Agriculture is particularly vulnerable to the vagaries of seasonal and climatic variation. Research has worked to find the means to manage climatic extremes—such as drought-tolerance traits in crops—and to better predict seasonal variations—such as long-term forecasting.

For farmers, managing the risk involved is a frustrating part of the job. For smallholder farmers struggling to achieve food security and earn an income to escape poverty, often farming marginal or low-yielding land, even small shocks can cause major crop losses.

ACIAR’s projects help lay the groundwork, both to mitigate such shocks and to help farmers adapt to changes in climate. They do this by promoting the development of sustainable, market-linked farming systems that help promote food security and income for poor farmers.

A critical component of this approach is managing water resources, both for irrigated and rain-fed farming systems. ACIAR’s water management projects link on-farm approaches to water management and savings to system-wide approaches.

Water is of critical importance to agriculture around the world and it is the leading factor limiting productivity today and into the future. This is also the case in many Australian agricultural systems.

Efficient water use and sustainable management of water resources are two key areas of ACIAR activity that deliver important sustainability benefits for agriculture, food security and farm profitability.

It was estimated in 2006 that 1 trillion (1,000 billion) litres of water were saved in Australia per year as a flow-on benefit from just four projects conducted by Australia’s overseas aid program, with the innovations capable of delivering an
THE FOUR PROJECTS THAT DELIVERED THE ONE-TRILLION-LITRE WATER SAVINGS

MORE RICE WITH LESS WATER—THE MURRUMBIDGEE AND COLEAMBALLY IRRIGATION AREAS

This ACIAR project was conducted in partnership with the Yellow River Basin in China. The ability to generate three sets of data, based on similar climatic and soil conditions, provided scientists with greater certainty about how much water was being lost during its transport from rivers to farms and where the losses were occurring. The project also identified additional possible gains. Project outcomes included:

- converting flood and furrow irrigation to sprinkler and trickle irrigation
- matching water savings investments with higher-value cropping systems
- matching different crop varieties to soil, water and groundwater conditions
- reducing delivery-system leakages through channel lining, piping and replacing outdated equipment.

IMPROVING IRRIGATION EFFICIENCY—THE ORD RIVER IRRIGATION AREA

High irrigation water use and leakages from Lake Kununurra and its irrigation channels has led to rapidly rising watertables in the Ord River Irrigation Area (ORIA). As a result, waterlogging and salinisation threaten large sections. CSIRO scientists working on an ACIAR-funded project in China also sought to better understand the movement, distribution and quality of water. By lowering the water levels of Lake Kununurra they demonstrated that water savings of up to 5,000 litres a year could be achieved through reduced leakage.

The increased subsurface drainage in the Packsaddle Plain helped to lower the watertable by 1–2 metres for the first time since irrigation began in the early 1960s. This is helping to prevent salinity and waterlogging in the Packsaddle Plain, the most affected area in the ORIA. Modelling of irrigation management strategies across the whole area identified savings of up to 30% of irrigation water simply by modifying irrigation schedules—savings that can be realised without productivity losses. Recent estimates found that about 20% of growers had implemented improved irrigation practices, reducing their water use by about 20%.

SUSTAINABLE RE-USE OF SALINE DRAINAGE WATER—THE MURRAY–DARLING BASIN

This project investigated options for the sustainable re-use of drainage water from agricultural areas in Pakistan and Australia. The system that was tested—serial biological concentration (SBC)—re-uses drainage effluent, cascading it through a series of crops that reduces its volume while increasing its salinity, with final containment of a small volume of highly saline effluent in an evaporation basin. The process maximises productive use of water, extends the lifespan of irrigation areas through salinity management, and increases productivity of limited water resources.

Piloting of the SBC system in Pakistan helped finetune the technology for deployment in Australia. In areas of the Murray–Darling Basin, 60,000 hectares of land have been identified as highly suitable for the use of SBC, allowing for water savings of 120,000–180,000 million litres of saline recharge, depending on the crops sown and water allocations.

CONTROLLED TRAFFIC FARMING—THE DARLING DOWNS AND NORTHERN NEW SOUTH WALES

This project identified improvements in soil management practices for rainfed cropping environments that can increase water storage in soils. ACIAR-commissioned research in China demonstrated the importance of restricting tractors and other heavy vehicles to fixed, permanent lanes, with crops grown on undisturbed zones between these traffic lanes. This prevents soil compaction and the break down of soil structure that reduces rainwater infiltration, waterholding capacity and the availability of this water to crops. Leaving crop residues on the soil surface further reduces water loss in run-off and evaporation. It also has the potential to affect return flows to either groundwater or surface water systems. Another benefit is the ability of traffic lanes to better support traffic in wetter conditions, allowing farmers to plant sooner after rainfall. When conventional tillage is replaced by controlled traffic and zero tillage, the amount of rainfall available for crop growth increases by 32%. There are also fuel savings of 4–8 litres per hectare due to the reduced level of traffic across paddocks. Benefits to Australia were estimated to be worth $145.4 million in 2006.

additional 2 trillion litres per year. This is equivalent to filling Sydney Harbour six times or filling three million Olympic-size swimming pools.

The four projects that delivered these savings were all run in partnership with Asian countries facing similar challenges to the river basins and irrigation areas most important to Australian agriculture.

The projects tackled diverse challenges, from salinity from rising watertables caused by irrigation through to trialling water re-use systems that maximise production opportunities from limited water resources. These projects sit within a broader program.
in which, over 25 years, ACIAR has invested in 98 collaborative research projects to improve water productivity. Gains were made through improved irrigation schemes, better catchment management and more efficient water allocation systems that also reduced losses. The results are helping farmers to use their water more efficiently. 

The objective is to achieve ‘real’ water savings. This means using less water or getting more production out of the same amount of water—‘more crop per drop’.

For example, one ACIAR project focused on growing more rice with less water. Researchers studied water-saving options in three irrigation schemes in China and Australia. Water savings were achieved at the system level and on-farm. This meant irrigators could use limited water resources productively and reduce the amount of water lost through system inefficiencies.

Another project carried out in China’s Ningxia province helped improve irrigation management in Australia’s Ord River Irrigation Scheme. CSIRO scientists and their Chinese counterparts from the Chinese Academy of Sciences were able to improve water management, reduce losses and better use groundwater to reduce salinity build-up.

These are issues of vital importance in Australia and many of ACIAR’s partner countries. In Pakistan, India and China the available water resources no longer satisfy population demands. Even in higher rainfall countries such as Vietnam and the Philippines, water availability and competing demands create pressures on water usage and quality.

Agriculture, particularly irrigated production systems, is the major user of fresh water in the world. By 2025 current population growth rates are projected to double the use of fresh water. Feeding the world will require an additional 5,600 trillion litres of water for agricultural, industrial and household use.

More sustainable, productive and profitable ways of managing water, such as those already generated within ACIAR programs, will be vital to providing the world’s future food, feed and fibre.

**SOIL-PROFLING AID TO FARMERS**

**ACIAR ACTION:** ACIAR collaborators developed a simple Soil Constraints and Management Package (SCAMP) that uses properties of soil—be it collected samples or soil in the field—to identify constraints and indicate appropriate management strategies. It was developed in an ACIAR project to help sustainably manage upland soils in Vietnam. The inclusion of a soil/water partitioning model into SCAMP expanded its capabilities, allowing it to trace the major pathway of water movement—run-off, ponding, drainage—for any soil, based on its drainage and permeability ratings. This information has been used to map the major pathways of water movement in soils of the wet tropical coast of Queensland.

**ACIAR project:** SWL/1990/048

**NEWS IN BRIEF**

**Peanuts**

Peanut varieties with improved drought tolerance and increased water-use efficiency were developed through ACIAR-funded research led by the Queensland Department of Agriculture, Fisheries and Forestry in the decade to 2003. The improved germplasm was made available to breeders in Australia and India to lift production in drought-prone areas.

**ACIAR project:** CS1/1997/114

**Rice**

The adoption of permanent raised beds in rice-based cropping can improve returns on every 1,000 litres of water used from $96 to $136 per litre, and thus a significant saving. Project beneficiaries included rice irrigators in south-west New South Wales. The project was led by CSIRO and the NSW Department of Primary Industries and jointly funded by ACIAR, the Grains Research and Development Corporation and the Rural Industries Research and Development Corporation.

**ACIAR project:** LWR/2000/089

**Citrus**

Victorian citrus orchards achieved water savings of 25% through improved management of irrigation schemes, which was developed in an ACIAR project involving the Victorian Department of Primary Industries and the China Agricultural University in Beijing. Impacts included reduced water wastage and matching the amount of water applied and the time of application to meet specific crop needs.

**ACIAR project:** SWL/1990/048