

Water in Primary Industries

INTRODUCTION

I&I NSW conducts research to encourage sustainable and appropriate use of water by the state's primary industries.

The Water in Primary Industries Unit specialises in water research at the paddock, farm and small catchment scale because this is where land use and water management decisions are made by primary producers. If there is to be change in water outcomes, it will be driven at the paddock scale where we specialise.

The Unit recognises that our water systems are connected. Primary production can be a consumer of water in downstream irrigation areas – however it is also a producer of water through the land use choices in headwater catchments. These upstream land use choices directly impact the amount of water available to be shared between consumptive and environmental needs in downstream areas.

We not only produce good science, we work hard to ensure it has practical and affordable applications and collaborate closely with extension officers so it is actually put into practice. Our water research also underpins the development of sound policies and plans for land use and water management.

- A network of hydrology research sites in headwater catchments collecting data on the impact of land use on interception, stream flow and ground water.
- A focus on ensuring our research is actually adopted, through close collaboration with extension colleagues and primary producers.
- Strong partnerships with key industry and research players including numerous CRCs, Research & Development Corporations, CSIRO, National Centre for Groundwater Research & Training, Universities and producers.

The Water in Primary Industries Unit comprises 24 water research staff implementing 35 projects. Summaries of each project are presented in this document.

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RESEARCH CAPABILITIES

- Primary Industries Science & Research manage nine dedicated research institutes within the Murray Darling Basin and several supporting research stations.
- Research experience and projects into water management in both rainfed and irrigated systems.

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Disclaimer: The information contained in this publication is based on knowledge and understanding at the time of writing (May 2011). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of NSW Department of Primary Industries or the user's independent adviser.

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Water in Primary Industries Unit

Research Projects

(last updated 31 March 2011)

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Research Project Description

Adapting to climate change by increasing soil carbon content, water and nutrient use efficiency

Principal Investigator:

Dr Malem McLeod, Tamworth Agricultural Institute

Funding sources / project partners:

I&I NSW, ACIAR, NCCARP-AGRP

Objectives:

To evaluate strategies to secure soil carbon, increase nutrient and water use efficiency on a range of crops and pastures.

Summary:

Unpredictable rainfall and higher temperature caused by global changes in climate means that farming decisions need to be adaptive and opportunistic to ensure soils are in the best condition for cropping. Increasing and maintaining high soil carbon increases the adaptive capacity or resilience of soil to sustain production under changing climate. High soil carbon content improves structure, water, and nutrient holding capacity of soil and enhances nutrient mineralisation through increased microbial activities. However, soil carbon accumulated through the traditional method using pasture phases in crop rotation or residue retention can be easily lost during cropping phases.

This project evaluates alternative strategies to secure soil carbon and increase nutrient and water use efficiency on a range of crops and pastures under variable water availability. The outcomes will offer choices of applied technologies to secure and maintain high carbon level in the soil for resilient agriculture.

Research Project Description

Approaches to manage spatial variability of rice

Principal Investigator:

Mr Geoff Beecher, Yanco Agricultural Institute

Funding sources / project partners:

I&I NSW, RIRDC

Objectives:

- Identify and understand factors contributing to in-field spatial variability in rice yield
- Identify and evaluate methods by which rice growers can manage in-field spatial variability in yield to increase production, profitability and water productivity

Summary:

Rice production is generally based on uniform input of production resources such as water, fertiliser and herbicides. However despite relatively uniform input to crops, rice crop yields vary greatly with growers reporting yields between 4 and 14t/ha. This variability in yield is believed to be due to differences in soil physical and chemical properties including soil salinity, sodicity and fertility levels and interactions with water depth, wind action and temperature.

Rice growers need to be able to increase crop and water productivity and improve the returns they achieve for the inputs applied. Precision agriculture and associated tools of GPS and remote sensing allow assessment of soil properties and crop growth, identifying areas of paddocks that are likely to perform differently. This project will use the tools of precision agriculture to identify means to lift the crop performance of low yielding parts of rice fields and increase total profitability and water productivity.

This project, in partnership with the Rural Industries Research & Development Corporation (RIRDC) will build on the results obtained in earlier investigations.

Research Project Description

An evaluation of evaporation control technology

Principal Investigator:

Dr Harnam Gill, Yanco Agricultural Institute

Funding sources / project partners:

I&I NSW, CRC for Polymers, National Water Initiative

Objectives:

1. Evaluate selected monolayer formulations for their potential to reduce evaporative water losses.
2. Compare selected rates and frequencies of applying monolayer formulations for reducing evaporation of water.
3. Quantify evaporative losses of water from irrigation channels and potential water savings by using monolayer formulations.
4. Assess changes in water quality (pH, EC, dissolved oxygen, ionic chemistry) due to the application of monolayer formulations.

Summary:

Australian agriculture and the environment depend heavily on water storages both on and off farms. The efficiency of these storages is reduced by loss of water through evaporation, however there has not been significant scientific attention paid to this problem until now. Drought, climate change and reduced allocations of irrigation water are reasons for researching losses of water from evaporation.

Recent research in the CRC for Polymers has led to the development of experimental formulations using polymer technology for intervention in evaporation from urban and irrigation water storages and channel supply systems. I&I NSW has developed specialised infrastructure at its Yanco Agricultural Institute which offers five different scales at which evaporation can be reliably measured; from small tubs in a controlled environment to modified rice bays that mimic open bodies of stored water. The CRC for Polymers and Science & Research have been collaborating over recent years to test new technologies for evaporation suppression, at a range of different scales.

The project is evaluating new monolayer formulations by comparing their rates and frequency of application. A commercial or field scale investigation is being targeted this year, where a section of irrigation channel has been compartmentalised into five storage areas. Each storage is fully lined to prevent seepage, with any losses of water from the channel sections being a result of evaporation. Losses are measured both manually and by data logging equipment for periodic changes in water levels in all storages. An automatic weather station at the site records meteorological data and periodic changes in water temperature is also monitored using data loggers.

Research Project Description

A reality check on carbon sequestration in soils

Principal Investigator:

Mr Ian Daniells, Tamworth Agricultural Institute

Funding sources / project partners:

I&I NSW

Objectives:

Review, through a close scrutiny of past and current studies, the feasibility of increasing soil carbon under a hot, dry climate.

Summary:

Carbon sequestration in soils has been proposed both as a means to mitigate climate change and also to help agriculture adapt to a changing climate. Soil carbon accumulated through traditional methods (residue retention or incorporating pasture phases) can be lost during cropping phases.

Exploring alternative technologies to enhance persistent soil C is indispensable for resilient agriculture. The question remains whether current recommendations for soil carbon management are based upon the best available evidence. Are the techniques to accumulate carbon effective, and will they continue to be effective under a hotter, drier climate?

Research Project Description

Baldry Key Site

Principal Investigator:

Mr Tony Bernardi, Queanbeyan

Funding sources / project partners:

I&I NSW, University of NSW, DECCW, National Centre for Groundwater Research & Training.

Objectives:

- To provide data to underpin and enhance confidence in water and salinity modelling;
- to understand the biophysical processes of water and salt movement within a catchment;
- to understand and quantify the effects of intervention actions that minimise recharge;
- to understand how changing land use impacts the movement of salt and water through the landscape; and
- to provide reliable information to inform property/catchment scale investment decisions, and to assist in the development of public policy for the management and sharing of the State's water resources.

Summary:

As water moves across the land and through our soils, it carries naturally occurring salts. Sometimes these salts accumulate in our soil and water resources, causing a salinity problem.

There are many different factors that influence the movement of water and changes in salinity. These include combinations of vegetation, geology, soil type, slope and land management. Computer modelling is a valuable tool to help make estimates about the processes causing salinity and what might happen if different land uses or salinity management approaches are adopted. However, the models are only able to replicate what happens in the real world if the processes that drive salt and water movement are understood. Confidence in the models estimates is enhanced if it can replicate actual catchment observations with reasonable accuracy. Comprehensive data on these different combinations are essential if the models are to provide estimates that can be relied on.

To provide this data, a 260 ha sub-catchment of the Little River, on the upper reaches of the Macquarie catchment was instrumented to measure all components of water and salt movement. Measurements are taken of the water volume and its quality, from its initiation as rainfall until it either returns to the atmosphere via evapotranspiration, leaves the catchment via the stream or finds its way into the watertable. Half of the catchment was planted to trees, with the other half left to normal farming practices to study the effect of a significant change to landuse that is intended to reduce the movement of salt to the river.

This research commenced in 2003 and is increasing our understanding of how water and salt moves from the landscape to the streams during the dry El Niño phase and is now providing valuable insights during a wet La Niña phase. This will assist in the development of public policy for environmental management and sharing of the State's water resources.

Research Project Description

CATPlus

Principal Investigator:

Dr David Mitchell, Orange Agricultural Institute

Funding sources / project partners:

I&I NSW, FFI CRC, DECCW, Vic DPI

Objectives:

- To allow project partners and CRC participants to assess the impacts of selected on-ground actions, prioritised by the FFI CRC, on end of catchment, or across catchment outcomes in terms of water quality and quantity.
- To improve hydrological model outputs through developing better standards and guidelines for data collection and manipulation, and through improvements to the structuring of data within the current model.

Summary:

There is widely promoted public policy to increase the perennial plant component of upland farms, specifically perennial pastures. The full effect of this policy on the ecology, the water cycle and on a range of other biophysical outcomes is unknown.

This project will assess the impacts of selected on-ground actions, prioritised by the Future Farm Industries Cooperative Research Centre (FFI CRC), on end of catchment or across catchment outcomes relating to water quality and quantity. Ultimately this will allow catchment managers or other external users to better predict the impacts of perennial vegetation systems on water management, including impacts on specific assets that are targeted.

This project will apply and further develop the existing Catchment Analysis Tool (CATPlus model) to evaluate the impacts of farming systems and technologies developed by the FFI CRC, particularly with regard to catchment water resources. This work will include improvements to the structure of standard input data layers so that CATPlus may be run across a broader range of spatial scales. Research will initially focus on a catchment in Victoria and the Tarcutta catchment in the Murrumbidgee valley of NSW to ensure that research outputs are directly applied and model improvements tested.

Research Project Description

Catchment-level economic analysis of dryland salinity

Principle Investigator:

Dr Robyn Hean, Armidale

Funding sources / project partners:

I&I NSW, Future Farm Industries CRC

Objectives:

To develop bio-economic models at a catchment and farm scale, linked to hydrological models, to help policy makers and catchment managers assess the long-term economic and environmental impacts of changes in land management.

Summary:

Dryland salinity is a serious land-management problem in Australia. It has been caused by replacing perennial native vegetation with annual crop and pasture species that allow a larger proportion of rain to recharge groundwater systems, and is evidenced by high and rising saline water tables in low-lying, discharge areas of catchments. Land-use decisions by upstream landholders can affect the depth of the water table in the lower catchment, and thereby impose a cost on downstream landholders through the negative effect of salinity on crop yields and profitability.

In this project, a computer modelling tool is being developed for land-management and policy analysis of dryland salinity at the catchment level. We are taking a spatially-explicit approach to model development. This approach represents the landscape in fine spatial detail consistent with available spatial data sets; it maintains the integrity of the spatial heterogeneity of the landscape, and it makes explicit the relationships that describe how adjacent parts of the catchment interact or are spatially connected.

The model uses a raster-based approach where a catchment is represented as a grid of neighbouring cells. Each cell is defined by a set of seven attributes: land use, elevation, soil type, rainfall, aquifer thickness, groundwater-table depth and groundwater salinity. Cells receive and transmit groundwater information to and from neighbouring cells through a simplified hydrology model. The hydrology model is combined with an economic model and can be used to analyse the effect of alternative spatial patterns of land use. The model is being designed to allow users to test any arbitrary spatial pattern of land use and explore its long-term consequences for a catchment. This facility permits the analysis of tradeoffs between financial (profit) and environmental (salt-affected area, water yield and water quality) outcomes. The model is being designed to estimate the cost of upstream land use choices downstream, as well as the costs imposed by government policies such as end-of-valley salinity targets.

The model is being applied to the Boorowa River Catchment, which is a small agricultural catchment of 129 ha in central-west NSW, Australia. Model results for ground-water table depth are being tested against observed data recorded by several piezometers located across the catchment. Testing the model against observed data for Boorowa will give us confidence in the model's performance. The model will then be applied to additional catchments to ensure model results influence land-use decisions and policy.

Research Project Description

Central NSW node of the National Centre for Groundwater Research & Training

Principal Investigator:

Dr David Mitchell, Orange Agricultural Institute

Funding sources / project partners:

I&I NSW, UNSW, NCGRT

Objectives:

- Assess and quantify the effect of landuse and climate on the response of surface and groundwater and the interconnections between the two
- Identify the effect of landuse and climate on the flows of water, energy and carbon.

Summary:

It has been proposed that in areas targeted for salinity intervention, the planting of perennial species will result in improved outcomes for water and salt movement. This is based on the simple assumption that groundwater moves uniformly down the slope and shallowest groundwater and highest salinity will occur towards the bottom of the slope. Long term monitoring has shown that this is not the case at sites in central NSW.

This project is measuring the flows of water, salt, energy and carbon at a number of long term research sites in central west NSW. These measurements aim to better understand the effects of landuse, climate and landscape on these processes in this environment.

The continued monitoring of sites at Baldry, Sloanes Ck and Gumble will allow better understanding of water and salt movement, across a range of variations in current climate patterns, particularly as landuse changes over time. The ongoing measurements will provide data that will show how climate variation affects the movement of salt within the landscape and from the landscape to streams, providing better information with regards to landuse options. Model validation will continue to ensure that models are capturing changes from the effects of plant and tree growth and climate change on salt, carbon and water dynamics.

Research Project Description

Centre pivot irrigation in the southern Riverina

Principal Investigator:

Mr Sam North, Deniliquin AR&AS

Funding sources / project partners:

I&I NSW, Murray Irrigation Limited (MIL), RM Consulting Group

Objectives:

- 1) Provide objective performance data on centre pivot systems used to irrigate winter crops and lucerne for hay in the southern Riverina by quantifying crop yields per ML of irrigation applied; documenting practices that lead to these yields; and evaluating the cost of machine operation
- 2) Determine the financial implications of changing to or taking up centre pivot irrigation technology.

Summary:

The number of centre pivot and linear move (CPLM) irrigation systems in the southern Riverina has increased, driven by low irrigation allocations and the desire to find irrigation systems that use less water. However, CPLM systems require a large capital investment and are not suited to all soil types. Objective information regarding the viability and suitability of CPLM systems has not been available and this has led to inappropriate and costly decisions.

This study sought to address this lack of information and found:

- Pressurised irrigation systems can apply 1.2 and 2.5 megalitres less irrigation water per ha in wheat and lucerne respectively, without significantly reducing yields
- Achievable target yields under CPLM on suitable soils with sufficient water were found to be 6–7 t/ha for wheat and 18–20 t/ha for lucerne.
- Profitable returns from CPLM systems are unlikely for winter cropping enterprises and on dispersive heavy clay and sodic soils.
- The viability of an investment in CPLM is most sensitive to changes in gross income (i.e. price and yield), so the best strategy is to maximise income rather than reduce costs (particularly if this affects income).
- Dispersive, heavy, clay soils are not suited to CPLM irrigation as they are prone to waterlogging. This reduces the yield potential and, therefore, the gross income and viability of a CPLM system.
- In the southern Riverina, towable pivots irrigating 2-3 circles of winter crop should have a design capacity of 15 mm/day and a pivot irrigating one circle of summer crop should have a design capacity of 17 mm/day.
- Capital costs are > 50% of the annualised total cost of CPLM systems. Total costs (per ha or ML) will be reduced if capital costs are spread over more ha and more ML (i.e. use the machine as much as possible).

Key outputs include a Scoping Study Report, a Final Report and a Manual for growers. Training based on the Manual has been delivered to 30 irrigators in the Murray Irrigation Limited area of operations as an introduction to the national training program “Improving irrigation with pivots and laterals”. Copies of the Manual were mailed to all irrigators (approx 60) who submitted an EOI to invest in CPLM under the DSEWPC “On Farm Irrigation Efficiency” program.

Research Project Description

Cropping soil and recharge monitoring

Principal Investigator:

Dr Sean Murphy, Tamworth Agricultural Institute

Funding sources / project partners:

I&I NSW, Lower Murray Darling CMA, DECCW

Objectives:

1. To determine the impact of land management intervention on stored soil water, and ground water recharge in the Lower Murray Darling CMA.
2. Establish a monitoring network to be used as a resource for current and future ground water recharge investigations.

Summary:

The Lower Murray Darling Catchment Management Authority aims to ensure that water leaving the catchment is of the highest possible quality. Land clearing and land management practices have an impact on the rate of ground water recharge and so potential saline flows to the River Murray system.

A monitoring framework was established to record the impact of land management activities on stored soil water and ground water recharge and to build this record up from the paddock to the catchment scale. This framework is a resource for current and future ground water recharge investigations.

This project was made possible through the collaboration between I&I NSW, Lower Murray Darling CMA and NSW DECCW, representing a substantial investment of FTE and commitment by landholders in the catchment area.

Research Project Description

Developing improved farming systems in rainfed regions of southern Lao PDR

Principal Investigator:

Mr Brian Dunn, Yanco Agricultural Institute

Funding sources / project partners:

I&I NSW, ACIAR, CSU

Objectives:

- Diagnosis and integrated assessment of farming and marketing systems
- Optimisation, testing and adaptation of crop and livestock technologies and new marketing and extension approaches
- Sharing of knowledge and pilot scaling out of varieties, crop and livestock technologies and marketing approaches
- Alleviation of constraints posed by drought and uncontrolled flooding

Summary:

This project has been developed with research and extension activities being conducted in Lao PDR and Australia. It is a collaborative project between I&I NSW, Charles Sturt University, a range of international partners and the Australian Centre for International Agricultural Research (ACIAR). Although the irrigated rice-based mixed farming system in Australia differs in scale from smallholder rainfed rice-livestock systems in southern Lao PDR, a number of critical issues are common. Reduced supply of irrigation water, a need for greater water productivity, and a shift to direct seeding techniques are common to both the Lao and Australian rice farming systems. These result in similar challenges of unreliable crop establishment, reduced nutrient availability, higher production risk and greater threats from weed competition.

The Australian component of research includes investigating the delayed permanent water (DPW) system for rice production. This dries the soil between flush irrigations, reducing the evaporative demand compared with the normal permanent water system. Preliminary research in Australia has shown an increase of up to 17% in water productivity for the DPW system compared to the traditional drill sown practice. Future delayed permanent water experiments conducted in Australia will determine potential yields and water savings and investigate several agronomic issues associated with management of the production system. One of these agronomic issues is when to apply nitrogen, as intermittent flushing will mean larger losses of early-applied nitrogen. Grass weed control is also a challenge and more difficult than the current early ponded system and rice development is usually delayed when rice is moisture stressed.

A multidisciplinary research and extension team will conduct adaptive trials on farm and on-stations in Lao PDR. The development of simple tools, including decision support tools such as 'RiceCheck' and support to capacity building will utilise the Lao PDR and Australian research to facilitate knowledge flow to extension and community development efforts in southern Lao DPR.

Research Project Description

Environment and economic gains of changing land management to meet NRM targets

Principle Investigator:

Dr Iain Hume, Wagga Wagga Agricultural Institute

Funding sources / project partners:

I&I NSW, Caring for Our Country, Charles Sturt University (EH Graham Centre for Agricultural Innovation), Eastern Riverina Landcare Network

Objectives:

1. To characterise the land use/management practices and soil types and to benchmark their natural resources as measured by soil water, groundcover and soil health indicated by soil carbon levels.
2. Use an extension & communication program to (a) improve skills and knowledge of landholders in assessing NRM values and achieving NRM targets; (b) disseminate outputs from project to landholders, community and industry.

Summary:

The soil is the basic natural resource of agriculture. To maintain the soil in its best condition farmers and natural resource managers need to know which activities improve the soil and which degrade it. It is important to know if some soils are more resilient than others and if some land uses are more beneficial than others.

With the assistance of a Landcare Network we identified the five main soils and three landuses of a mixed farming area near Henty in SE NSW. These soils were benchmarked by sampling their acidity, carbon content and water content. Continuous monitoring changes in the soil water content of three landuses (cropping, permanent pasture and remnant native vegetation) on three soils gives a feel for how these combinations best manage the rainfall resource.

Land uses were perennial pasture grazed by cattle, intensive continuous cropping and roadside remnant native vegetation. Three main soil types were identified cracking grey Vertosols, Kurosols, Dermosols and Chromosols.

Total soil carbon across all land uses was low ranging from 27 t C ha⁻¹ to 54 t C ha⁻¹ with an average of 39 t C ha⁻¹. The mean values for crop, pasture and native vegetation were 34, 38 and 49 t C ha⁻¹. Poor productivity in a run of exceptionally dry seasons is the likely cause of these low values. Brown Chromosols had the lowest carbon content (33 t C ha⁻¹) and Dermosols the highest (43 t C ha⁻¹). Within a soil type management and cause up to 50% variation in carbon storage. Stubble retention systems achieved much higher levels than conventional burning and cultivation systems.

Soil water monitoring has shown that for a given soil perennial pasture had the lowest soil water holding and infiltration capacity. The landuse with the highest values was intensively cropped land where the stubble was retained. Soils were saturated (water contents greater than the drained upper limit) and crops were subjected to waterlogging for most of the very wet 2010 growing season.

Research Project Description

EverGraze - Hydrology of improved pasture in southern NSW

Principle Investigator:

Dr Iain Hume, Wagga Wagga Agricultural Institute

Funding sources / project partners:

I&I NSW, CRC for Future Farm Industries, MLA, AWI, Charles Sturt University

Objective:

- To determine the effectiveness of vegetation in managing hillslope hydrology.

Summary:

Salinity in the upland regions of eastern Australian states is often due to excess water accumulating in the lower parts of the landscape where it mobilises salt. Preventing the movement of water down slope is one way to mitigate this form of salinity. Belts of shrubs planted on the contour should create dry soil buffers that are capable of absorbing water flowing down slope either over the soil surface or on top of the subsoil.

We tested the capacity of shrubs to create these dry buffers in stands of annual pasture and lucerne. Also tested was the effect of the shrubs and pasture on the accumulation of water in the soil at the foot of the slope.

Two 5 m wide belts of acacia shrubs have been planted 30 m apart into lucerne and annual pasture/phalaris in 2005. The belts were designed as three row wind breaks with a single row of taller *Acacia deanei* and *A. decurrens* in the centre row and a mix of shorter, denser *A. decora* and *A. iteaphilla* in the outer rows.

Soil water was measured every month from January 2008 until March 2011. These measurements show that at the top of the slope where the soil is shallow, the shrubs create a dry buffer in both the lucerne and annual/phalaris pastures. At the bottom of the slope where the soil is deeper the shrubs have created a dry buffer in only the annual/phalaris pasture. These dry buffers filled with water following heavy summer rain in 2010 but soon returned to a dry state.

The shrub belts have completely sheltered the paddock from damaging winds three years after establishment so providing a nursery shelter for new born lambs.

Research Project Description

EverGraze: Northern NSW Project

Principal Investigator:

Dr Sean Murphy, Tamworth Agricultural Institute

Funding sources / project partners:

I&I NSW, FFI CRC, MLA and AWI

Objectives:

1. Demonstrate the role of lucerne-grass mixtures compared with lucerne monocultures as persistent and productive pastures, leading to a 25% increase in the area sown to lucerne-based pasture mixtures.
2. Investigate the water runoff/recharge issues associated with lucerne, lucerne grass mixtures and the growing of annual forage oats.

Summary:

Lucerne is the most widely sown improved pasture in northern NSW, but it has problems associated with poor persistence, low growth in winter, bloat in cattle and low ground cover leading to high runoff. Forage oats are sown on summer rainfall in February to provide high quality feed in winter-spring, but it also has problems in terms of low ground cover in summer, the need to be sown annually, and can potentially make a negative contribution to ground water recharge.

Best bet lucerne-grass mixtures suited to this region were tested in field plots to determine if they are more productive and persistent than lucerne monocultures, and if can they provide better NRM outcomes. Clearly, lucerne-grass mixtures improved ground cover, reduced runoff and erosion, increased water use efficiency and achieved improved NRM outcomes. Forage oats, while being an essential component of the forage base for productive animal enterprises have substantial erosion risk in summer and contribute to groundwater through winter.

Lucerne-tropical perennial grass mixtures offer improved forage for productive animal enterprises from spring through summer to autumn. Forage oats are still important to the animal system because of their growth in winter-spring and are best used strategically on farm in appropriate paddocks.

Research Project Description

Farming system options and catchment salinity response

Principal Investigator:

Dr Iain Hume, Wagga Wagga Agricultural Institute

Funding sources / project partners:

I&I NSW, GRDC, CSIRO, Alma Park/Pleasant Hills Landcare Group

Objectives:

To test the likely adoption of land use changes predicted by hydrologic and bio-economic models to manage stream salinity.

Summary:

Monitoring the salinity levels in streams has identified areas of the landscape that deliver large quantities of salt. One solution to these issues is to replace annual crops and pastures with perennial vegetation and financial incentives are often available to achieve these changes. These solutions ignore capacity or willingness of the farmers to make these changes.

The Simmons Creek catchment in southern NSW has been identified as a high salt donor catchment. We examined the usefulness of these 'traditional' solutions to salinity management in a novel process which used social science and co-learning with farmer groups.

Traditional agricultural hydrology and bio-economic modelling produced similar technical solutions to this problem that involved annual cropping with perennial pasture and/or tree plantations on well defined areas of land. These solutions both came at a high cost to those farmers who were asked to change their landuse.

Our work found that the areas where change was needed to achieve environmental benefit were those where the desire for and the capacity to change were low.

Change is a sequential process and traditional technical solutions achieve only the first step; the review, selection and location of land use options that would achieve desirable environmental outcomes. Demonstration of these options to the wider community is the next step towards real change. Quantifying the value of action by upstream farmers to those downstream would give a commercial basis for landuse change which may offset incentives paid for land-use change.

Research Project Description

Hydro-geological Landscape Mapping (HGL)

Principal Investigator:

Mr Vic Shoemark, Wagga Wagga Agricultural Institute

Funding sources / project partners:

I&I NSW, DECCW, CMAs, University of Canberra

Objectives:

- Monitor and measure the effect of landuse and climate on interception of shared water resources
- Informing regional based decision makers on appropriate on ground works for improved NRM particularly water
- Provide professional project management that includes field technical training to agencies staff (CMA DECCW) and universities on a proven delivery platform includes training of water practitioners

Summary:

Stream water quality is a key indicator to the overall health of a catchment and the landscape more generally. Stream water quality provides an integrated measure of upstream land and water management activities.

This project measures the longitudinal electrical conductivity of small streams in a larger catchment. It has an aim of providing information to characterise and identify the right landuse in the right landscape, optimising environmental, social and productivity outcomes. By profiling the electrical conductivity along the length of the stream, sections of the catchment can be identified that deliver high salt loads to these streams. Once these sections of the catchment that are contributing the majority of the water quality problems are identified, on ground actions can be prioritised that will result in reducing the amount of salt moving to streams and maximising fresh water flows.

The project is highly collaborative, involving staff of I&I NSW, DECCW, CMAs and the University of Canberra. It also links with the CRC Future Farm Industries CATplus project. The project involves field measurements including stream flow gauging, spot field data (EC, pH, temperature), and water sampling for further laboratory analysis.

Research Project Description

Improving water measurements in NSW

Principal Investigator:

Mr Tony Bernardi, Queanbeyan

Funding sources / project partners:

I&I NSW, Bureau of Meteorology, DECCW

Objectives:

- to obtain long term high quality and high resolution hydrological data;
- to develop better knowledge to manage both upland and intermediate based on hard data;
- to provide long term high quality and high resolution hydrological data;
- to provide reliable information to inform property/catchment scale investment decisions, and to assist in the development of public policy for the management and sharing of water the State's water resources.

Summary:

In eastern Australia, it is generally considered there is a lack of high resolution water quantity and quality data in upland and intermediate catchments. This lack of data reduces the understanding of water movement and the mobilisation salt and sediments in the landscape.

To address this data gap, I&I NSW operates eight highly instrumented headwater catchment monitoring sites under the Key Sites research project. These sites are from Quirindi in the north to Wagga Wagga in the south and measure all components of the water balance. They are all well described and measurements are being taken at strategic locations within the catchments for up to 16 years.

Many of the instruments that provide data at the I&I NSW sites are old and are breaking down, resulting in missing information at critical times, or they have broken down and not been replaced.

Together with the Bureau of Meteorology and DECCW we are replacing the most critical of these aging instruments and re-installing instruments at some sites. Newer, more accurate and durable equipment is now capturing information from the current wetter La Nina climate phase and is expected to capture how the catchments respond to different seasonal and climatic conditions into the future.

This monitoring will improve the understanding of the processes of water movement and water quality to better manage the State's natural resources. This knowledge is contributing to the development of public policy for the management and sharing of water. The data is contributed to the Bureau of Meteorology under the obligations of I&I NSW as a registered Category B provider for the Survey for Water Regulations Online.

Improving rice establishment and productivity in Cambodia and Australia

Principal Investigator:

Mr Geoff Beecher, Yanco Agricultural Institute

Funding sources / project partners:

I&I NSW, ACIAR, Rice Research Australia PL, University of South Australia and seven international partners

Objectives:

In Cambodia:

1. Assess the current and potential rice establishment methods used by farmers to develop corresponding strategies to raise grower productivity.
2. Develop the Cambodian Land and Environment Atlas and Resource (CLEAR) to better target rice establishment options for specific Cambodian locations.
3. Determine strategies, options and training materials that optimise rice establishment, weed management and rice farming systems.
4. Identify agronomic practices and develop training materials to raise productivity by 25% for irrigated dry season rice systems.
5. Increase the capacity of Cambodian organisations to lead adaptive research and demonstrations of rice establishment practices and associated technologies.

In Australia:

6. Investigate current and predicted future problems with rice seedling establishment including cultural practices and soil type interactions and issues related to the use of groundwater.

Summary:

Rice is the basis of Cambodian agriculture. However over recent years radical changes have been taking place with production systems. These changes relate to increase in the proportion of irrigated rice, the uptake of direct seeding and mechanisation replacing draft animal use in field preparation. Rice is also a very important agricultural crop in Australia, with a significant proportion of irrigation water used for its production. However rice production is having to adapt to lower water availability and a need to increase water productivity.

I&I NSW have a long standing partnership with the Australian Centre for International Agricultural Research (ACIAR) where agricultural research programs are operated with activities in NSW and in many overseas countries. During 2009 discussion took place between the two organisations to develop a research program that would benefit producers, water management and food security needs of both Cambodia and Australia. I&I NSW now lead this large and important research program that targets water management and food security, in partnership with nine Australian and international collaborators.

To improve rice productivity in Cambodia, six different agencies and the International Rice Research Institute are researching a range of new technologies that address issues relating to rice establishment methods, use of agricultural machinery, soil fertility and weed management. The knowledge will be used to develop training materials and strategies to raise grower productivity. Increasing the capacity of the Cambodian agencies to lead research, development and extension activities is an important objective of this project.

In Australia, a research program is being implemented at Yanco and Deniliquin that includes replicated field experiments on I&I NSW land and on cooperating farmers properties. These will investigate issues relating to crop establishment, cultural practices and soil type interactions. Replicated glasshouse experiments will investigate the effectiveness of a range of soil amendments on plant growth. Replicated field and glasshouse experiments will also quantify the impact of saline groundwater on the yield of current and potential rice varieties.

Research Project Description

Improving the performance of contour irrigation designs in the southern MDB

Principal Investigator:

Mr Sam North, Deniliquin AR&AS

Funding sources / project partners:

I&I NSW, Murray Irrigation Limited, CRC for Irrigation Futures

Objectives:

1. Determine the current state of knowledge, practice and tools for basin irrigation system design and performance evaluation.
2. Develop clear recommendations for “best practice” basin irrigation system design(s) based on hydraulic and economic performance.
3. Develop tools and techniques that can be used to evaluate basin irrigation system performance.
4. Train irrigation surveyors and designers in the use of recommended design software and irrigation system evaluation tools.

Summary:

In the southern Murray Darling Basin (SMDB), 83% of all irrigated land is watered using two main types of surface system: border check, used for dairy and grazing; and basin, used for rice and annual crops. Considerable work has been done to improve border check systems but very little has been done on basin systems. Fine textured soils, sodicity at depth, low hydraulic conductivity and flat slopes suit the production of paddy rice in basin systems but predispose these systems to waterlogging. This is the greatest single constraint to increased irrigated productivity of non-rice crops in the SMDB, with annual losses estimated to be in the order of \$80 million in wetter years.

Key findings include:

- Watering and drainage times in the most common type of layout used in the rice industry (i.e. side-ditch delivery) were found to be excessive (40–50 hours). Furthermore, it took on average around 60 hours after an irrigation for surface soils to dry to field capacity. This will cause waterlogging losses in most non-rice crops.
- Minimising the time water is ponded on the soil offers the greatest scope for improving productivity and cropping flexibility.
- Bays should be designed and operated so they are watered and drained in 10 hours. This may be extended to 18 hours for better draining RBE soils.
- For sodic soils, surface irrigation using basins will almost inevitably cause waterlogging losses. Strategies to minimise this include individual supply and drainage to bays, using beds/hills, reducing compaction, increasing organic matter and/or applying gypsum.

This research is generating a large and valuable data resource on flows of water within irrigation basins. The data is continuing to be analysed and used for the development of and validation of models to assist with irrigation design and in the development of extension materials for irrigation farmers.

Research Project Description

Key Sites – impact of landuse on water and salt flows from headwater catchments

Principal Investigator:

Dr David Mitchell, Orange Agricultural Institute

Funding sources / project partners:

I&I NSW, Bureau of Meteorology, National Centre for Groundwater Research & Training, DECCW

Objectives:

1. Determine water balance of agricultural and forestry enterprises and native systems at catchment and landscape scales.
2. Determine farm scale [sub catchment] water balance in priority catchments representative of priority areas targeted for salinity management across NSW.
3. Provide scientific data to validate the range of modelling approaches that are used for property management and catchment planning.
4. Provide the science base for natural resource management options salinity management.

Summary:

Management of water has emerged as one of the key environmental and economic issues for NSW and the Murray Darling Basin. The recent release of the guide to the MDB Plan has highlighted the need to have scientific evidence of how flows of water and salt are generated and transported as effected by landuse, landscape and climate particularly in upland catchments.

The management of water includes the obvious lack of water during droughts, and paradoxically, the 'excess' water which leads to salinity. Salinity is a major symptom of inappropriate water management and has become a social, economic and environmental issue. It has a direct negative effect on the environment and infrastructure and imposes costs on the community for land rehabilitation and from reduced production.

The Key Sites project seeks to 'ground truth' the validity of these methods in eight first-order sub-catchments which feature a range of common land uses from annual cropping through to forestry. This project has improved understanding of the processes that control dryland salinity; it has quantified the effects of land use on salinity and allowed improvement to modelling and decision support tools for catchment planning.

Research Project Description

Landuse, climate and water interactions in the Liverpool Plains Catchment of NSW

Principal Investigator:

Dr Malem McLeod, Tamworth Agricultural Institute

Funding sources / project partners:

I&I NSW, NCGRT, UNSW

Objectives:

1. Assessment and quantification of soil water and chemical dynamics in soils within the unsaturated zones
2. Optimising water (surface and groundwater) use efficiency
3. Assessment of surface-groundwater interactions
4. Conduct socioeconomic analysis, capacity building and communication activities

Summary:

There are concerns that the quality and quantity of groundwater resources may be adversely impacted by agriculture, industries, and urban activities. Dryland salinity and soil structural degradation are two major issues supporting such concerns.

This research evaluates the effect of agricultural landuse on water quality and quantity within the crop root zone and its interactions with groundwater across landscapes that are typical of the Liverpool Plains in northern NSW. These landscapes span from the coarser soil on the ranges to the alluvial soils on the plain with varying aquifer depths. Assessment of socio-economic impacts of agricultural landuse is also being conducted.

This project forms the northern NSW component of collaborative research taking place under the National Centre for Groundwater Research & Training (NCGRT) and with the University of NSW.

Research Project Description

Managing sodic soils & groundwater irrigation in the Murray Irrigation Districts

Principal Investigator:

Mr Sam North, Deniliquin AR&AS

Funding sources / project partners:

I&I NSW, Murray Irrigation Limited, Adelaide University

Objectives:

1. Develop guidelines for the management of sodic soils and groundwater in the Murray Irrigation Districts.
2. Develop cheaper and easier methods of testing soils for farmers to use
3. Educate farmers on the management of groundwater for irrigation and train them to undertake simple soil tests for aiding decision making.

Summary:

Groundwater pumping is recognised as one of the key management actions available for controlling water-tables and salinity in the irrigation areas of southern NSW. However, groundwater from production bores in this region is saline and sodic and its impact on soils needs to be managed if these bores are to remain in production over the long term and continue to provide control of water-tables.

Key findings of the study were:

- A previous correlation between sodium adsorption ration (SAR) and electrical conductivity (EC) of a 1:5 soil:water solution and soil dispersion for Victorian red-brown earths was not generally applicable to soils in the Murray Irrigation Limited (MIL) area. New threshold electrolyte concentrations relating SAR_{1:5} and EC_{1:5} to soil dispersion were developed.
- Clay mineralogy indicates the soils in the MIL area are moderately sensitive to the effects of exchangeable sodium.
- Field tests indicated that irrigation of fresh water following previous groundwater irrigation is likely to severely reduce infiltration rates (average 50% reduction). These tests confirmed the applicability of permissible SAR levels in irrigation water to the soils of Murray Irrigation region and highlight the need for gypsum to be applied prior to winter rainfall or fresh water irrigation to leach accumulated salts.
- Simple soil and water tests that can be used by farmers to directly observe soil behaviour, rather than inferring from guidelines, were developed

Key outputs have been a Final Report and a Manual for groundwater users (*Diagnosis and management of sodicity and salinity in soil and water in the Murray Irrigation region*). Training materials for groundwater irrigators have been developed and workshops delivered to irrigators in the Murray Irrigation area of operations.

Research Project Description

National Centre for Groundwater Research & Training

Principal Investigator:

Dr David Mitchell, Orange Agricultural Institute

Funding sources / project partners:

I&I NSW, UNSW, Flinders University

Objectives:

- Develop collaborative research proposals that allow the skills of National Centre for Groundwater Research & Training (NCGRT) personnel to be used to meet current and future water research priorities in NSW.
- Provide applied research skills to more fundamental research projects to provide relevant research outcomes for water managers in NSW.

Summary:

The NCGRT is a jointly funded initiative between the Australian Research Council and the National Water Commission. The NCGRT was developed in response to a recognised lack of investment into groundwater research and that few groundwater scientists being trained for the future.

I&I NSW is a partner in the NCGRT which offers potential for future water research collaborations. I&I NSW's involvement allows us to collaborate with a range of highly specialised and skilled scientists in the discipline of groundwater research. Water management is one of five priority themes within our Science & Research division and the NCGRT will assist I&I NSW to deliver outcomes that are benefit to water managers and the community of NSW.

The NCGRT has five research programs that explore the key questions from the basic understanding of groundwater origins and processes, through groundwater interactions with surface water, vegetation, and the environment, to the decisions we are taking about the management of this resource.

I&I NSW has contributed the long term data collected under the Key Sites project. This data is being used collaboratively within the NCGRT to better understand the role of landuse, landscape and climate on groundwater processes. Additionally the data is being used by PhD students of the NCGRT to improve groundwater models to better simulate groundwater processes.

I&I NSW scientists are actively collaborating with UNSW staff under the auspices of the NCGRT to better understand the effect of landscape, landuse and climate on a range of water, carbon and energy flows.

Research Project Description

National Roadside Survey Review

Principal Investigator:

Dr Sean Murphy, Tamworth Agricultural Institute

Funding sources / project partners:

I&I NSW, Caring for Our Country, DECCW

Objectives:

1. Develop a manual of nationally consistent minimum standards for roadside survey and ground reference site monitoring of wind/water erosion (including hazard) appropriate for agricultural land use systems.
2. Review field databases currently used by State agencies to navigate, capture and manage data during roadside surveys (eg. LandMAPT – NSW) and identify minimum specifications for a nationally compatible field database for monitoring of wind and water erosion.

Summary:

To improve targeting of investment in management practices that reduce erosion through the Commonwealth Government's Caring for Our Country program, improved monitoring of soil erosion at national, state and regional scales is required.

A review of current procedures recommended that methods of observation, data capture and data storage be standardised. Specifically, it was recommended to develop a roadside methods manual for surveys of wind and water erosion, together with an appropriate national database to accept the roadside survey data. Currently, four States use a range of field methods and data management systems to conduct roadside surveys and/or ground reference site monitoring for soil erosion on agricultural land.

In future, implementation of recommendations made in this project will see standardisation of assessment protocols across the nation and so more timely and accurate monitoring of land management affects on resource condition.

Research Project Description

Permanent beds for sustainable agriculture

Principal Investigator:

Mr Geoff Beecher, Yanco Agricultural Institute

Funding sources / project partners:

I&I NSW, RIRDC, ACIAR, CSIRO Griffith

Objectives:

To increase the sustainability, resource use efficiency, yield and profitability of rice based cropping systems through improved soil, water and nutrient management using permanent beds.

Summary:

To remain profitable and environmentally sustainable farmers need to be able to readily respond to market opportunities, increase productivity, increase water use efficiency and manage watertables (and thereby soil salinisation and drainage water salinity). Our hypothesis is that increases in profitability, water use efficiency, sustainability, and ease of management, can be achieved through changing from cropping systems where rice is grown in flat bays to permanent bed cropping systems.

New irrigation layouts that include beds within terraced, bankless channel systems are being adopted for a range of crops including rice, wheat, maize, cotton, faba beans, chickpeas, barley, sunflowers and cotton. While the area of bed layouts adopted is not great at this stage, considerable attention is being applied to the performance of these commercial fields by other irrigators.

This project is investigating irrigation designs and layouts that will allow more intensive cropping, improve water productivity and will lead to more sustainable use of land and water.

Research Project Description

Productive and persistent tropical perennial grasses

Principal Investigator:

Dr Sean Murphy, Tamworth Agricultural Institute

Funding sources / project partners:

I&I NSW, FFI CRC, MLA and AWI

Objectives:

1. Develop, demonstrate and promote agronomic packages for regionally based high production / high quality perennial grass-based farming systems in northern NSW and northern agricultural region of WA.
2. To measure at the plot scale the hydrological performance of perennial subtropical grasses compared with alternative pasture species based on plant rooting depth, change in soil water content and surface runoff.

Summary:

Tropical perennial grasses, which are productive, resilient and drought tolerant are at face value well suited to the summer dominant rainfall pattern in northern NSW. Leading producers are using them, and the challenge is to move towards widespread adoption by mainstream graziers, but several barriers to adoption were recognised.

Agronomic information for tropical perennial grasses was developed to address issues such as establishment, sowing time and depth, weed control, response to nitrogen, impact on water balance, and appropriate legume companions, and this information was published as a producer's guide for northern inland NSW.

The success of this project has seen >250,000 ha of tropical perennial grasses sown in northern inland NSW over recent 3 years and the ongoing enthusiasm by producers for these grasses.

Research Project Description

Review of the New Forests research program

Principle Investigator:

Dr Robyn Hean, Armidale

Funding sources / project partners:

I&I NSW

Objectives:

1. To identify the inputs to the program and estimate their cost.
2. To identify the outputs and outcomes of the program and their beneficiaries.
3. To value the (net) benefits of the program (by calculating the difference between the “with” and “without” program scenarios).
4. To analyse the benefits and costs of the program within a benefit-cost framework.

Summary:

The New Forests research program was established by Forests NSW (FNSW) in November 1999. It was amalgamated into the newly-formed NSW Department of Primary Industries in July 2004, which subsequently became the Primary Industries Division of Industry & Investment NSW in June 2009. Since July 2004, the program has provided FNSW with specialist R&D and technical services under a formal Memorandum of Understanding in which it is proposed that the cost of forestry research should be funded by its beneficiaries in accordance with the beneficiary pays principle.

This project represents a first attempt at evaluating the program within a benefit-cost framework. The approach taken has been to divide the program into a few distinct clusters of research projects with similar objectives, and to compare the mix of funding from private, public and external beneficiaries with preliminary estimates of the benefits they receive, for the program as a whole and for each of the research clusters. Comparisons will also be made between the pre- and post-amalgamation periods.

Research Project Description

Rice NIR Tissue Test

Principal Investigator:

Mr Brian Dunn, Yanco Agricultural Institute

Funding sources / project partners:

I&I NSW, RIRDC, SunRice

Objectives:

- update the NIR nutrient calibrations each season
- ensure that the instrument is providing accurate nitrogen predictions for the rice tissue test and research projects
- keep abreast of NIR technology applications and opportunities in agricultural research.

Summary:

Over 35% of rice crops in NSW have their nitrogen status assessed mid- season by the SunRice NIR Tissue Test Service. Testing at mid season when the rice panicle starts to develop provides growers with a nitrogen fertiliser application rate that is specific to their crops nutritional needs.

SunRice operate a specialised and high technology Bruker FT - Near Infra Red (NIR) instrument to test the nitrogen status of dried rice tissue samples as a service to growers. I&I NSW work with SunRice to ensure the equipment is operating correctly and provides accurate fertiliser recommendations.

Many of the I&I NSW rice research projects are also dependant on accurate and cost efficient sample analysis by the Bruker FT- NIR instrument. The maintenance of the NIR instrument and annual update of the numerous rice shoot, grain and straw nutrient calibrations is essential to the provision of accurate topdressing recommendations as well as the success of many research projects.

Research Project Description

SALTCAP & SALTDECIDE

Principal Investigator:

Dr David Mitchell, Orange Agricultural Institute

Funding sources / project partners:

I&I NSW, Future Farm Industries CRC

Objectives:

1. To produce a decision support system that enables landholders to be able to select and establish appropriate saline land management systems
2. To establish if saltland revegetation can reduce downstream impacts of salinity and if so what benefits accrue to NRM and water resource managers
3. To predict the impact of water management using integrated plant-based and engineering interventions both on-site (water-table drawdown) and off-site (volume and salt concentration in off-site flows).

Summary:

The presence of saltland on farms can be a major concern, not only for the negative effect on the environment and profitability but also because saltland contributes to the decline in aesthetic appeal. Landholders are very keen to manage this saltland for a range of economic, environmental or aesthetic outcomes.

This project will devise a simple decision support system (called SALTCAP) to provide saltland management options to landholders. SALTCAP will be primarily focused on providing plant-based options for sites that are already saline. The project will also develop a hydrological modelling tool called SALTDECIDE which will determine the biophysical impacts (salinity, groundwater levels, flows and loads) of the options recommended by SALTCAP. Biophysical data (salt load, runoff watertable depth, landuse) from one site at Gumble in NSW and one site at Yealering in Western Australia, will be used to develop the model.

The project will deliver a robust, simple decision support system for land managers to assist in deciding the most appropriate landuse option for saline sites.

Research Project Description

Salinity tolerance of Australian rice cultivars

Principle Investigator:

Mr Sam North, Deniliquin AR&AS

Funding sources / project partners:

I&I NSW, ACIAR

Objectives:

1. Determine the relative salinity tolerance of Australian rice cultivars
2. Develop management guidelines for the use of saline groundwater on rice
3. Develop a simple method for screening rice cultivars for salinity tolerance

Summary:

Groundwater use in the rice growing areas of southern NSW has more than doubled since the early 1990's and its contribution to total irrigated production has risen from 4% to over 10%. This is expected to continue to increase given predictions of reduced surface water availability in the southern Murray Darling Basin. For example, groundwater contributed well over 30% and up to 80% of the income generated from irrigated agriculture in the NSW Murray valley during the recent drought. However, groundwater contains salts (predominantly sodium chloride) and there is potential for significant yield loss if salts are concentrated in irrigation bays by evaporation.

In order to ensure high yields from Australian rice grown with groundwater, the salinity tolerance of existing and potential rice varieties needs to be assessed and management guidelines refined.

This experiment forms part of the ACIAR funded project "Improved rice establishment and productivity in Cambodia and Australia" that is being led by Geoff Beecher.

Research Project Description

Storage dam evaporation mitigation

Principal Investigator:

Dr Harnam Gill, Yanco Agricultural Institute

Funding sources / project partners:

I&I NSW, CRC for Irrigation Futures, University of Southern Queensland, University of Melbourne

Objectives

- Develop physical facilities for conducting investigations on evaporation at various scales.
- Evaluate selected commercial and experimental products for their efficacy in reducing water losses through evaporation.
- Assess performance of the selected commercial and experimental products under different environmental temperature and environmental conditions.
- Test pressure sensitive transducer technology and instrumentation on commercial irrigation channel for measuring evaporative losses.

Summary

Annual evaporation losses from on farm water storages can potentially exceed 40% of the storage volume and have been estimated to exceed 12,500 GL per year. Commercial products such as floating covers exist to reduce losses from evaporation from small storages up less than 10 ha but larger storages pose a greater challenge. Chemical mono-layers offer significant potential to reduce evaporation but the performance of current commercially available compounds is difficult to quantify and believed to be low.

This project will include research into the performance of commercial evaporation mitigation products and new technology mono-layer compounds. The research will be undertaken at a range of scales utilising specialised infrastructure at the Yanco Agricultural Institute. These scales range from small tub experiments in a controlled atmosphere to large modified rice bays that mimic open bodies of water storage. Trials are evaluating commercial products (Water\$avr and Aquatain) and two experimental compounds developed by the CRC for Polymers.

Results to date of experiments with commercially available products to reduce evaporation show their efficacy declines under open environmental conditions when compared to their use in open ponds. Water savings at their recommended rates were not significant and far less than claimed by their manufacturers. However experimental polymer products showed considerable promise in reducing evaporation. Further improvements to these compounds and robust commercial evaluation are required and an alliance with the CRC for Polymers has been formed to pursue this.

Research Project Description

System Harmonisation research

Principal Investigator:

Mr Saud Akbar, Richmond

Funding sources / project partners:

I&I NSW, CRC for Irrigation Futures, University of Melbourne, University of Western Sydney, Charles Sturt University, Coleambally Irrigation

Objectives:

- Identify business opportunities for improving the management of surface and groundwater resources to satisfy environmental and consumptive demand in irrigated catchments.
- Assess the economic, environmental and social impact of these changed management practices

Summary:

Irrigation and environmental sustainability have to date been managed as competing enterprises under separate and divergent control. There is increasing support for a 'harmonised' business approach to sustainable uses of our land and water resources. The CRC IF System Harmonisation research program seeks to identify business opportunities for irrigators to become part of an expanding environmental services industry and in doing so support a truly sustainable and diversified irrigation business environment.

The main aim of this program is to identify business opportunities for improving the management of surface and groundwater resources to satisfy environmental and consumptive demand in irrigated catchments. The research has an explicit and directed emphasis on irrigation water use as an important part of water resource management.

I&I NSW research under the System Harmonisation program is principally in the Coleambally Irrigation Area and the South Creek in western Sydney. This component of the study is intended to establish the baseline hydrologic and economic position of the region and identify the key pressure points in the system. In particular this includes the hydrologic opportunities to optimise on farm and near farm irrigation system performance and water demand patterns to deliver productive and environmental dividends.

I&I NSW is carrying out detailed channel and on farm water balance and economic analysis in targeted areas to understand impacts of change in water use from the adoption of new strategies for managing irrigation water at the supply and on-farm scales.

Research Project Description

The Assessment of Water Losses from Irrigation Water Delivery Systems

Principal Investigator:

Mr Saud Akbar, Richmond

Funding sources / project partners:

I&I NSW, CSIRO

Objectives

- Determine the magnitude and importance of seepage losses from on-farm and off farm channels in irrigation areas.
- Develop “farmer friendly” methods for determining distribution efficiency of on-farm channels and Irrigation supply channels.
- Identify the need for treatments to reduce losses from channels.
- Use EM surveys to identify relationship between the seepage losses and EM values.

Lay Summary

Anecdotal evidence indicates that 99% of on-farm channels and drains in irrigation areas are currently unlined. Seepage losses from unlined channels both on-farm and as part of an irrigation district supply system often ranges from one-quarter to one-third of the total water diverted. Seepage causes immediate environmental impacts from lost water which would otherwise have been used for irrigation.

This project is identifying and quantifying the location in an irrigation supply system where localised significant water losses are occurring through evaporation, seepage, leakage and operational processes. The knowledge developed will inform irrigation water providers of the location and quantity of water loss in their irrigation area, and assist them to identify various strategies for reducing those losses during planning and implementation of the modernisation of their irrigation infrastructure.

The data, its quality and verification processes will ensure the investment of public funds for modernising irrigated agricultural infrastructure is based on facts and objective data.

Research Project Description

Understanding hardsetting soils

Principal Investigator:

Mr Ian Daniells, Tamworth Agricultural Institute

Funding sources / project partners:

I&I NSW

Objectives:

To determine whether hardsetting soils benefit from tillage.

Summary:

Hardsetting soils set to a hard, structureless mass as they dry and remain difficult or impossible to cultivate until the soil profile becomes fully wet again. Consequently, there is restricted time during which they may be tilled, difficulty in producing a good tilth, constraints to seedling emergence, and constraints to root growth.

Guidelines are needed to help a farmer choose between continued cropping with poor returns and high costs, and pasture with potentially poor returns but with low input costs. Key questions are whether a hardsetting soil benefits from judicious tillage, and how to manage it under no tillage.

Research Project Description

Use of biochar to improve nutrient and water use efficiency in north-west NSW

and resilient farming systems in Nanggroe Aceh Darussalam and New South Wales". The effect of poultry litter biochar on soil and plants in the hot, dry environment of Tamworth will be compared with those in the more humid tropical environment in Aceh, Indonesia.

Principal Investigator:

Dr. Malem McLeod, Tamworth Agricultural Institute

Funding sources / project partners:

I&I NSW, ACIAR, Indonesian Soil Research Institute, BPTP Aceh

Objectives:

(1) to evaluate fertiliser and water use efficiency of premier digit pasture (*Digitaria eriantha* cv. *Premier*) under the presence of poultry litter derived biochar.

(2) to monitor carbon and nitrogen mineralisation of animal waste and plant residue when mixed with poultry litter biochar

Summary:

Maintaining high level of soil organic matter is a prerequisite for productive soil. But, most soils in the hotter and drier regions in the North-West of NSW contain very low carbon levels, usually less than 2%. As a result water and nutrient availability are major constraints to agricultural production in this region.

This research uses poultry litter biochar, fertiliser, and organic amendments to manage soil carbon and assesses its impact on production of premier digit grass, water and nutrient use efficiency, and nutrient mineralisation. The project will result in the identification of adaptation strategies to improve water and fertiliser use efficiency for production and environmental benefits. It will also improve understanding the role of biochar as a carbon offset for carbon trading.

This project is part of an Australian Centre for International Agricultural Research (ACIAR) funded project titled "*Building more profitable*

