environmental, cultural, economic and social conditions is required to determine where management intervention is required and to assess its effectiveness, thereby assisting prioritisation of NRM investment. Monitoring systems developed in more populous areas do not transfer well to vast, data-poor northern landscapes. Simple indicators are required that can be used in regular rapid assessments, with more comprehensive assessments used only for targeted purposes. Condition and trend should therefore readily inform planning and management decisions to improve environmental, cultural, economic and social conditions.

Regional variation and considerations

- Condition and trend assessment should be based on both Indigenous and western scientific knowledge
- Monitoring should encompass the range of assets identified in State of Environment reporting. However, specific assets identified as requiring regular monitoring and reporting include seagrass beds; wetland condition; river health; human health, education and capacity; and economic diversification
- ABS statistics are inadequate for condition assessment through remote areas
- ANZECC water quality standards have been identified as ill-fitting northern conditions

Relationship to other themes

Theme 4: Monitoring and reporting of trend and condition can provide Indigenous employment and support investment in environmental management, including through offset programs.
Theme 3: Condition and trend assessment should be used to inform landscape planning by highlighting areas of exceptional values and likely impacts of new developments.
Theme 12: Wetland assessment will be aided by the development of a robust and regionally appropriate set of condition metrics.
Theme 11: Condition and trend monitoring is required to prioritise and evaluate biodiversity management.
Theme 1: Tracking condition and trend will provide an instrument to influence policy development, and allow assessment of policy effectiveness in improving environmental, cultural, economic and social outcomes.

Theme 7 Water quality improvement

Summary

Efforts to improve water quality have focused on management of fertilisers, herbicides and sediment in the cane, grazing and horticultural industries in the Great Barrier Reef (GBR) catchments. Reduction of sediment pollution has focused on improving grazing land condition to reduce hillslope erosion. However, other industries, land uses and landscapes contribute to pollution of northern waterways. In particular, road building and maintenance have been identified as major sediment sources, and recent research has highlighted the role of gully and stream banks erosion. In light of this work, Best Practice (BP) guidelines to reduce erosion and its impact on water quality have been developed for the Normanby catchment (Shellberg & Brooks, 2013), but are also applicable across northern Australia. However, prioritisation of investment in efforts to improve water quality requires further advances in understanding of the role of land type, vegetation condition and land management practices, and the effectiveness of remediation efforts. This theme will produce and calibrate decision support tools to allow both spatial prioritisation of pollution reduction efforts and identify industry-specific guidelines on the efforts they can take to reduce sediment, nutrient and herbicide losses.

Regional variation and considerations

- This research needs to be extended beyond current focal areas in the GBR catchments
- Sources of heavy metal contamination in the Mitchell River need to be identified and remediation options developed
- The low level of private benefit delivered by remediation of stream banks, gullies and highly degraded lands needs to be taken into account when assessing the relative merit of rehabilitation strategies

Relationship to other themes

Theme 2: Water storage, groundwater extraction and fracking all have water quality implications.
Theme 5: Uptake of BPs to improve water quality will be informed by studies into mechanisms to increase BP adoption and the development of management practice codes.
Theme 12: Wetlands play a significant role in filtering pollutants from land-based activities.

Theme 8 Efficient resource production and use to minimise footprint

Summary

Provision of water, energy, transport and communications is essential for maintaining our ability to manage natural resources across northern Australia, but pose significant challenges and inefficiencies, especially in remote areas. Research is required to identify innovative and cost-effective ways to provide these services, while minimising their environmental footprint. High priorities include identification of low-maintenance renewable energy options and ways to improve water use efficiency and extend availability. Solutions should be scale-dependent, from as simple as solar pumps on bores for filling watering troughs to as complex as efficient rail systems. Assessment of impacts of any new technologies, practices or associated infrastructure will be required to ensure minimal adverse environmental social, cultural or economic impacts.

Regional variation and considerations

- Emphasis is required on remote communities, followed by rural and regional communities
- Exploration of cost effective, resource efficient, innovative energy generation and distribution should facilitate economic and social growth

Relationship to other themes

Theme 2: More efficient water use will help reduce environmental footprints.

Theme 9 Carbon abatement and sequestration options

Summary

The carbon economy is a growing but uncertain area for deriving income through natural resource management. Currently-approved methodologies[8] for carbon sequestration and emission abatement applicable to NRM in northern Australia include *Savanna Burning*; *Native forest protection projects*; *Reforestation and afforestation*; *Native forest from managed regrowth*; and *Environmental plantings*. Feasibility other options applicable to northern Australia needs to be assessed and appropriate methodologies developed.

This theme will investigate several options such as biochar; blue carbon; wetland management; and fire management in areas receiving less than 1,000 mm, or where cultural or environmental values are not compatible with a shift from late dry season to early dry season fires. It will include a cost-benefit analysis for participating each scheme, including opportunity costs associated with changes in land management, as well as the costs associated with project approval, monitoring and reporting. It will investigate options for integrating carbon farming into property and catchment management, and assess the relative benefits of carbon farming in different parts of the landscape. It will identify, develop and promote informed policy options to deliver effective carbon abatement and sequestration across northern Australia.

Regional variation and considerations

- Development of carbon sequestration and abatement methodologies needs to be informed by local values and aspirations

Relationship to other themes

Theme 5: Best practice guidelines will be developed for incorporating carbon farming with integrated fire, weeds and pest animal management under different environmental settings and scenarios.

Landscape planning (Theme 3) informed by biodiversity assessments (Theme 11 & Theme 12) and climate change vulnerabilities (Theme 10) will identify the parts of the landscape in which carbon farming is most appropriate.

[8] www.climatechange.gov.au/reducing-carbon/carbon-farming-initiative/methodologies/methodology-determinations

Theme 10 Climate vulnerability and adaptation

Summary

Climate extremes pose significant challenges to maintaining improvements to environmental health. Northern Australia has experienced more than its fair share of droughts, floods and cyclones in recent years, and these are expected to increase in frequency with climate change. In the longer term, increases in temperate and sea-level and changes in rainfall distribution and seasonality will place further pressure on environmental conditions, human resilience and industry viability.

Significant advances have been made in incorporating climate change science into NRM planning through the DOE's Regional NRM Planning for Climate Change Fund[9]. However, NRM groups seek ongoing information on specific climate vulnerabilities and adaptation strategies. Ongoing research needs identified include:

- Identification of areas, species, ecosystems and industries vulnerable to climate extremes and/or climate change
- Implications for industry viability under different climate scenarios
- Appropriate management interventions and adaptation strategies to respond to climate change and extreme events
- Ongoing monitoring to allow responses to climate change impacts as these occur
- Improvement in climate forecasting and integration into property management
- Incorporating extreme climatic events – floods, cyclones and storm surges – into disaster relief policy

Regional variation and considerations

- Mapping of flood zones and inundation events is a high priority in the Northern Gulf

Relationship to other themes

A sound knowledge of likely climate change impacts is required for water resource planning (Theme 2); development of new economic and employment opportunities (Theme 4); biodiversity threat assessment and management (Theme 11 & Theme 12); and policy development (Theme 1).
Theme 6: Rapid assessment tools will help track the impacts of climate change.

[9] www.environment.gov.au/cleanenergyfuture/regional-fund/

Theme 11 Biodiversity values, threats and management

Summary

Biodiversity underpins the unique character of the north and its natural resource values. Direct management may be required of high-value species and habitats, so it is important to identify where these occur; threats they face; and appropriate management responses. Protection of the north's biodiversity values also involves maintaining the condition of extensive landscapes. So we need to know how to plan for land use while retaining representative native vegetation and essential habitat; and to achieve integrated grazing, fire and pest management. Monitoring is also needed for prioritising and evaluating biodiversity management. As some of the highest biodiversity values occur on Aboriginal lands, it is important to identify co-management arrangements and opportunities for Indigenous employment in their management.

Regional variation and considerations

Cultural values are included in international definitions of biodiversity and Indigenous knowledge should be used alongside western science in assessment of values, threats and management responses.

Species that were singled out as requiring specific research included:

- Northern Quoll (*Dasyurus hallucatus*) (Cape York Peninsula)
- Javelin Grunter (*Pomadasys kaakan*) (Northern Gulf)

Threats identified as requiring research on impact and management responses included:

- Woody weeds that transform high value riparian areas; introduced grasses; and emergent weeds
- Pest fish species and barriers to fish passage

Relationship to other themes

Theme 2: Water storage and groundwater extraction have implications for biodiversity.
Theme 4: Development of new crops and agricultural practices should minimise threats to biodiversity.
Theme 3: Landscape design should incorporate biodiversity values, processes and management principles.
Theme 5: BP implementation is required to maintain the integrity of the north's biodiversity values.
Theme 6: Condition and trend monitoring is required to prioritise and evaluate biodiversity management.
Theme 12: Wetlands play a significant role in maintaining biodiversity health and connectivity.
Theme 10: Biodiversity threat assessment and management responses requires a sound knowledge of likely climate change impacts.

Theme 12 Coastal to freshwater wetland values, ecosystem services and management

Summary

Wetlands are among the north's most valuable ecosystems, having high cultural and scenic values and providing critical habitat, fish nurseries, carbon sequestration, nutrient cycling and pollutant filtering. They are possibly also its most vulnerable, subject to damage from weeds, pest animals, overgrazing, water extraction and climate change. Mapping of fresh and saline wetlands (including springs, swamps, lakes, floodplains and mangroves); quantification of the ecosystem services they provide; assessment of their condition; and identification of the threats to them will assist prioritisation of investment in their management.

Regional variation and considerations

- High value coastal wetland ecosystems are crucial for Indigenous livelihoods, particularly in the Torres Strait, Cape York, the Gulf, Kakadu and Arnhem Land
- In north-east Queensland, there was an emphasis on extending GBR research to include assessment of the role floodplains and coastal wetlands in maintaining reef water quality
- Wetland assessment and prioritisation for management should be based on both Indigenous and western scientific knowledge
- Prioritisation of wetland management needs to be informed on the long-term outlook for each wetland, particularly vulnerability to climate change

Relationship to other themes

Theme 2: Water storage and groundwater extraction have implications for water quality.
Theme 4: Valuation of ecosystem services provided by wetlands will help justify employment in wetland mapping, monitoring and management, particularly in maintenance of their capacity to sequester carbon (Theme 9).
Theme 3: Understanding of wetland values is requisite for sustainable landscape planning.
Theme 6: Wetland assessment will be aided by the development of a robust and regionally appropriate set of condition metrics.
Theme 11: Wetlands play a significant role in maintaining biodiversity health and connectivity.
Theme 10: Prioritisation of wetland management needs to consider climate change vulnerability.

Governance framework

Stakeholder identification

NRM groups and RDAs considered that engagement in environmental research will be effective only if it is appropriately inclusive. Anyone involved in the management of the land, water or sea across northern Australia was recognised as a stakeholder, although their level of engagement would depend on the research theme and the type of outcome intended (Q9; Table 3).

Table 3: Environmental research stakeholders identified by NRM groups and RDAs

	CYNRM	FBA	NGRMG	NQDT	Rangelands WA	Reef Catchments	SGC	Terrain NRM	Territory NRM	TSRA	RDA FNQ&TS	RDA Kimberley	RDA MIW	RDA NT	RDA TNW	Total
Industry representative groups	+	+			+		+	+	+		+			+	+	9
NRM groups		+		+		+		+				+	+		+	7
RDAs	+		+			+	+		+	+			+			7
LGAs			+	+				+			+	+		+	+	7
Indigenous communities/ Traditional Owners			+	+	+			+	+		+	+				7
State/ Federal government agencies and authorities				+	+			+	+					+	+	6
Alliances and special interest groups	+	+			+		+							+		5
Regional economic development groups							+				+		+		+	4
Regional organisations of councils	+					+							+		+	4
Research organisations and consultants	+		+			+										3
Port/infrastructure developers						+										1

NRM groups

NRM groups considered themselves to be key stakeholders of environmental research programs, with the capacity to extend stakeholder engagement and communication through their own networks (e.g. Traditional Owners, small community groups and individual land managers) and develop extension and education materials. In some cases, NRM subcommittees (e.g. the Southern Gulf Pastoral Industry Advisory Group) were nominated as the appropriate point of engagement with future environmental research programs.

RDAs

RDAs and NRM groups considered RDAs to be key stakeholders, again with the capacity to extend stakeholder engagement and communication through their own networks. These included LGAs, LGA alliances and enterprise groups.

Industry representative groups

Industry representative groups were identified as key stakeholders across northern Australia. Depending on the program emphasis, their participation was deemed appropriate at either the program or project level. Those listed included

- AgForce
- Agribusiness sector

- Agricultural bodies
- Canegrowers Mackay
- Gulf of Carpentaria Commercial Fishing Association
- Industry clusters
- Kimberley Cattlemen's Association
- Mareeba District Fruit and Vegetable Growers Association
- Meat and Livestock Australia
- National Farmers' Federation
- Northern Beef Crisis Committee
- Northern Gulf Graziers Group
- Northern Territory Agricultural Association
- Northern Territory Cattlemen's Association
- Northern Territory Horticultural Association
- Port/infrastructure developers and managers
- Queensland Farmers' Federation
- Queensland Resources Council
- Regional Economic Development Corporation in RDA MIW area
- Tourism bodies
- Western Australian Pastoralists and Graziers Association

Local Government

Local Government Associations (LGAs) were identified as a key stakeholder group in Queensland and Western Australia. However, the level at which they should be engaged would depend on the outcome being sought. LGAs were seen as integral to achieving on-ground outcomes and identifying research locations and partners. However, LGAs were seen as having a limited capacity to participate in program design or evaluation. Where this is the case, RDAs saw themselves as best-placed to facilitate engagement and communication with these organisations.

Indigenous communities/ Traditional Owners

Traditional Owners were recognised as primary stakeholders in all regions. However, views on the means by which they should be engaged varied. In some areas, appropriate TO representative groups, such as Land Councils or Prescribed Body Corporates, could be easily identified; in others NRM groups had appropriate engagement structures in place. However, there was a strong feeling that TOs in each region should be asked how they should be engaged, rather than assuming existing structures were appropriate.

State/ Federal government agencies and authorities

State and federal government agencies and associated authorities and advisory bodies were identified as stakeholders. Specific mention was made of the Great Barrier Reef Marine Park Authority and National Park agencies. The Queensland government's Regional Managers' Coordination Network was identified as an effective channel for broad Queensland government engagement. Throughout discussions, it was evident that NERP's current emphasis serving the needs of the federal government was viewed as unfortunate.

Alliances and special interest groups

Groups that have formed to address specific issues were seen as ideal stakeholders for reaching specific target audiences, and for spreading the transaction costs of stakeholder engagement. Those listed included:

- Australian Wildlife Conservancy
- Environs Kimberley

- Kimberley Rangelands Biosecurity Association
- Kimberley to Cape Network
- Land Conservation District Committees
- Northern RDA Alliance
- Rangelands NRM Alliance
- Reef Alliance (5 major reef catchments with industry linkages)
- WWF

Regional economic development groups

Groups with an economic development agenda were identified as stakeholders by RDAs. These groups were viewed as grappling with big issues around economic development and sustainability. Those listed included:

- Remote Area Planning and Development Board
- Chamber of Commerce
- Advance Cairns
- Gulf Savannah
- Cape York Sustainable Futures
- Townsville Enterprise
- Mount Isa to Townsville Economic Development Zone
- Regional Economic Development Corporation in RDA MIW area

Regional organisations of councils

Regional organisations of councils are alliances of neighbouring LGAs in Queensland that tackle issues of common interest. They are often involved in NRM, especially weed management, and so were viewed as legitimate stakeholders. Those listed included

- Far North Queensland Regional Organisation of Councils
- Regional Economic Development Sub-Committee of the North Queensland Regional Organisation of Councils
- Whitsunday Regional Organisation of Councils

Research organisations and consultants

Other researchers and research organisation were seen as important to engage in future research programs. Those listed included

- Charles Darwin University
- James Cook University
- Local consultant researchers
- Rural Industries Research and Development Corporation
- State Government agencies

Port/infrastructure developers

Only one mention was made of port/ infrastructure developers. However, the scope for these individual organisations to cause adverse impacts (particularly to GBR water quality) suggests that effort should be made to include them in the stakeholder base for water quality research.

Engagement processes

NRM groups and RDAs had clear views on the engagement processes that they consider necessary to provide research of value to their organisations and broader NRM initiatives (Q6 and Q7). They believed that engagement should be about making sure the program delivers

products that can be incorporated into their operations (FBA), and not about being delivered products at the end of the process and told to use them (NGRMG, NQDT). Therefore engagement processes need to be designed to meet this objective, and not be about signing off on research just to get it over the line.

Terminology and definitions

Some groups were concerned about the use of particular terminology and thought it was important that everyone involved in a research program should have the same understanding of the terms used. Many responses included a discussion of the difference between an *end-user* and a *research partner*. In addition, there was discomfort around what many researchers considered as adequate engagement, so the first step in the engagement process should be to define terms and the types of processes that these encapsulate (CYNRM).

For the sake of this report, *end-users* is applied to stakeholders who are consulted at the start of the program to have input into project design, but may then have minimal involvement until outputs are ready for testing and implementing. They may then be involved in broader stakeholder engagement, and the dissemination and uptake of research finding through wider networks. *Research partners*, on the other hand, is used to refer to stakeholders that are actively engaged throughout the research, having regular opportunities to meet to provide critical advice and assess progress, and may have direct involvement in the research delivery. NRM groups and RDA that expected to play a more active role preferred to be considered *research partners*, while those with less capacity to participate seemed to be more comfortable with being called *end-users*.

Processes and MoUs will be required to ensure that the pivotal role of research partners and end-users is recognised and that they can build their responsibilities into their programs (NQDT, RDA FNQ&TS). This should include stakeholder representation on strategic-level steering committees or advisory committees (FBA, Territory NRM, RDA Kimberley).

Engagement plans

Engagement and communication plans should be developed and implemented for both the program and individual projects (NQDT, RC, Territory NRM, RDA MIW). These will vary depending on project focus and objectives, with projects that aim to produce tangible deliverables having a higher level of engagement that those that involve blue-sky research (NQDT, RC, RDA MIW). Funds allocated to engagement should be identified in each project budget, with at least some being allocated to the engagement costs incurred by stakeholders. Depending on the level of engagement required of each organisation (particularly where they are a stakeholder for multiple projects), funding may need to cover the cost of that organisation employing a liaison officer (TSRA). If engagement is to go beyond tokenism, adequate time also needs to be allowed for the engagement process (TSRA, NGRMG, Rangelands WA). A longer funding cycle would also allow real gains to be made and for stakeholders to see the program as worthwhile (NQDT).

Engagement schedules should identify organisations as stakeholders, rather than individuals, and processes should be put in place to ensure continuity when the contact person in the project or the stakeholder group moves on (NQDT). They should also identify what the stakeholder is expected to deliver both through engagement processes and as project outcomes, as well as what the stakeholder can expect to receive in these areas.

Stakeholders as co-investors and research partners

If the aim of engagement is to deliver science that will be incorporated into on-ground action, then engagement processes should ensure stakeholders have confidence that they will obtain a useful product as a result of being involved in the research. Stakeholders are most likely to get what they require when they are the buyer (RC). Some NRM groups would prefer to do this by co-investing and leveraging other funding opportunities through their networks (RC). This would ensure that the stakeholders are in a position to drive research program priorities and direct project investment.

Stakeholder buy-in can also be gained through close collaboration (Terrain, Territory NRM). To achieve this, the program must demonstrate user involvement in research, including design of management questions; user involvement as researchers; review of progress and communication and dissemination of research findings (NQDT). Few groups interviewed were confident that research outputs would be useful to them if they do not have input into the program's research focus, operation and deliverables.

Stakeholders as end-users

As described above, end-users have a less hands-on role that research partners, but this role is also important. After identifying their expectations of the research, an end-user must have confidence in the processes designed to deliver useable outcomes. This necessitates keeping end-users well-informed of progress and providing them with opportunities for feedback, even if they are not directly involved in the project delivery or progress reviews (CYNRM, Terrain, NGRMG, NQDT, RC, RDA TNW, RDA MIW, RDA NT, RDA Kimberley). This will maximize the chance of successful adoption.

Stakeholders as co-researchers

At the program level, the co-research model was seen as the best model of engagement likely to result in adoption of research findings into on-ground adoption (CYNRM, Terrain, NGRMG, Territory NRM). For key projects, this would involve either action learning or citizen science (CYNRM, NGRMG) using an adaptive management approach (Territory NRM).

Inclusive engagement

As discussed earlier, NRM groups and RDAs supported engagement across a broad base. In particular, they wanted engagement of the NERP program to extend beyond the Australian government to include community and industry stakeholders, with research institutions being treated as one subset of stakeholder groups (NGRMG, RDA MIW). Engagement should not just be about who is consulted, but acceptance of a more diverse range of local, traditional and scientific knowledge systems and points of view (CYNRM, Rangelands WA). Several NRM groups are using resilience thinking approaches to achieve an acceptable balance between the integrated, complex and often competing socio-ecological systems (CYNRM). So engagement may require researchers to adopt, or at least understand, this approach to problem-solving (CYNRM). A more integrated approach to engagement should be achieved through a culture of collaboration, adaptive learning, knowledge transfer, implemented management, learning by doing, and action research (CYNRM). Existing on-ground practitioners and community groups should be consulted at the start of the project, and be given the opportunity to develop research priorities and choose whether to be involved in its delivery (TSRA, CYNRM, Rangelands WA, RDA Kimberley).

Inclusive engagement also means not limiting research and engagement to an artificially-constrained geographic area (CYNRM, NQDT). Research concerning the GBR should be applied

across the entire GBR (TSRA, RC, FBA, BMRG) and research relevant across northern Australia should not be constrained to a single area or stakeholder group (NQDT). This should be achieved by research that is thematically-driven (CYRMN, NQDT).

Prioritising Indigenous engagement

Proper stakeholder engagement is costly and takes time and resources, particularly when it involves Traditional Owner consultation and approvals (TSRA). Indigenous engagement needs to be a priority for any program where Indigenous interests are involved, with adequate time allocated to do the job properly. As with all stakeholders, engagement with Indigenous communities needs to occur from the start and continue throughout the program, with respect for their perspectives, knowledge and opinions (TSRA, CYNRM, Terrain, Rangelands WA). Protocols need to be established for working with Indigenous people or on lands where Indigenous interests exist. This includes making sure that the right people speak for and work on Country, and developing appropriate protocols for project operation when direct involvement of TOs is not possible (CYNRM). Protocols also need to be established for any collection, storage and use of Traditional Knowledge and to ensure its continuity so that it contributes to improved management decisions (Terrain).

Useful outcomes and outputs

Stakeholders are only likely to be interested in engaging with a research program if they expect it to deliver useful products (NQDT). So the prioritisation and planning process must include mechanisms for ensuring stakeholder needs will be met by producing useful outcomes and outputs. This includes aligning priorities to the NRM plans and RDA road maps (Territory NRM) and decision-support requirements (FBA). Useful products for NRM and RDAs are described in *Framing research priorities* on page 41.

Milestones

Having clear milestones was seen as part of good engagement as it provides the investors, research partners and end-users with confidence that the program will meet expectations to deliver useful products (Territory NRM). In any project, some milestones may report on research effort, but others must include specific deliverables. Milestones that are specifically about communication outputs and dissemination were also specifically requested (Territory NRM). There was broad agreement that milestone payments should be paid only on milestone achievement, and that including operational milestones should be adequate to keep the researchers employed through times of low output (RC, Territory NRM). This did not mean that the groups supported onerous milestone reporting. Indeed the need to minimise bureaucratic processes and report writing was stressed (RDA FNQ&TS).

Co-location

Better collaboration and cooperation would be formed and, with it better research results, if a percentage of research was conducted as residencies with groups based in regions where the research was being conducted (NGRMG).

Communication

Solid and committed investment in communication activities was considered essential to ensuring research findings were applied (Terrain, SGC, RC, Territory NRM, RDA FNQ&TS, RDA NT, RDA Kimberley). Depending on the project this could include:

- Best practice methodologies which integrate NRM gaps (knowledge, skills and capacity building for groups and community) (Rangelands WA)
- Informative and easily navigable websites that provides a centralised repository with simple overviews that point to research outputs (SGC, RC, Rangelands WA RDA NT)
- Newsletters or enewsletters with simple and brief project summaries and updates (RDA,-FNQ&TS, RDA NT)
- Webinars (RDA FNQ&TS)
- Forums in key locations, such as central towns, and in the communities where the research is being undertaken (SGC, FBA, Territory NRM, RDA FNQ&TS, RDA Kimberley)
- Annual get-togethers of stakeholders around specific themes (RC)
- Synthesis and summary of not just relevant research but how it informs practice change (Terrain, SGC, FBA, RDA FNQ&TS)
- Visualisation tools e.g. 3D modelling undertaken see Bennett et al. 2010[10] (Territory NRM)

Use of simple, audience-appropriate language and formats was seen as essential in all communications (SGC, Territory NRM, Rangelands WA, RDA FNQ&TS, RDA NT), as well as incorporating local, traditional and scientific knowledge (CYNRM NGRMG). Simple navigation tools are also required to help access relevant information, as the current plethora of websites was seen as confusing, with the effort needed to find and use them rendering them ineffective (RC).

Effective communication was seen as being a two-way exchange of experience and expertise (CYNRM, Terrain, NQDT, RC, RDA MIW, RDA NT, RDA Kimberley). Stakeholders have valuable experience to share about identifying problems and assessing whether proposed solutions are likely to be achievable on-ground in their own environments and industries (RDA Kimberley). Forums and other communication and engagement processes should therefore be an opportunity for input into projects, rather than just information sessions about project progress. One suggestion was that forums be held in two stages: first, overviewing multiple projects, describing what research is planned, then followed up with more detailed sessions for those wanting more detail or to get involved (RDA FNQ&TS). Their timing also needs to be scheduled around regional events and activities e.g. wet season is a good time for meetings in the Kimberley (RDA Kimberley). Presenting at, or dovetailing with existing events was also viewed as important (RDA FNQ&TS). One response was that you should not expect stakeholders to turn up to, or gain value from, academic talk-fests (RDA NT).

Communication activities need to be allocated a sizeable portion of the program budget, and the budget of all projects should be dedicated to synthesis and dissemination (RC). However, the onus of information dissemination can be shared between all stakeholders, with NRM groups and RDAs playing a role here (RC, Rangelands WA, RDA TNW).

Using existing networks

Efficiency of stakeholder engagement can be achieved by working through existing processes and programs. In particular, NRM groups and their alliances and RDAs and their alliances are well-positioned to engage with a broader stakeholder base (RC, RDA TNW, RDA MIW, RDA NT). Other opportunities for integration or alignment include:

- Previous consultation done for other prioritisation process
- Linking with internal NRM or RDA prioritisation processes (CYNRM, RDA FNQ&TS)
- RDAs helping to form linkages with local government on-ground activities in rural and remote areas (RDA TNW)

[10] Bennett, R., Pettit, C., Aurambout, J.-P., Sheth, F., Senot, H., Soste, L., and Sposito, V. Visualizing climate change impact with ubiquitous spatial technologies. In 'Joint international conference on theory, data handling and modelling in geospatial information science, ISPRS Technical Commission II, Hong Kong', 2010, pp. 461-466.

Role of NRM groups and RDAs

NRM groups and RDAs had clear views on the roles their organisations should play in future environmental research programs (Q6 and Q7). All groups desired a higher level engagement than has been possible under the current round of NERP. Any regional variation was based more on organisational capacity rather than on interest. Formalised identification of roles through an MoU was seen as desirable, ensuring that involvement continued through the life of the research program (NQDT).

NRM groups

Most NRM groups saw themselves as being active *research partners* (see Terminology and definitions). However, NRM groups with low capacity were more likely to see themselves as *end-users*. NRM group participation in future environmental research programs was seen as desirable at all levels, including program design, project selection, performance criteria, progress assessment and dissemination of communication, as discussed earlier in this chapter.

Many NRM groups already buy their own research (e.g. NGRMG) or operate devolved grant schemes for other purposes. They also have that capacity to co-invest and leverage funds from other organisations (RC). So as well as participating and contributing to a NERP program administered externally, they could manage and distribute NERP funds through devolved grants to projects that both deliver on the needs of their own organisations and align with NERP criteria (Terrain).

RDAs

RDAs were more likely to see themselves as *end-users* than as active *research partners*. Most have limited capacity for involvement through the course of program delivery. Hence they typically saw their role topping and tailing the research program, helping to prioritise research areas through broader stakeholder consultation at program start-up and helping to communicate program findings as these are released.

Broader stakeholder engagement

NRM groups and RDAs have strong capacity to undertake or facilitate engagement with a wide and diverse range of stakeholders (CYNRM, Terrain, FBA, RC, Rangelands WA, RDA MIW, RDA Kimberley), as well as to advise on which mechanisms work for different sectors (FBA). This includes engagement at the program or project level. They can help to broaden the engagement beyond the entrenched stakeholder base (RDA NT). The importance of allocating enough time and resources for groups to undertake this engagement was stressed (TSRA).

Project steering and design

Most groups consulted were interested in participating in project steering and design (CYNRM, NGRMG, SGC, NQDT, Terrain, FBA, Territory NRM, Rangelands WA, RDA Kimberley, RDA FNQ&TS, RDA NT). Participation would be contingent on the program priorities and relevant project outcomes and outputs. Roles identified included

- Input into program priorities and direction
- Program design (including engagement processes and terminology)
- Project selection
- Deciding on funding allocation

Some groups explicitly mentioned that these roles should be undertaken as part of a steering committee and/or advisory body (FBA, Territory NRM, RDA Kimberley). NRM groups and RDAs should not only be invited to participate in these processes, but also to advise on their design (FBA). One suggestion was that NRM groups and RDAs help define different terms, including

types of engagement (e.g. collaborative; participatory; co-generative), as well as the type of processes that were expected in each case (CYNRM).

Input into the identification of program priorities and direction that could be provided by these groups would include advice on aligning research with different policy platforms, including their own plans and road maps, as well as the broader policy environment. This alignment would help maximise impact on the formulation of government and industry policy, regulations and programs, as well as on pathways to uptake by industry and other stakeholders (RDA FNQ&TS). Identified priorities would be used to decide on strategic direction (FBA).

Input into program design would include defining or refining research questions and identifying the most applicable deliverables (Terrain, Territory NRM). These groups also have expertise they are willing to contribute to designing selection criteria and metrics; critical success factors and their assessment; and shaping milestone requirements (CYNRM, Terrain, RC).

Progress assessment

Several NRM groups considered their involvement in program and project review was essential to ensuring usable outputs. This could involve participating in annual review of program/project progress, assessing milestones achievement and advising on any required change of direction (Terrain, NQDT, RC, FBA, Territory NRM).

Communication

A core role of NRM groups and RDA is communication and dissemination of research findings through their existing communication programs. Their newsletters and social media activities reach thousands of stakeholders across different sectors. Most groups expressed a preparedness to use these processes to disseminate the outputs of future environmental research programs that meet the needs of their stakeholder base (Terrain, RC, FBA, Territory NRM, RDA TNW, RDA NT, RDA Kimberley). One suggestion was that NMRM groups may also be more effective than some researchers at communicating research findings and their implications (FBA), and are adept at procuring extension and education packages (NQDT). They can also be effective advocates for the uptake of research findings into management and policy (RDA TNW).

Feedback to NERP

Importance was placed on two-way communications with stakeholders (see Communication program). NRM groups and RDAs believed they have a role in facilitating this at all stages from priority setting, identification (or dismissal) of knowledge gaps, and project design to feedback on usefulness of project outputs (CYNRM, Terrain, NGRMG, NQDT, RC, RDA TNW, RDA MIW, RDA NT, RDA Kimberley).

Operational support and project participation

Many NRM groups were interested in supporting researchers, either hosting them in their own organisations (SGC, Territory NRM) or co-supervising research students (Territory NRM). They could also assist in on-ground project delivery, linking researchers with their own field staff (SGC). They could coordinate citizen-science, with the local people collecting information that would be more expensive to collect by researchers having to drive long distances (CYNRM, NGRMG).

Some groups were interested in active research participation, with NRM staff and/or their stakeholders being involved in collecting data and participating in analysis and interpretation (CYNRM, NGRMG). This would build on the research already undertaken in these organisations.

Integration of research findings into NRM and RDA business

The key to ensuring NRM groups and RDAs use research findings is to produce outcomes and outputs that are relevant to these organisations' priorities (Terrain, NGRMG, NQDT, RC, Rangelands WA, RDA MIW). Retrofitting communications by engaging end-users late in the day will not only mean outputs are a poor fit, but this process will also alienate people.

NRM groups and RDAs identified several mechanisms for ensuring the integration of research findings into their planning and operations. These were (1) governance mechanisms that developed effective partnerships with research partners and end-users; (2) action research that directly involves NRM groups and their stakeholders in research; (3) simple operational arrangements to aid information flow; and (4) investment in effective communication dissemination of fit-for-purpose communication products.

Program governance

Many groups stated that the best way to ensure useful products were produced and incorporated into NRM/RDA business was through robust and effective governance arrangements that involved research partners and end-users in program design and delivery (Terrain, NQDT, FBA, Territory NRM, RDA FNQ&TS, RDA MIW).

Summarising from the previous sections, most NRM groups saw themselves as active research partners, while some RDAs and low-capacity NRM groups were more likely to see themselves as end-users. For end-users to gain value maximum from research, they need to be consulted at the start of the program; have input into project design and identify their commitment to investing in specific outcomes and outputs; and then evaluating these before they are finalised. They will also be involved in broader stakeholder engagement, and application and dissemination of research findings through wider networks. In addition to these roles, research partners would have input at all stages, with regular opportunities to meet to provide critical advice and assess progress, and may have direct involvement in the research delivery. This could be through a strategic steering committee, or a more broadly based research advisory group (FBA, Territory NRM, RDA Kimberley).

Such arrangements should develop clear project delivery agreements that enunciate what is being purchased from the researcher (NQDT) and strong partnerships that ensure projects stay on track to deliver useful outcomes (Terrain, NQDT, RC). Effective and ongoing engagement should also help NRMs/RDAs get early value from projects (including through the resultant culture of information exchange) (NQDT, RC).

Partnership processes and MoUs will not only acknowledge the pivotal role of research partners and end-users, but will ensure that they can build their responsibilities into their organisation's programs (NQDT, RDA FNQ&TS).

Action research

Action research that involves NRM staff and/or their stakeholders was viewed by some groups as a most effective mechanism for ensuring stakeholders had ownership of research findings, and would therefore be more likely to incorporate them into their management (CYNRM, NGRMG, NQDT). This would minimise transaction costs and increase the capacity of NRM groups to participate and to draw value from the research projects (CYNRM).

Operational arrangements

Long-term funding will help to ensure effective communication and engagement, which are more likely to be neglected in in short-term projects (RDA Kimberley). A coordinator should be appointed to identify the relevant science and its applications (FBA), and this person should work from within the NRM/RDA sector, rather than as a communication officer of the relevant NERP hub.

Opportunities that facilitate direct communication between researchers and NRM groups and RDAs should be pursued (SGC, Terrain, Territory NRM, RDA FNQ&TS, RDA NT). These can be as simple as co-location of researchers and NRM groups; co-supervision of students; creation of a science network (NGRMG); or holding meetings to talk with researchers about policy implications of research (RDA FNQ&TS).

Timing the delivery of outputs and activities to meet stakeholders' needs was also seen as desirable (RDA FNQ&TS). This includes:

- Avoiding meetings during NRM/RDA reporting periods or proposal
- Producing policy analysis in time for it to be considered in submissions for policy reviews

Communication program

See the Communication section on page 63 for the views of NRM groups and RDAs about communication needed to facilitate research findings being incorporated into their activities.

Workshop

A workshop was held on 11 June 2014 to consolidate the information collected in the consultation process in order to develop a final environmental research plan to meet the information needs of NRM groups and RDAs. This section described the workshop processes used to refine and populate the research plan.

All organisations contributing to the plan were invited to send representatives to the workshop. Attendees are listed in Table 1. In addition, administrative staff from both northern NERP hubs attended to provide advice on how the plan would inform submissions by the hubs to future National Environment Science Programs.

Research priorities

Workshop participants prioritised the 12 themes identified in the interim report for discussion and decided to consolidate them further down to five research themes (Table 4). These combined themes were then discussed individually to identify research needs and potential projects for addressing them. Research needs were framed as problems needing solving or opportunities to be grasped. Practical solutions were then identified to ensure research projects were designed to produce applicable outputs that would be of use to NRM groups, RDAs and their respective stakeholders. Research providers and other stakeholders were identified for each project, where possible. Alignment with Australian government programs and priorities were also identified. These elements were combined with those from the synthesis of responses to provide the research priorities detailed in the research plan in the main body of this report.

Table 4: Research themes identified in the workshop and their relationship to the themes identified in the interim report

Research plan	Consultation report
1. Governance, policy & influence	1. Influencing policy development 6. Intelligent condition & trend assessment 5. Achieving on-ground best practice 8. Efficient resource production & use to minimise footprint 9. Carbon abatement & sequestration options 10. Climate vulnerability & adaptation
2. Sustainable livelihood & agricultural options	4. Sustainable livelihood & agricultural options 8. Efficient resource production & use to minimise footprint 9. Carbon abatement & sequestration options
3. Water resource planning & water quality improvement	2. Water resource planning 7. Water quality improvement 8. Efficient resource production & use to minimise footprint 10. Climate vulnerability & adaptation
4. Landscape planning for land use & management	3. Landscape planning 8. Efficient resource production & use to minimise footprint 10. Climate vulnerability & adaptation
5. Biodiversity & wetlands	11. Biodiversity values, threats & management responses 12. Coastal to freshwater wetland values, ecosystem services & management 5. Achieving on-ground best practice 9. Carbon abatement & sequestration options 10. Climate vulnerability & adaptation

Governance framework

The workshop identified key elements to be included in the governance of programs designed to deliver this research plan to maximise the utility of the research outputs. These included broad principles and practical mechanisms for implementing them. These elements were combined with those from the synthesis to provide the governance framework described in the research plan in the main body of this report.

Plan finalisation

A draft research plan was prepared based on the research themes and governance framework identified in the workshop, and further populated from the synthesis of responses from individual NRM groups and RDAs. This was circulated among all contributors, and their feedback was incorporated before the plan was finalised. The result was the final version of the research plan as presented in ''An environmental research plan for Natural Resource Management organisations and Regional Development Australia boards across northern Australia''.

The plan identified 48 potential projects to address 39 priority research needs organised under five research themes

1 Governance, policy and influence
2 Sustainable livelihood and agricultural options
3 Water resource planning and water quality improvement
4 Landscape planning for land use and management
5 Biodiversity and wetlands management

Priority knowledge needs were presented as NRM-related problems that needs solving or opportunities to be grasped. Potential research approaches were then identified to deliver practical and applicable solutions to assist NRM groups, RDAs and their respective stakeholders to improve sustainable management of nature resources and build community resilience.

The plan also described the governance arrangements required to ensure research programs meet these knowledge needs. To an extent only limited by their institutional capacity, NRM groups and RDAs saw themselves as partners in the broader business of environmental research programs. They also considered that such partnerships need to operate from the initiation of research bids through to project delivery. They desired research partnerships with NRM groups and RDAs to be formalised through strategically-managed processes and partnership arrangements that provide recognition of their roles, responsibilities and expectations.

References

Dale, A., Taylor, N., & Lane, M. (Eds.). (2002). Social assessment in natural resource management institutions. Melbourne: CSIRO Publishing.

Shellberg, J., & Brooks, A. (2013). Alluvial gully prevention and rehabilitation options for reducing sediment loads in the Normanby catchment and northern Australia: Australian Rivers Institute, Griffith University.

Spencer, C., McVay, P., & Sheridan, S. (2014). Evaluation of the National Environmental Research Program (NERP). Vista Advisory on behalf of the Department of the Environment.

State of Queensland. (2013). Reef Water Quality Protection Plan 2013: Securing the health and resilience of the Great Barrier Reef World Heritage Area and adjacent catchments. Brisbane: Reef Water Quality Protection Plan Secretariat.