Salinity Inquiry
Submission No. 48

FITZROY BASIN ASSOCIATION

Fitzroy Basin Association
Building 354
CQU City Centre
ROCKHAMPTON QLD 4700

Response to House of Representatives Standing Committee on Science and Innovation:
Inquiry into coordination of the science to combat the nation's salinity problem

Introduction

The Fitzroy Basin Association (FBA) is a community based natural resource management group structured as a peak body of sector groups in the Central Queensland region. It has been in existence for about ten years, and in 2002 was charged with responsibilities of a regional body under the National Action Plan for Salinity and Water Quality (NAPSWQ). Its geographical area includes the Fitzroy Catchment, a focus catchment for the NAPSWQ, and the associated catchments of Boyne and Calliope Rivers and catchments of the Curtis and Capricorn coastal streams. The regional natural resource management plan, currently under development by FBA, is nearing completion and should be available in draft form for comment within weeks.

FBA, as a community based nrm group, believes that natural resource management has no distinct boundaries of influence and impact. Therefore, communities should have power to make decisions regarding natural resource management, as these decisions will affect social, political, cultural, economic, and environmental dimensions of those communities.

As the regional body for the purposes of planning and investment of funds through the NAPSWQ, FBA has a vested interest in the quality and quantity of science to support those activities. It should also be noted that dryland salinity problems are not as apparent in the Fitzroy Basin as in some southern catchments and that the big issue in this catchment is elevated sediment levels in streams and waterways. It is with this in mind that we make this submission.

Response to terms of reference

a) Use of the salinity science base and research data (including the development of new scientific, technical, and engineering knowledge) in the management, coordination, and implementation of salinity programs

Knowledge of salinity and the systems that drive it is not well advanced in the Fitzroy basin. The Salinity Hazard Map for the catchment, developed through a State Level Investment Program under the National Action Plan for Salinity and Water Quality (NAPSWQ) was released last year. The project to develop that map used the best science available and its production is a step along the way to improved information for management. A workshop held by FBA (report Appendix A) after its release determined that a risk map to augment the Hazard Map is needed so that real management decisions could be made at local (on-property) through to regional levels. In order to develop the risk map, the following is required:

1. More specific knowledge of land use at a scale comparable with the Salinity Hazard map, through mapping of agricultural practices
2. Improved knowledge of leakiness attributes of soils under these land uses
3. Improved knowledge of groundwater flow systems attending these land uses, regolith, and soil types
4. Assimilation and interpretation of this new knowledge to determine areas at risk of salinisation and therefore requiring management to reduce risk.

Other State Level Investment Projects relating to salinity are being implemented in the Fitzroy basin. Outputs from these projects will significantly increase the knowledge base from which decisions might be made, and will provide input into the development of a salinity risk map for the basin. The Fitzroy Basin Association is likely to invest some funds in the development of this map and associated management programs flowing accreditation of the regional natural resource management plan.

There are no large-scale salinity management programs currently operating in Central Queensland in either rural or urban areas, although programs such as the Sustainable Farming Systems project incorporate considerations of salinity.

b) Linkages between those conducting research and those implementing salinity solutions, including the coordination and dissemination of research and data across jurisdictions and agencies, and to all relevant decision makers (including catchment management bodies and land holders)

Much interaction and dissemination occurs across jurisdictions and agencies, however, many of these interactions occur through personal relationships and not particularly well supported by structure or process. In the conventional research – extension model, scientific findings are incorporated into extension programs through person-to-person interactions among staff of agencies that carry out both the research and the extension, and from personal relationships developed among researchers of associated disciplines in different agencies. That is to say, transfer of knowledge happens within agencies or within disciplines, and this continues to be the case.

With the introduction of regional bodies into the change process, there are neither same-discipline nor same-agency structures and processes to support dissemination of findings. The onus is on regional bodies to support their activities with sound scientific findings, but the means of accessing those findings is very much at the mercy of personal relationships developed between staff of regional bodies and individuals within research agencies. While agency staff members (at a personal level) are usually very helpful in providing information and advice when requested, support at an organisational level within agencies is not so forthcoming for a variety of reasons, such as resource allocation conflicts, conflict with organisational priorities etc. In addition, specific requests on specific topics can leave gaps in strategic information required to create holistic pictures.

Regional bodies have a responsibility to develop close links with resource managers and through these relationships to help facilitate change at the property level. Therefore, the holding of strategic knowledge within, and in close and easy access to, regional bodies is vital to the success of programs such as NAPSWQ and NHT2. Thus, a more structured approach to the dissemination of information to, and communication with regional bodies will be a critically important element of both research programs and implementation programs.

In these early days of regional bodies, much of the dissemination occurs through the development of personal relationships between the regional bodies' science coordinator (if they have one) and researchers. This leaves that body, and resource managers, open to a gap in sourcing relevant information, should the science coordinator leave, or if insufficient funds are available to maintain the position. Technical panels can and do provide advice, but members of these panels are usually employed by agencies, the priorities of which will place other demands on those members' time, thus they will usually be responsive to requests rather proactive in delivering information and advice. In other words, this arrangement is not supported by structure or process to the degree that it could be.

As the NAPSWQ is implemented, development of structures and processes for dealing with dissemination of science to regional bodies and thence to resource managers must be considered. In some regions, where there has been significant work done with respect to salinity and its amelioration and prevention, there are probably good working models. In regions such as the Fitzroy basin, little work has been done with resource managers in management and more especially prevention of salinity. Development of personal relationships with researchers is a fragile way to handle this important task.

c) Adequacy of technical and scientific support in applying salinity management solutions

As discussed above, knowledge about salinity processes and drivers in the Fitzroy basin is not well advanced. There are no large-scale salinity management programs running in the region, and therefore, adequacy of technical and scientific support is not an issue at this time. Following development of the risk map, its information should be incorporated into the development of sustainable production systems and property management plans. That step will require significant technical support, and in the interim, resource allocation within agencies should consider this need. Should a magic wand produce a risk map right now, it is unlikely that sufficient technical support would be available to incorporate its information into implementation plans operating in this region. Agency staff members have sufficient levels of knowledge, but allocation of their resources to that specific task could be problematic.

For further information or clarification on any point in this submission, please contact

Claire Rodgers
Science and Knowledge Coordinator
Fitzroy Basin Association
Phone 07 4921 2033
Fax 07 4921 2860
Email: c.rodgers@cqu.edu.au

Salinity workshop

North Street Annexe
Rockhampton

11th December 2002

1.0 Participants

Chris Carroll
Suzie Christensen
Bruce Cowie
Bruce Forster
Mat Gilfedder
Ian Gordon
Gavin Graham
Justin Lane
Bob Noble
Colin Pain
Barbara Wildin
Claire Rodgers

1.1 Apologies

Jayne Kuskie
Neil Hoy

2.0 Acknowledgements

Gavin Graham, QDPI, Colin Pain, Geosciences Australia, and Mat Gilfedder, CSIRO, are acknowledged for their assistance with the preparation of this report and their review of drafts.

3.0 Background

As the Fitzroy basin Association (FBA) accepts its responsibilities under the National Action Plan for Salinity and Water Quality (NAPSWQ), it has an increasing need for good scientific advice to ensure that investments made under that and other programs are wise and will provide a good return. The state of knowledge of dryland salinity in the Fitzroy region is not as advanced as in other regions such as the Murray-Darling catchment, and public awareness of issues is certainly behind that in some other regions. Therefore, FBA sought to gain a consensus scientific view on the status of knowledge and understanding of dryland salinity in the basin and to gain an appreciation of the relevant gaps in that knowledge.

4.0 Methodology

Focus questions were prepared to guide discussions and ensure that the output stayed relevant to FBA's needs. Questions follow

- What does the salinity hazard map tell us? / What do we know about salinity hazard and risk?
- What doesn't it tell us that we need to know?
- What research is indicated?
- What management actions does it indicate, or should indicate?

Questions were circulated to participants up to a week prior to the meeting.

A list of invitees was prepared with the following considerations:

- A smaller number of strategically selected participants would be more likely to elicit a considered consensus response than a largely more loosely focused group
- Output from the workshop will be circulated to a much larger group to ensure its findings were consistent or congruent with views of other groups and individuals, from organizations represented at this meeting and others. These people will review the output and the resulting recommendation/s will be proposed to Management and Stakeholders for action.

Suzie Christensen facilitated the workshop. Following the workshop, publications noted in the workshop were reviewed for studies relevant to salinity in the Fitzroy and associated catchments. References are noted in this report.

5.0 Purpose of workshop

The purpose of the meeting was to provide guidance to FBA on what needs should be addressed in terms of onground action and possible research, and to determine whether sufficient knowledge exists to give that advice currently. Participants noted that future research into salinity must be focussed on what effect any findings might have on planning decisions. Issues not addressed in the workshop but of concern to regional planning included

- Should we be trying to determine the effect of nothing changing with respect to land management?
- How should any findings be incorporated into the vegetation management planning processes?
- Research conducted under the current scenario can be dislodged entirely by the construction of a dam such as Nathan, because of changes in land use and water balances.

In determining the appropriateness of salinity work as a priority action project, it has to be considered that remediation of symptoms is not the crucial issue. Any such work should address areas of risk, to lower the chance of salinisation occurring. That is, prevention strategies should be the focus of on ground action. The balance to this is to provide some funds for restoration, as this is critical in educating and gaining support for prevention strategies for which no visible gain is apparent.

6.0 Findings

6.1 Links with State Investment Projects

The State Investment Projects (SIPs) are not likely to provide sufficient information early enough to make management changes during the life of NAPSWQ. These changes need to link with social and economic assessments. However, ongoing information and knowledge from these projects can provide input into more highly targeted research and changes in management practices.

6.2 Salinity and vegetation systems

The *likelihood of salinisation occurring is a function of the impact of land use change given leakiness attributes of the area's soil, dynamics of groundwater flow systems, and existing salt hazard.* Studies of soil attributes under different land uses have been carried out in the Central Highlands (Irvine and Doughton 2001; Irvine and Dalal 2000). This has established some of the risk factors operating and under what conditions greatest risk of salinisation exists. It further provides a foundation for estimates of economic and social costs of various scenarios from "do nothing" through to changes in land use and management practices within land uses. Further information for management decisions is contained in such publications as "Salinity Management Handbook" (DNR 1997) and Clarke and Wylie (1997). However this information is based on current knowledge of land use impacts, soil attributes, and groundwater flow systems, without significant emphasis on existing salt hazard.

A study worthy of note in that its findings are contrary to generally held views about the effect of land use change on recharge rates was carried out by Lawrence et al (1993). This study was conducted in Brigalow lands in the Fitzroy catchment and provides information on the recharge attributes of soils underlying former Brigalow forests. It concluded that in measured catchments in a semi-arid, sub-tropic location receiving 670 mm average annual rain and potential evaporation of 2200 mm/year;

- Clearing Brigalow forest for pasture production increased annual runoff from 26 to 47 mm/year
- Average monthly evapotranspiration was similar for Brigalow forest and buffel pastures, consuming 90% of rainfall
- Groundwater recharge rates in Brigalow and pasture catchments were not significantly greater than zero
- Replacing Brigalow with buffel grass provided indistinguishable differences in groundwater recharge

The absence of sustained recharge in the pasture catchment is contrary to the generally held view that agricultural development results in a significant increase in recharge compared to virgin conditions.

Stirzaker et al (2000) suggest various production systems for reducing salinity risk in a number of rainfall regimes, and some of these could be applied to the Fitzroy and associated catchment in light of findings of indicated research.

Further information is indicated in the lack of large scale knowledge about soil attributes and groundwater flow systems under various land uses in the Fitzroy region. This will allow greater application of known best management practices and point to potential changes in land use to reduce risk of salinisation, for instance from annual cropping regimes to tree based production (timber, fodder etc)

Currently, risk assessment can only be carried out to provide a ranking of general land management practices, ie, grazing, dryland cropping, and irrigated productions. Quantum differences are demonstrable at this level, with differences between various specific cropping practices, for example, displaying little effect on salinity risk. A review of recharge studies conducted by Petheran et al (2002) bears this out. As median rainfall increases, recharge also increases, with the differences between the three systems (grazing, cropping, irrigation) increasing as median rainfall increases.

However the important point to note is that recharge in areas under forest is less than in areas under annual systems.

Zhang, Dawes, and Walker (2001) also conducted studies into evaporotranspiration rates in different land use systems on a series of different soil types and climatic conditions. Invariably the same basic relationships were found. Systems under forest had a higher evaporotranspiration rate than mixed (for example, grazing with some forest, some cleared) systems, which in turn were higher than those under cropped systems (that is, fully cleared of forest). Thus, while the relationship between tree cover and evapotranspiration is not linear (Sahin and Hall in Zhang, Dawes, and Walker 2001), it can be assumed that there exists a continuum of evapotranspiration rates, with the maximum being in a fully forested perennial growth state, and the minimum being in a treeless annual growth state.

Considering this in light of the catchment water balance equation

$$P = ET + R + D + \Delta S$$

(P = precipitation, ET = evapotranspiration, R = surface runoff, D = recharge to groundwater, ΔS = change in soil water storage), it can be seen that where evapotranspiration is minimised by lack of tree cover, and long term change in soil water content is zero, recharge and runoff increases to compensate. This recharge, or leakage, is to shallow water tables, not necessarily to those aquifers associated with pumping for water supply purposes.

In the pre-European, naturally forested state, leakage below the root zone was less than 5mm per year for southern areas. For areas such as the Fitzoy catchment, where potential evaporation exceeds precipitation, leakage is most likely the result of heavy rainfall and flooding, rather than annual and ongoing leakage (Walker, Gilfedder, and Williams 2000). However, given the higher recharge rate of most cleared systems, it is clear that discharge from this system must occur, and its timing will depend on the ability of the groundwater system to absorb the increased recharge.

The lag between land use change and discharge or outbreak of salinisation differs from system to system. However, it can be said that if recharge into a system increases tenfold (through reduced evapotranspiration rate for instance), then water exiting the system (to the surface or streams) will increase tenfold. This extra water exiting the system will carry with it salt dissolved from soil. It will happen. The time lag between the change in land use and saline response is dependent upon the scale of the groundwater system into which recharge is increased. Localised systems respond faster than larger scale systems (Stirzaker et al 2000). Thus, where large-scale groundwater systems dominate, a longer response time to salinisation will be experienced. In some systems, the process is incredibly slow, so the response time of particular systems may be a criterion for prioritisation.

6.3 Research indicated in the Fitzroy region

Further research for the Fitzroy and associated catchments is indicated to provide

5. *More specific knowledge of land use at a scale comparable with the Salinity Hazard map, through mapping of agricultural practices*
6. *Improved knowledge of leakiness attributes of soils under these land uses*

7. *Improved knowledge of groundwater flow systems attending these land uses, regolith, and soil types*
8. *Assimilation and interpretation of this new knowledge to determine areas at risk of salinisation and therefore requiring management to reduce risk.*

With targeted research, it can be determined what areas in the Fitzroy basin have a potential problem. The hazard map cannot be used on its own because it only defines where salt has been for a very long time. It does not indicate where salt is moving or what the changes in salt dynamics for that site are, thus it does not give any trend information. Some of the biggest hazard areas could be very safe due to their location within very safe management (such as in protected forested areas). One of the issues with descriptions of risk in terms of land use change is that once a change has been made, for instance from virgin timber to cropping, it cannot be returned. That is, the major land use change has already occurred, and the discussion needs to centre on the resilience of the system to salinisation. Some systems are much more resilient in the face of land use change. For instance, sandy soils are more absorptive of recharge than clay soils under land use change (Petheran et al 2000), and therefore more subject to salinisation. As previously mentioned, response time is also dependent on the scale of the groundwater system receiving recharge.

6.3.1 Approach and potential techniques

There are several techniques that can be used to assist in determining risk of salinisation in salinity hazard areas. The question of which techniques and approach is potentially most efficacious should be determined by the following methodology

- Collect and collate data already in existence – this will include geology, soils, regolith, groundwater, plus any geophysical surveys that may exist. The objective will be to build on the GIS for the Fitzroy basin, with all relevant coverages.
- Assess this data to determine any known information about the impact of land use change, in this or other regions
- Interpret and synthesise knowledge of groundwater flow systems and their behaviour
- Determine what techniques and methodologies should be used to provide missing information

The objective is to assess available information first, and then collect only that information that is necessary to address the objectives of the research

In this particular region, much of the groundwater data gathered recently in test and other bores has not been entered and interpreted yet. Its entry and interpretation of is essential before considering the investment of funds in airborne geophysics as this data could point to areas of particular interest for this technique.

7.0 Recommendations

7.1 Directions for Fitzroy Basin Association investment

In order to protect the region's assets, both natural and infrastructure, the FBA should invest in research to provide the following:

1. *More specific knowledge of land use at a scale comparable with the Salinity Hazard map*

2. *Improved knowledge of leakiness attributes of soils and regolith under these land uses*
3. *Greater knowledge of groundwater flow systems attending these land uses and soil and regolith types*
4. *Assimilation and interpretation of this new knowledge to determine areas at risk of salinisation and therefore requiring management and/or land use change to reduce risk.*

These first three points are a reasonable target for investment, the target being:

The development, by January 2005, of a salinity risk map for the Fitzroy and associated catchments for the purposes of directing investment in management actions aimed at protecting and/or restoring the region's assets from degradation caused by salinity.

This knowledge will assist in identifying management actions for reducing salinity, and should be used in conjunction with social and economic impact assessments to inform policy formulation with respect to potential changes in land use and management.

Report prepared by Claire Rodgers
Fitzroy Basin Association
07 4921 2033
c.rodgers@cqu.edu.au

7.0 References

Clarke, AL, and Wylie, (1997) *Sustainable Crop Production in the Subtropics*, DPI, Brisbane

Irvine, SA, and Doughton, JA, (2001) "Salinity and Sodicity, Implications for Farmers in Central Queensland", in *Proceedings of the 10th Australian Agronomy Conference, Hobart,* available on line at
www.regional.org.au/au/asa/2001/

Irvine, SA, and Dalal, R, (2000) "Sodicity and salinity – their implications to dryland cropping in the Central Highlands, Queensland" in *Research Update – Northern Region 2000,* available on line at
www.grdc.com.au/growers/res_upd/north/00-01.htm

Lawrence, PA, Cowie, BA, Yule, D, and Thorburn, PJ, (1993) "Water balance and soil fertility characteristics of Brigalow (*Acacia harpohylla*) lands before and after forest clearing", in *Proceedings of the XVII International Grasslands Congress 1993.*

Petheran, C, Walker, G, Grayson, R, Thierfelder, T, and Zhang, L, (2002) Towards a framework for predicting impacts of land-use on recharge: A review of recharge studies in Australia", in *Australian Journal of Soil Science,* Vol 40, 2002

Salinity Management Handbook, (1997) Department of Natural Resources, Brisbane

Stirzaker, R, Lefroy, T, Keating, B, and Williams, J, (2000) *A Revolution in Land Use: Emerging Land Use Systems for Managing Dryland Salinity,* CSIRO, Canberra

Walker, G, Gilfedder, M, and Williams, J, (2000) *Effectiveness of Current Farming Systems in the Control of Dryland Salinity,* CSIRO, Canberra

Zhang, L Dawes, WR, and Walker, GR, (2001) "Response of mean annual evapotranspiration to vegetation changes at catchment scale" in *Water Resources Research,* Vol37, no 3, March 2001