

Country Profile

China

November 2006

The Australian Centre for International Agricultural Research (ACIAR) operates as part of Australia's international development cooperation program, with a mission to achieve more productive and sustainable agricultural systems, for the benefit of developing countries and Australia. ACIAR commissions collaborative research between Australian and developing country researchers in areas where Australia has special research competence. It also administers Australia's contribution to the International Agricultural Research Centres.

© 2006 Australian Centre for International Agricultural Research
GPO Box 1571 Canberra ACT Australia 2601

ACIAR. *Country Profile: China*. 2006.

ISSN 1449-9452

Additional copies of this publication are available from ACIAR offices:

In China:

Ms Catriona Murray
Manager China
Tel: +86 10 6532 2331 ext 401
Fax +86 10 6532 4943
Email: catriona.murray@dfat.gov.au
Postal address:
Australia Embassy
21 Dongzhimenwai Dajie
Sanlitun 100600
Beijing
Peoples Republic of China

In Australia:

Communications Program Manager
Tel: +612 6217 0500
Fax: +612 6217 0501
Email: comms@aciarc.gov.au
Postal address:
GPO Box 1571
Canberra ACT 2601

Website: www.aciarc.gov.au

Printed by Elect Printing, Canberra

Contents

Preface	5
China Report 2005–06	7
China Plan 2006–07	12
Active projects as at 30 June 2006	16
Concluded projects 1 July 2005 – 30 June 2006	69
Projects under development as at 30 June 2006	85
China consultations	87
ACIAR publications	89

Preface

The ACIAR Country Profiles are designed to give a snapshot of the collaborative research being carried out between Australia and our various partner countries. This publication contains short summaries of bilateral and multilateral projects with China that were active from 1 July 2005 to 30 June 2006. At that time there were 23 active bilateral projects, and two active multilateral projects, the latter being led by international agricultural research centres. There were another 13 bilateral projects under development, many of which are expected to start in 2006–07 financial year.

This publication also sets out the key outputs and outcomes from four bilateral projects and three multilateral projects that have been completed from 1 July 2005 to 30 June 2006.

In addition to these project summaries, the publication includes an extract from ACIAR's 2005–06 Annual Report covering China, our near-term program as outlined in the 2006–07 Annual Operational Plan and a record of the most recent consultations held between ACIAR and China on the medium-term priorities for the joint program.

ACIAR updates this profile each year and distributes it to key stakeholders in China and Australia.

We hope you find the publication useful as a record of the progress and achievements between China and Australia. For information on ACIAR's overall program, we invite you to visit our website at www.aciar.gov.au.



Peter Core
Director

November 2006



Catriona Murray
ACIAR Country Manager, China
catriona.murray@dfat.gov.au

China Report 2005–06

(extract from ACIAR Annual Report 2005–06)

Active projects in 2005–06	34
AOP budgeted expenditure in 2005–06	\$3,684,000
Actual bilateral country expenditure in 2005–06	\$3,733,227
Bilateral country expenditure in 2004–05	\$3,926,454
Bilateral country expenditure in 2003–04	\$4,231,678

Key performance indicators	Performance 2005–06
<ul style="list-style-type: none"> Significant co-investment by Chinese partners in all new projects 	Chinese investment in ACIAR projects is substantial, and exceeds the investment by ACIAR in some projects, but there is no evidence that there has been a change since this KPI was introduced.
<ul style="list-style-type: none"> New priorities for cooperation agreed at 2005 China–ACIAR country consultation 	A large, formal consultation meeting was not held in 2005–06. Instead it was agreed that priorities for the ACIAR program be discussed in individual meetings between senior ACIAR staff and senior representatives of Chinese Ministries (including the Chinese member of the ACIAR Policy Advisory Council).
<ul style="list-style-type: none"> Closer integration between teams working on ACIAR-funded projects with CGIAR centres (multilateral projects) and bilateral projects 	A workshop to formalise linkages between multilateral and bilateral natural resource management projects held with Chinese, CGIAR and Australian teams in September 2005. Seven ACIAR projects and three CGIAR centres participated, and a comprehensive overview of ACIAR's work on water in China has been published.
<ul style="list-style-type: none"> Policy options for improved allocation and management of water from the Yellow River communicated to and acknowledged by senior decision-makers 	Policy options for improved allocation and management of water developed and communicated to senior decision-makers, with a number of combined workshops involving other ACIAR projects, donors and international agencies. Value of this work recognised as it directly led to initiatives funded through AusAID and USDA.
<ul style="list-style-type: none"> Further adoption of alternative irrigation methods to reduce water use by rice growers in eastern China 	Adoption of alternative wetting and drying water saving irrigation for rice growing is continuing at Zhanghe, Hubei province. Where water supplies to the irrigation system have been further reduced farmers have been able to maintain rice production by further expanding the area using alternative wetting and drying irrigation techniques.
<ul style="list-style-type: none"> Initial assessment of regional impacts of revegetation on water resources of the Loess Plateau completed 	A program of on-farm research to compare conservation tillage (stubble retention and no-tillage) with conventional farmer practice begun in 2005 at Dingxi and Xifeng. However it is too early to assess success of conservation tillage as trial results have not been completely assessed.
<ul style="list-style-type: none"> Initial trials on double cereal–legume cropping feasibility completed in relevant parts of the Tibet Autonomous Region 	The results from the initial trials indicate that it is technically possible to introduce a legume in the existing cropping system in Tibet without impacting on the yield of the existing cereal crops. More detailed trials are planned to optimise the system and quantify the potential benefits.
<ul style="list-style-type: none"> 40% of new projects designed to have significant farmer or policy-maker impacts within 5 years of completion 	Of the five projects designed or commenced in 2005–06, three (LWR/2002/094— <i>raised cropping beds</i> and FST/1999/095 and FST/2001/021— <i>wood products</i>) were assessed as being designed for significant impacts within five years of completion.

Position

ACIAR has funded and managed a program with China since 1984. Major areas of research support have included management of water for agriculture, selection of Australian trees suited to Chinese forestry, improvements through integrated pest management in brassica crops, studies of livestock production and diseases with a focus on sheep and wool, quality management in stored grains and citrus improvement. Adoption of conservation tillage in some central western provinces has been recognised as part of the solution to improve crop management and reduce wind-blown dust in Beijing. Reduced use of excessive nitrogen fertilisers has been widely adopted in the North China Plain, with financial savings to farmers and reduced risk of nitrate contamination of groundwater.

The focus of ACIAR's program has shifted towards western China. Important issues are the need to raise farmers' incomes, better management of scarce water resources, producing better quality agricultural products, and uptake of opportunities arising from previous research. In view of the significant human and financial resources available within the Chinese national agricultural research system and the strong mutual benefits to Australia, ACIAR requires that projects have significant sharing of costs with Chinese and Australian research providers. Projects chosen must address the highest priority of Chinese partners and also embody an emphasis on poverty reduction in western China through institutional reform and environmentally sustainable rural development.

ACIAR also funds small investments that foster collaborative linkages between activities primarily funded from other Australian and Chinese sources. In 2005–06 the program also continued to emphasise benefits for resource-poor farmers in the Tibet Autonomous Region, based on a suite of four activities initiated in 2003–2004.

Achievements

A comprehensive study has been under way to understand the implications of **China's accession to the World Trade Organization (WTO)** in terms of the country's food security. More is now understood about the Chinese economy following the development of a general equilibrium model that separates the economy into regional dimensions based on the 44-sector input–output tables of 28 provinces. The model aggregated this information into three regions—eastern, central and western—and could distinguish between rural and urban households.

Analysis at regional level detected that **regional income disparity**, which has been worsening since 1991, will be reinforced rather than eased by the WTO accession. The eastern coastal region will have much higher gains than the inland regions. Rural–urban inequality will worsen in all regions. According to the model, after WTO accession the agricultural sectors are adversely affected—agricultural output falls, grain and total food self-sufficiency rates decline, and rural–urban income inequality worsens. However, the magnitudes of the impacts are smaller than widely anticipated.

China is poorly resourced with water, and this too is a major threat to long-term food security. In a study of the Yellow River Basin researchers are working with Chinese policy makers to develop an integrated model that simulates the economic impact of **alternative water allocations** and is exploring water trading in the basin. This model is enabling the researchers to explore the effectiveness of different water trading schemes as well as other policy instruments on the efficiency of water use and the reliability of supplies to different regions and industries in the Yellow River Basin. Project members reported on progress with the model at the 2nd International Yellow River Forum on 'Keeping the Healthy Life of the River and Modern River Basin Management', held in October 2005.

In 1999 the Chinese Government implemented a program in China's northwest provinces to **convert cropland to forests** (the 'Grain for Green Program'—GFGP), spurred by the extent of land and water resource degradation that has put the future of agricultural production in the region at risk. ACIAR has funded a financial and socio-economic assessment of the GFGP, involving a livelihood impact analysis of its introduction across four counties in two provinces in northwest China. Researchers concluded that the GFGP has enhanced farm incomes, and that even if subsidy payments were withdrawn the changes in land-use have improved farm income.

On the hilly parts of the Loess Plateau large-scale revegetation is under way using perennial plants (grasses, shrubs and trees), with the intention of **reducing soil erosion** and thus improving **water quality** of the Yellow River. A project has developed spatially distributed models to help target revegetation activities for the most appropriate places. Databases have been developed to include monthly climate and stream flow from 1980 to 2005, soil parameters, land use and topography for the target regions. GIS-based software developed for the region can help predict the impacts of various levels of revegetation on annual stream/river flows.

Major efforts have been directed to improving the productivity and sustainability of farming systems. In the western Loess Plateau of Gansu Province, **advances in conservation tillage** have been enthusiastically embraced by farmers in Dingxi and Xifeng. A program of On-Farm Research (OFR) begun in 2005 at both locations is continuing, with studies of comparisons between the system of conservation tillage (stubble retention and no-tillage) and conventional farmer practice. Two Australian Youth Ambassadors have worked with the farmers during 2005.

Efforts to improve productivity of **peas and faba beans** in the drier parts of China involve a focus on common interests by breeders, pathologists and genetic resource specialists. Their major goal is to develop cultivars with multiple resistances to disease and abiotic stress (such as drought). Extensive collecting expeditions have been under way in Qinghai (spring sown) and Yunnan (autumn sown) provinces for landraces of pea and faba bean traditionally grown by the farmers. Germplasm exchange continued—Australia has sent elite breeding material to China, and in return received collections of landraces and a core collection of peas.

Another project seeks to improve the **productivity of oilseed brassica** cultivars in China, India and Australia, through germplasm exchange, crossing and selection. Significant progress was made during 2005 to identify variability for key agronomic, quality and disease-resistance characters, using screening protocols established earlier in the project. The first exchange of germplasm of *Brassica napus* and *B. juncea* between India, China and Australia was completed by mid 2005 and field trials were planted in the 2005–06 season.

Further progress took place in developing a toolkit that will aid the take-up of integrated pest management for **brassica crop production**. In Zhejiang, following an extensive needs analysis conducted in early 2004, the project team has developed two tools—a decision-support and training multimedia system targeted mainly at extension officers, and a field guide to integrated management of vegetable brassicas targeting mainly farmers.

Work with **sugarcane germplasm** from China and other parts of the world has found that the Chinese representatives of the species *Erianthus arundinaceus* are genetically diverse compared with material in the Australian collection—the latter material being mostly sourced from Indonesia. Characterisation of clones of non-Chinese *Saccharum spontaneum* (wild sugarcane)—from Australian, USA and Brazilian collections—is complete, and work continues to characterise the Chinese *S. spontaneum*. The scientists are using these analyses to establish small core sets of clones from both species that constitute a broad representation of genetic diversity for Chinese and Australian collections.

ACIAR has embarked on several projects to help advance agriculture in the **Autonomous Region of Tibet**. One project aims to optimise the use of resources to produce both food-grain and fodder crops, through careful matching of crop types to the agro-climatic environment. The scientists are testing the feasibility of growing two crops in one year in the relatively short growing season and harsh climate. Results to date indicate a definite opportunity to introduce a fodder option, possibly vetch or lucerne, in conjunction with cereal crops.

A study has provided the first evidence of the **mineral status of livestock** in Tibet. Deficiencies of sodium and phosphorus seem widespread, with micro-nutrients selenium, copper and zinc marginal in some soils and deficiencies notable in some species. The success of this work has stimulated a follow-up project to determine the level of response to these apparent deficiencies. Also in Tibet, scientists are seeking to **increase milk production**. A survey has found that milk yields are around 4–5 litres per day at the best, falling to less than 1 litre per day at the end of lactation. Inter-calving intervals are also long, at 18–24 months. The market is strong for milk, so there is plenty of incentive for improvement.

A fourth project in Tibet has tested the premise that damage to livestock production due to the increased abundance of **plateau pikas** (small grassland mammals) can be reversed by improved management of grazing pressure on alpine meadows. The work has shown that poisoning has only short-term benefits, with numbers back to former strength the following summer. The team has developed a more rigorous technique for estimating pika numbers, which is now being used by other Chinese and international agencies.

Animal production in some of China's challenging environments should receive a boost from the development of **advanced breeding lines of lucerne** with high levels of tolerance to adverse factors such as salt, acid/aluminium soils, waterlogging or drought. In other research, the **forage species** selected in earlier ACIAR research for China's red soil region are now being taken up by smallholder enterprises in Hunan and Jianxi (see box on next page).

Severe erosion has contributed to massive flooding and excessive sedimentation in the upper catchment of the Yangtze River in Sichuan. ***Pinus radiata***, a conifer widely used in Australia in commercial plantation, holds promise for revegetating the area. Australian and Chinese forest scientists are investigating the potential for a better range of *P. radiata* germplasm in the Yangtze catchment. They have already identified some general and specific health risks to the long-term success of *P. radiata* introduction, particularly the possible presence of pine pitch canker. Climate modelling has helped to identify areas suitable for *P. radiata*. An experiment testing five natural *P. radiata* provenances (Monterey, Año Nuevo, Cambria, Guadalupe and Cedros) is now established at three sites.

About 80 per cent of farmer income in the northern central and north-west provinces of China is derived from melon sales. An ACIAR project sought to improve **postharvest disease control, handling and market quality of melons** to improve returns to growers. The project fulfilled all its objectives, and now a 2-year extension intends to boost the efficiency of supply chains to help the farmers to market their produce more effectively.

Patience rewarded in China's red soils region

The red soils region of central southern China covers an area the size of Western Australia (2.6 million km²) to the south of the Yangtze River. The region characteristically has high, soil-erosive rainfall in spring, high evaporation rates in summer, and cold winters. Almost half the area has suffered serious erosion through excessive deforestation.

The impetus to develop these soils for agricultural production comes from population pressure and continued economic growth. Three previous ACIAR projects have delivered technologies for establishment and persistence of pasture forages to help control erosion. The challenge for a more recent project was to convert these adapted forages into economic benefits for farmers, by developing a forage-based ruminant production system that integrates well with other activities of smallholder farmers.

In China the team gathered and collated data about farmers' animals—reproductive efficiency, growth rates, mortality, herd structure, age and weight at sale—from around 240 households in three counties in Jiangxi and 300 in three counties in Hunan. These data became the benchmarks for later assessment of productivity gains. The team also completed an inventory of available feed resources, identifying suitable local feedstuffs and by-products such as straws derived from rice, peanut, sweet potato or soybean, together with corn stalks.

A list of recommended perennial summer-growing grass species was drawn up for commercial use by smallholder farmers. Research showed that these species are advantageous in this environment, due to their superior dry matter production, over-wintering capabilities and a growth habit suited to harvesting in a cut-and-carry system. Annual grass species were successfully integrated into rice-growing with beef production. The majority of the legumes tested showed marginal suitability for beef production. Ammonia treatment of rice straw was successful, and in some areas this may be a preferred alternative to silage for winter feed.

Findings from 14 cattle growth experiments have led to recommendations for year-round feeding of beef cattle that deliver annual liveweight gains of 100–200 kg. The team produced seasonal calendars on CD-ROM, describing land requirements, fodder production and dietary alternatives for cattle production. As well, a household economic model, incorporating data from the village surveys along with forage evaluation and animal-feeding studies conducted in China, was developed for a smallholder crop-forage-livestock system.

Peri-urban vegetable production has become a popular means of increasing the availability and diversity of fresh vegetables in the growing urban centres. But the system suffers from high levels of spoilage and contamination, and a project is seeking to improve the situation. Already Chinese and Australian partners have conducted process audits of four fresh vegetable supply chains in the Beijing area, examining the flow from production to retail and identifying human and plant health hazards. Next researchers undertook a microbiological contamination audit on pak choi, carrots and tomato from these supply chains. They sampled vegetables at harvest, during washing and at retail, and also tested five environmental sources—soil, organic fertiliser, irrigation water, wash water before use and used wash water.

China Plan 2006–07

(extract from ACIAR Annual Operational Plan 2006–07)

GNI per capita ¹		Bilateral actual 2004–05*	\$3.82m
Population ²	1,315.8 million	Bilateral budget 2005–06**	\$3.68m
Population 2015/2050 ³	1,604.6/ 1,586.7 million	Bilateral budget 2006–07***	\$3.13m
Active bilateral projects	23	Bilateral + Multilateral	
Active multilateral projects	1	budget 2006–07	\$3.43m

*Includes co-funding of \$0.08m (Grains R&D Corporation) and \$0.16m (AusAID).

**Includes co-funding of \$0.34m (Department of Environment and Heritage) and \$0.13m (AusAID).

***Includes co-funding of \$0.24 (Department of Environment and Heritage).

Medium-term strategy

ACIAR's program in China will focus on sustainability aspects of agricultural production through policy and technical projects on better management of land and water resources in western China. In addressing sustainable production the need to raise farmers' incomes through increased productivity and profitability is also taken into account in project design. In recognition of the evolution of Australia's development assistance relationship with China all new activities will take the form of partnerships that include significant co-investment by our Chinese partners. ACIAR will make small investments through a new China Linkages Scheme to foster collaborative linkages between projects that have been funded from other Australian and Chinese sources and facilitate broader interactions between Chinese partner agencies and Australian agencies in subjects of high priority to both countries. Funding for exchange visits for workshops or other small activities for exposure to Australian agricultural policies, natural resource management practices, institutions and research management may also be provided for activities involving China.

Key performance indicators (2006–07)

- Significant co-investment by Chinese partners in all new projects
- Medium-term strategy for program in Tibet Autonomous Region developed and agreed between ACIAR and Chinese counterparts
- Communication of results of analysis of technical barriers affecting trade communicated to Chinese policymakers
- Evidence of integration of biophysical and policy considerations in development of grassland management strategies
- 40 per cent of new projects designed to have significant farmer or policy-maker impacts within five years of completion

¹ Source: Commonwealth of Australia, *Australia's Overseas Aid Program 2006-07*, Statement by Minister Alexander Downer, May 2006.

² Source: United Nations Population Division, 2005, *World Population Prospects: The 2004 Revision*, http://www.un.org/esa/population/publications/WPP2004/World_Population_2004_chart.pdf.

³ Source: United Nations Population Division, 2005, *World Population Prospects: The 2004 Revision*, http://www.un.org/esa/population/publications/WPP2004/World_Population_2004_chart.pdf.

Position

ACIAR has had a program with China since 1984. Major areas of research have included agricultural water management, selection of Australian trees suited to Chinese forestry, improvement and integrated pest management in brassica crops, studies of livestock production and diseases with a focus on sheep and wool, quality management in stored grains as well as broadacre crop and citrus improvement. Adoption of conservation tillage in some central western provinces has been recognised as part of the solution to improve crop management and reduce wind-blown dust in Beijing. In 1999, the focus of ACIAR's program shifted towards western China, in line with the need to raise farmers' incomes in this part of China and to better manage land and water resources.

In view of the significant human and financial resources available within the Chinese National Agricultural Research System and the strong mutual benefits to Australia, ACIAR requires that projects in China have significant sharing of costs by Chinese and Australian research providers. In many cases, ACIAR will seek a funding commitment through case-by-case exchanges of letters at the stage of development of full project proposals. Only a small proportion of the highest-priority projects can be supported. Projects chosen must:

- Address the highest priority of Chinese partners
- Address overall Australia-China development policy (to "Further mutual interest by supporting China's balanced development policies and working together in the region"⁴)
- Complement other schemes for China–Australia collaboration, including the AusAID Australia-China Environment Development program, to commence in 2006
- Be in areas where the overwhelming driver is Australian technical comparative advantage
- Complement rather than duplicate activities of other (larger) donors.

Within our stated priority areas, ACIAR will also fund small investments that foster collaborative linkages between activities that have been primarily funded from Australian and Chinese sources.

ACIAR projects form only one part of the China–Australia inter-Governmental cooperation in agriculture and natural resource management. Some information on the other programs, several of which provide financial support for collaboration between Chinese and Australian agricultural researchers follows. Most of these programs operate through annual calls for applications.

- Department of Agriculture, Fisheries and Forestry—Australia (DAFF) and the Chinese Ministry of Agriculture jointly administer the **Australia/China Agricultural Cooperation Agreement** (ACACA, www.affa.gov.au/acaca), which provides funding for agricultural-oriented exchange projects between Australia and China. Projects from researchers, businesses, industry associations and farmers that help develop trading relationships, enhance cooperation in a wide range of agricultural sectors, provide a forum for the exchange of scientific information and especially encourage commercial linkages are encouraged. The focus of the present program is on projects that demonstrate potential for commercial outcomes and provide clear flow-on benefits to industry. Over 175 projects have been completed since 1984.
- Australian Government Department of Education Science and Training (DEST), 'International Science Linkages program' (www.dest.gov.au/science/isl). This includes competitive grants under the **Australia–China Special Fund for S&T Cooperation**, in which agriculture, biotechnology and environmental research form three of the priority areas. The Australian Government through DEST has also provided funding to support a new Australia–China Centre on Water Resources Research. The Centre will increase research networks between Australian and Chinese scientists and promote multi-disciplinary research collaboration into water resources in both countries. Finally, the first exchanges under the DEST-managed Australia–China Young Scientist Exchange Program will commence during 2006–07.

⁴ Source: China-Australia Country Program Strategy 2006–2010, AusAID, November 2005.

- In addition **DEST** supports international exchanges, targeted scientific and technological individual visits, missions and workshops to promote S&T collaboration. These are managed by the Australian Academy of Science (www.science.org.au/internat/index.htm) and the Australian Academy of Technological Sciences and Engineering (www.atse.org.au).
- Food Standards Australia and New Zealand and the Chinese Ministry of Science and Technology recently entered into a MoU on **Scientific and Technological Cooperation in Food Safety**.
- The **Joint Declaration on Bilateral Cooperation on Climate Change** between the Australian Greenhouse Office (Department of Environment and Heritage, DEH) and the National Development and Reform Commission for China (www.deh.gov.au/minister/env/2003/mr24oct203.html) sets out cooperation in technology development and policy. During 2006, DEH will release the 'Australia–China Climate Change and Agriculture Research Prospectus' and fund several projects, of which at least one will be co-funding of a project managed by ACIAR.
- From the Chinese side, the **State Bureau of Foreign Experts Affairs of China** is responsible for accrediting international educators in China and for identifying and negotiating training opportunities across the world which will be of benefit to China. The related China Association for International Exchange of Personnel (www.china.org.cn) is a government sponsored institution also engaged in the international exchange of specialised technical and managerial personnel in several areas, including agriculture, science and technology.

Relationship to the AusAID China strategy

AusAID's new China strategy for 2006–2010 has the goal of furthering mutual national interest by supporting China's balanced development policies and working together in the region. It has the three strategic objectives of building capacity in selected sectors in China, in particular governance, environment and health; enhancing the Australia–China relationship by building institutional linkages; and working collaboratively to strengthen the region.

ACIAR's China program, while maintaining a focus on sustainable resource management in poorer Western regions reflects the strategic objective of building capacity in China, with a strong focus on capacity enhancement in technical and policy issues relating to the environment as it is either affected by agricultural production or in turn affects production sustainability. Governance and collaboration in the region are addressed by a second major emphasis on agricultural development policy issues, particularly relating to trade policy and environmental management. The basis of ACIAR's mode of operation in China is through the development of strong institutional linkages between Australian and Chinese government R&D and policymaking organisations, thus supporting the second strategic objective of the overall Australian aid program in China.

Indicative priorities

ACIAR has consultations with China to establish priorities for research collaboration, including meetings with senior leaders and researchers from the Ministries of Science and Technology, Agriculture, and Water Resources, the China Academy of Sciences, China Academy of Agricultural Sciences, State Forestry Administration, China Academy of Forestry, universities and provincial authorities.

ACIAR's China program has the following themes:

Subprogram 1: Sustainable agriculture in north western China

- Technologies for improved water use efficiency in irrigated and dryland agriculture
- Policies and institutions for improved land and water use

Subprogram 2: Improved agricultural productivity in Tibet Autonomous Region

- Improved crop-livestock systems in favourable areas of Tibet AR
- Protection and improved productivity of grasslands

Subprogram 3: Implications of Chinese trade developments for smallholders

- Implications of more open trade and associated economic policy reforms for poor smallholders in China, regional developing economies and Australian interests
- Identification of policy constraints to adoption of research findings

Subprogram 4: China linkages scheme

- Support for small activities arising out of ACIAR research to assist in communicating findings and to complement activities of other Australian-China cooperative programs

Key program managers

Dr Ray Trewin, Agricultural Development Policy
Dr Paul Fox, Crop Improvement and Management
Dr Ian Willett, Land and Water Resources

Country Manager

Ms Catriona Murray, ACIAR Country Manager, China

Active projects

1 July 2005–30 June 2006

Bilateral

ADP/1998/128	Achieving food security in China—implications of WTO accession	18
ADP/2000/120	Institutions and policies for improving water allocation and management in the Yellow River Basin, China	20
ADP/2002/021	Sustainable land use change in the north west provinces of China	22
CIM/1999/072	Oilseed Brassica improvement in China, India and Australia	24
CIM/1999/094	Improving the productivity and sustainability of rainfed farming systems for the western Loess Plateau of Gansu Province	26
CIM/2000/035	Increased productivity of cool season pulses in rain-fed agricultural systems of China and Australia	28
CIM/2000/038	Use and improvement of sugarcane germplasm	31
CIM/2002/093	Intensifying production of grain and fodder in Central Tibet farming systems	34
FST/1999/095	Improving the value chain for plantation-grown eucalypt sawn wood in China, Vietnam and Australia: Genetics and silviculture	36
FST/2001/021	Improving the value chain for plantation-grown eucalypt sawn wood in China, Vietnam and Australia: sawing and drying	38
FST/2001/086	Assessment of the potential of <i>Pinus radiata</i> for ecological restoration of the Yangtze River catchment in Aba Prefecture, Sichuan, China	40
HORT/1998/140	Postharvest handling and disease control in melons in China and Australia	42
HORT/1999/081	Reducing spoilage and contamination risks of fresh vegetables in China and Australia	44
HORT/2002/016	Improving the implementation of integrated crop management in Brassica vegetables through a decision support toolkit based on enduser needs in China and Australia	47
LPS/1998/026	Lucerne adapted to adverse environments in China and Australia	49
LPS/2001/094	Sustainable development of grasslands in western China	51
LPS/2002/104	Increasing milk production from cattle in Tibet	54
LWR/2002/018	Regional impacts of re-vegetation on water resources of the Loess Plateau, China, and the Middle and Upper Murrumbidgee Catchment, Australia	56
LWR/2002/094	Promotion of conservation agriculture using permanent raised beds in irrigated cropping in the Hexi Corridor, Gansu, China	58
LWR/2003/039	Improving the management of water and nitrogen fertiliser for agricultural profitability, water quality and reduced nitrous oxide emissions in China and Australia	60
PLIA/2005/123	Trends in world agriculture to 2030, implication for developing countries	62
PLIA/2005/152	Australia-China linkage for improved rice cold tolerance	63
SMCN/2005/059	Modelling water and solute processes and scenarios for optimisation of permanent raised bed systems in China, India, Pakistan and Indonesia	64

Multilateral

ADP/2004/044	Economic analysis of technical barriers limiting agricultural trade of China	65
ADP/2004/045	Exploring alternative futures for agricultural knowledge, science and technology (KST)	67

ADP/1998/128: Achieving food security in China—implications of WTO accession

Overseas Collaborating Countries	China
Commissioned Organisation	Australian National University, Asia Pacific School of Economics and Government, Australia
Project Leader	Dr Chen Chunlai Phone: (02) 6125-6565, (M) 0404 886 087 Fax: 61-2-6125 5555 Email: chunlai.chen@anu.edu.au
Project Web Site	http://apseg.anu.edu.au/research/research_units/china/ch_98128.php
Collaborating Institutions	China Center for Economic Research, China Center for Chinese Agricultural Policy, China
Project Budget	\$833,992
Project Duration	01/07/2000 to 30/09/2006 (Project extended from 01/07/2003 to 30/09/2006)
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

Since gaining WTO accession China has begun to liberalise its agricultural trade. In the short term, the impact will be limited. However, global trade liberalisation is likely to increase in the future. Whatever policies the country chooses to adopt in response, there will be changes to the economy - including effects on rural incomes and food security. The Chinese government will therefore need to set up policies to assist disadvantaged groups and help with a smooth transition. The choice of food policy in China will not only have a significant impact on the country's own economic structure, but will also help shape the pattern of world food trade and hence have important implications for major food-exporting countries such as Australia.

Joining the WTO came at a critical point in China's agricultural history. In the mid-1990s, domestic prices for major grain products, including rice, wheat and corn, rose rapidly towards (and even sometimes above) international prices. China could subsidise farmers and maintain prices for its own grains above international levels, or it could tax farmers (as in the past) by forcing its prices below world prices, or it could opt to open its markets to world trade.

The impact of these decisions by the Government determine if internationalisation of the food economy would destabilise the domestic food market; whether the country could earn enough foreign exchange if it had to import grain; and whether freer trade in food would prevent further increases to farmers' incomes and so widen the already large rural-urban gap in the country. Research is needed to examine these questions and their implications to analyse the effect of joining the World Trade Organisation (WTO) on China's food policies, and to devise a set of policies to help improve China's food security.

Project outcomes

Year 6 (01/07/2005–30/06/2006)

The project extension has three objectives.

Activity 1: Extension of the research

The review report proposed further work on implications for Chinese agriculture of new preferential trading developments in the Asia–Pacific region. More specifically, the suggestion is to ‘study the impact on Chinese agriculture of the new preferential trading developments in the Asia–Pacific region, utilising the same CGE model and methodological framework established for the WTO accession projected, adapted where necessary’.

Activity 2: Publication of ACIAR technical report

The review report also proposed to publish an ACIAR technical report drawing on key publications of the original project, such as:

- the model documentation
- final summary paper
- translated policy briefs

These items are designed to show the value in maintaining and continuing to use the model.

Activity 3: Maintenance and future use of the CERD CGE model

The research work in Activity 1 will also produce materials which when supported by appropriate training systems will help build sustainable modelling capacity. The project will be linked with other initiatives including:

- A Crawford Master Class on CGE modelling
- A study to develop a project on a similar set of questions facing policy makers in Vietnam.

Due to the delay in visa application, Dr Jun Yang (the main researcher of the project) arrived in Canberra in February 2006, so there was no formal research work during the period July–December 2005. However, the project conducted the work of collecting research materials for the modelling work, including data collection and relevant research materials. Dr Chunlai Chen travelled to China twice to visit Centre for Chinese Agricultural Policy of Chinese Academy of Sciences (the Chinese partner of the project) to discuss project implementation, personnel arrangement and relevant issues.

ADP/2000/120: Institutions and policies for improving water allocation and management in the Yellow River Basin, China

Overseas Collaborating Countries	China
Commissioned Organisation	Australian Bureau for Agricultural and Resource Economics, Australia
Project Leader	Dr Steve Beare Phone: (02) 6272 2040 Fax: (02) 6272 2318 Email: sbeare@abare.gov.au
Collaborating Institutions	International Water Management Institute, Sri Lanka Center for Chinese Agricultural Policy, China
Project Budget	\$763,191
Project Duration	01/01/2003 to 31/08/2006 (Project extended from 01/01/2006 to 31/08/2006)
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

China is poorly resourced with water, a major threat to long-term food security. Predictions indicate that by 2020 grain requirements will exceed current consumption by more than 40 per cent, with livestock demand expected to double. Arable land, however, is almost fully allocated. Increasing urbanisation, industrial demand and upward income mobility are increasing water consumption. Many of these factors are also resulting in rising levels of water pollution, which coupled with deteriorating irrigation systems and water misallocation are threatening supplies. Imbalances in water resources between regions, especially those in the arid north, compared to the more water-rich south, further complicate water supply and equity.

Water shortages have been considered through either technical or engineering perspectives, with the Government using innovative delivery technologies to try to increase efficiency. Despite this approach little has changed. Conflicts and shortcomings in or scarce incentive schemes demonstrate the continuing pressure on water resources.

Institutional limitations, including no integrated, multi-regional approaches or national coordination are the main factors behind continued water resource pressure. This becomes particularly so given the sectoral approach, with activities in one area often causing shortages downstream. Conflicting needs of industrial, agricultural and urban users further fragment approaches to water allocation.

Establishing equitable institutional arrangements in the Yellow River Basin that promote more efficient water allocations and management is being examined to ensure the productivity and sustainability of water will be increased.

Project progress

As at October 2006 the latest progress report is forthcoming, the previous report has been included for information.

Year 2 (01/01/2004–31/12/2004)

Data availability and analytical methodology were discussed extensively in meetings with representatives from ABARE, CCAP, USDA-ERS and UC Davis in 2003 and a framework was agreed in January 2004.

The framework covered:

- primary and secondary data collection and the construction of a basin level database of agricultural production and returns
- a hydrological database drawing on the structure of the World Bank basin level model of the Yellow River Basin
- future industrial and urban demand requirements
- a soil water balance model to facilitate the estimation of total crop water requirements in determining the crop yield response to irrigation
- water demand modelling and the construction of an integrated hydrological and economic model of the surface water use in the basin

The databases of agricultural production and returns, surface water hydrology and soil moisture balance are now mostly complete and the water demand modelling is scheduled to commence in May 2005.

- The agricultural production database contains county-level data on dryland and irrigated production, surface and groundwater irrigation water use, yields, revenue and production costs.
- The data were derived from county-level production statistics and both village and farm surveys conducted by CCAP.
- The database is spatially linked to GIS coverage of the Yellow River Basin that allows for the specification of regional estimates that align with catchment boundaries.
- The hydrological database includes a monthly time series of river flows at key gauging stations and reservoirs, as well daily pan evaporation and rainfall data from all the available weather stations within catchments of the Yellow River Basin.
- The soil moisture balance model has been constructed at the county level and can be linked to the GIS coverage of the Yellow River Basin.
- Water demand estimation procedures have been developed and implemented in GAMS to match the information in the agricultural production database and soil moisture balance models.

In October, 2004 representatives from ABARE, ERS and IWMI met with representatives from the MWR and the YRCC (Shang Hongqi, Gao Zhanyi and Li Ge) to discuss potential collaboration. The parties agreed to seek support to pursue collaborative research on a variety of issues including the development of water rights to facilitate water transfers, water saving through adoption of irrigation technology and practices, the impact of soil and water conservation practices on sedimentation, water quality and ecosystem protection. It was also agreed that the research would focus on the interrelationships between hydrology, agronomic practices, economic returns and environmental outcomes. Further, the research will assist in the development of a policy evaluation model based on existing ABARE modelling frameworks. The modelling framework may be extended to incorporate water quality, supported by an existing program to monitor water quality in collaboration with USDA and ecosystems research being done at YRCC.

The meeting with the YRCC led to visits by the President of the YRCC in late October 2004, a deputy Minister of the MWR and a number of division directors. They came to Canberra to visit ABARE to discuss both water policy issues in Australia and how our work in the Murrumbidgee would be extended to the YRB.

Key tasks for the second half of 2004–05 include:

- estimation of surface water demands for catchment areas in the Yellow River Basin
- design of an initial set of surface water reallocation policies to evaluate using the integrated hydrological and economic model.

Preliminary results from the model are scheduled to be presented at the 2nd International Yellow River Forum in October 2005.

ADP/2002/021: Sustainable land use change in the north west provinces of China

Overseas Collaborating Countries	China
Commissioned Organisation	Australian National University, National Centre for Development Studies, Australia
Project Leader	Professor Jeff Bennett Phone: (02) 6125-0154 Fax: (02) 6125-8448 Email: jeff.bennett@anu.edu.au
Project Web Site	http://apseg.anu.edu.au/staff/jb_susIndrr.php
Collaborating Institutions	China National Forestry Economics and Development Research Centre, China
Project Budget	\$399,734
Project Duration	01/01/2003 to 31/12/2006 (Project extended from 01/01/2006 to 31/12/2006)
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

Pollution caused by dust has been, and remains, a significant problem in northeast China. Dust-storms, pushed by prevailing westerly winds, begin in China's western provinces. From there the storms are blown eastwards, resulting in air pollution in eastern cities, most notably Beijing, and even reaching as far as Korea and Japan. The dust-storms have their beginnings in land and water resource degradation in western areas of China, lands that spawn the Yangtze and Yellow Rivers. Estimates put the extent of this degradation at 135 million hectares or approximately 14 per cent of China's land mass. This equates to 30 per cent of total pasture land in China being eroded, desertified or salinised. Of greater concern is that these areas of degraded land are expanding by 1.3 million hectares a year. Responding to this the Chinese Government has implemented the Grain for Green Program (GFGP) offering farmers incentives to establish trees and perennial pastures. Uptake has exceeded expectations, putting the financial viability of this program at risk.

The program has not sufficiently answered one key question: what will happen to the farmers in these areas if land use and agricultural practices are not sustainable and profitable? Developing sustainable land use requires farmers to earn an income in the short- and long-term. Short-term income assistance is on offer through the program, but this will only last five years and there are signs that this may be an insufficient period of time to establish sustainable industries. The challenge is to develop land-use practices that address degradation and ensure agriculture can continue sustainably well into the future.

This project is facilitating the development of policies for China's northwest provinces that will ensure changes in land-use management that are sustainable in the long term. Sustainability is defined in terms of the financial viability of farming communities, social acceptability and environmental impacts.

Project progress

Year 3 (01/01/2005–31/12/2005)

The livelihood impact analysis of the introduction of the Grain for Green Project (GFGP), carried out across four counties in two provinces in NW China was completed, a research report published and a journal paper based on the research report has been accepted for publication in the Journal of Environmental Planning and Management.

Detailed research on the projected biophysical impacts of the GFGP was undertaken, using predominantly secondary sources and interviews with researchers in that field. The information collected was used as the base for the design of a Choice Modelling questionnaire aimed at estimating the non-use, off-farm environmental impacts of the GFGP. Four key attributes of these impacts were defined: air quality (dust storm prevalence), water quality in the Yellow River, aesthetics of the landscape and biodiversity. Focus group and subsequent pre-testing of the questionnaire were carried out in Beijing, Xi'an and Ansai. These three sites were selected because of their differing geographic locations relative to the GFGP areas. They were the sites for the application of the survey which was administered in a face to face interview, with university students being used as the interviewers. The data collected from the surveys have been analysed and a research report outlining the findings has been written.

Members of the Chinese research team visited Australia on two occasions through the year. M. Zhang, M. Dai, Mr Wang and M. Zhu attended lectures at the ANU and made familiarisation visits to forest operations and voluntary tree planting groups around Canberra in August. In October, Mr Liang and Mr Zhang spent 10 days working on the Choice Modelling data analysis.

The project web-site provides wide access to the project's findings:
http://apseg.anu.edu.au/staff/jb_susIndrr.php

CIM/1999/072: Oilseed Brassica improvement in China, India and Australia

Overseas Collaborating Countries	China, India
Commissioned Organisation	University of Melbourne, Institute of Land and Food Resources, Australia
Project Leader	Dr Phil Salisbury Phone: 03 8344 7315, 9884 8068 Fax: 03 8344 4665, 9884 8068 Email: psalisburt@optushome.com.au, p.salisbury@unimelb.edu.au
Collaborating Institutions	Department of Primary Industries, Victoria, Australia South Australian Research and Development Institute, Australia National Research Centre on Rapeseed-Mustard, India NSW Department of Primary Industries, Australia Oil Crops Research Institute, China University of Western Australia, Australia Punjab Agricultural University, India Tata Energy Research Institute, India Indian Council of Agricultural Research, India Huazhong Agricultural University, China Haryana Agricultural University, India Department of Agriculture, Western Australia, Australia Institute of Industrial Crops, China
Project Budget	\$2,607,087
Project Duration	01/01/2004 to 31/12/2008
ACIAR Research Program Manager	Dr Paul Fox

Project background and objectives

Oilseed brassicas are an extremely important crop in China and India. More than 6 million hectares are planted to *Brassica napus* (rapeseed) in China and *B. juncea* (Indian mustard) in India. Achieving canola quality oils (low in erucic acid and glucosinolates) is an aim for both countries. *B napus* varieties grown in Australia, Europe and Canada all achieve canola quality, and those planted in Australia best suit Chinese and Indian growing conditions. Germplasm with improved traits for both *B napus* and *B juncea* will be tested to improve canola quality oilseed production in China, India and Australia.

A number of key diseases and environmental stresses limit brassica production in all three countries. Lines resistant to sclerotinia and white rust are needed to reduce losses from these diseases. Traits such as drought tolerance will also boost yields and oil quality. Molecular genetic and quality analysis can be used to determine key traits, including quality, disease resistance and drought tolerance.

This project is: identifying and developing effective screening/evaluation protocols., Activities include identifying appropriate variability within each key trait, using selection and breeding to enhance key traits in germplasm of all countries; identifying heritability of key traits by undertaking genetic variability/distance studies on available germplasm; and developing and providing appropriate information on improved germplasm and disease epidemiology for incorporation into existing technology transfer protocols.

Project progress

Year 2 (01/01/2005–31/12/2005)

Significant progress was made during 2005 to identify variability for key agronomic, quality and disease resistance characters through the use of screening protocols. The first exchange of germplasm of *B. napus* and *B. juncea* between Indian, China and Australia was completed by mid 2005 to allow sowing of field trials in the 2005–06 season. The material to be assessed in each country for the key characters consists of: *B. napus*—25 Australian, 20 Chinese and three Indian lines; *B. juncea*—22 Indian, 12 Australian and 10 Chinese lines. In Australia the field trials were sown in Vic, NSW, SA and WA and were harvested at the end of 2005. The data from these trials will be analysed in early 2006. In China the germplasm was sown at two sites in Wuhan in Sep–Oct 2005 and the key characters are currently being assessed. In India the germplasm was sown in Oct–Nov 2005 and to date emergence, early vigour and initiation of flowering data have been recorded. Results from a preliminary screening of Australian and Indian germplasm in India in the 2004–05 season indicated that there is substantial variability in key characters including date of emergence, seedling vigour, white rust incidence, oil and glucosinolate content and fatty acid composition.

Screening and characterisation of *B. juncea* and *B. napus* for seedling stage thermotolerance and terminal stage heat tolerance is under way in the field and laboratory at HAU Hisar and PAU Ludhiana, India. Drought tolerance screening is also under way at HAU. Screening of germplasm for sclerotinia was also initiated in 2005 at HAU, India and UWA, Australia. In Australia it was observed that most *B. juncea* germplasm was highly susceptible to sclerotinia, based on the length of stem lesions, although there were some more resistant lines from Australia and China. Significant differences for white rust resistance between Australian *B. juncea* lines were also observed in WA.

During 2005 activities were initiated to enhance the germplasm in all countries for key characters through selection and breeding. At PAU, India interspecific hybridisation between *B. napus* and *B. carinata*/*B. juncea* was undertaken, and desirable F₂/BC₁ plants from both the crosses will be backcrossed with selected Australian *B. napus* lines. At HAU, India 40 crosses have been made between Indian and Australian lines of *B. juncea*, and 60 crosses between Australian and Indian lines of *B. napus* are also being attempted this season. At TERI, India shattering-tolerant *B. napus* lines (developed at TERI) have been sown and will be crossed with the Australian lines to transfer shatter tolerance. In NSW 21 crosses were made between sclerotinia-tolerant Chinese lines and elite Australian lines, and further crossing will be done in 2006.

Progress was made in 2005 towards the identification of genetic distance and heterotic pools. At UWA, useful SSR markers were identified on all chromosomes for estimation of genetic distance among *B. napus* lines from Australia, China and India, and selfing and purification of these lines began for future genetic studies. At HAU, China a preliminary experiment was conducted to assess marker techniques for genetic diversity analysis. Results indicated that SRAP (sequence-related amplified polymorphism) are distributed on all 19 chromosomes of *B. napus* more equally than AFLP and the technique is more efficient than SSR, so SRAP and SSR markers will be used to evaluate the genetic diversity of all *B. napus* and *B. juncea* lines. At PAU, India DNA isolation from all the *B. juncea* genotypes has also been completed.

During 2005 significant progress was made towards the objective of increasing the scientific skills of scientists collaborating in the project through scientific exchanges. Dr Abha Agnihotri, Dr Dhiraj Singh and Dr Surinder Banga visited Australia in 2005 for a scientific interaction/study program. Dr Maharaj Singh (NRCRM, Bharatpur) also visited Australia from Sep to Dec 2005 for training, conducting a drought tolerance project supervised by Dr Rob Norton (University of Melbourne) at DPI Horsham.

Dr Martin Barbetti and Dr Caixia Li attended the International Sclerotinia Workshop in California in June 2005. Following this workshop, Dr Li visited Huazhong Agricultural University and Wuhan Oil Crops Research Institute, China, where she met with oilseed brassica scientists working on this ACIAR project and, in particular, had the opportunity to assess and develop common approaches on study of sclerotinia disease.

CIM/1999/094: Improving the productivity and sustainability of rainfed farming systems for the western Loess Plateau of Gansu Province

Overseas Collaborating Countries	China
Commissioned Organisation	University of Adelaide, Department of Agronomy and Farming Systems, Australia
Project Leader	Dr Bill Bellotti Phone: 08 8303 7728 Fax: 08 8303 7979 Email: william.bellotti@adelaide.edu.au
Collaborating Institutions	NSW Department of Primary Industries, Australia Gansu Grassland Ecological Research Institute, China Gansu Agricultural University, China CSIRO Sustainable Ecosystems, Australia
Project Budget	\$1,572,659
Project Duration	01/01/2001 to 31/12/2006 (Project extended from 01/01/2005 to 31/12/2006)
ACIAR Research Program Manager	Dr Paul Fox

Project background and objectives

On China's Loess Plateau a unique combination of slope, soil type, rainfall intensity, and inappropriate agricultural practices has resulted in some of the worst soil erosion in the world. The dominant farming system is a winter wheat monoculture that includes a three-month fallow during the high-intensity summer rainfall season. The high rate of erosion is the major cause of heavy sedimentation of the Yellow River. Conservation tillage has much to offer in reducing soil erosion and increasing crop productivity. Replacement of summer fallow with either short season legume crops, or developing rotations around perennial forage crops such as lucerne, also has great potential to reduce erosion and increase whole rotation productivity.

In Australia some farmers using conservation tillage complain of poor vigour of crops. One contributing factor to this is the changed spectrum of disease organisms that can develop in response to changes in tillage and stubble management. There is also strong interest in the use of legumes in cropping systems. Developments in system simulation provide a new and powerful tool for analysis and interpretation of rotation experiments and rotations practised on farm.

Through this project researchers are working to alleviate poverty in some of the poorest areas in China by introducing conservation tillage. This will also protect land and water resources through conservation tillage and legume–cereal rotations.

Project progress

Year 5 (01/01/2005–31/12/2005)

Project activity centred around two areas in 2005—the conduct of on-farm research and publication of research results from the previous four years. Good progress was made on both fronts. In addition, the conservation tillage experiments established earlier in the project were maintained using non-project resources.

1. On-farm research

Following training workshops in December 2004 and March 2005, a program of on-farm research (OFR) was begun in 2005 at Dingxi and Xifeng. At both locations the aim of the OFR was to compare a system of conservation tillage (stubble retention and no-tillage) with conventional farmer practice. In 2005 the main objectives were to evaluate the implementation of OFR under Chinese conditions and to set up soil and stubble conditions in farmers' fields for the 2006 growing season. Two Australian Youth Ambassador positions were assigned to the OFR component of the project in 2005.

2. Publication of project research results

A publication plan outlining eight scientific journal papers was accepted by project staff in 2005. This plan outlines how the key papers arising from the research will be published. While it is possible that additional papers may be published, it is important that the key papers in the plan are not compromised by ad hoc publications. The first paper in the plan, 'Lucerne-wheat rotations on the Loess plateau', was due to be submitted in February 2006 but will be actually submitted in April 2006. The next two papers in the plan will present the main results from the conservation tillage experiments at Dingxi and Xifeng. These papers are planned to be submitted in August 2006 and good progress is being made.

3. Continuation of long-term conservation tillage experiments

The two long-term CT experiments at Dingxi and Xifeng will be maintained with non-project resources from 2005 onwards. The transition from ACIAR to non-ACIAR funds appears to have gone smoothly. The experiments continued to be well maintained during 2005. At Dingxi, the NTS (no-tillage, stubble retained) treatment continues to yield higher than the conventional tillage (T) treatment. At Xifeng there were no significant differences between treatments, confirming earlier trends.

CIM/2000/035: Increased productivity of cool season pulses in rain-fed agricultural systems of China and Australia

Overseas Collaborating Countries	China
Commissioned Organisation	Department of Primary Industries, Victoria, Victorian Institute for Dryland Agriculture, Australia
Project Leader	Dr Robert Redden Phone: 03 53622151 Fax: 03 53622354 Email: bob.redden@dpi.vic.gov.au
Collaborating Institutions	NSW Department of Primary Industries, Australia Qinghai Academy of Agricultural and Forestry Science, China University of Melbourne, Australia University of Adelaide, Australia Hebei Institute of Cool Season Crops, China Institute for Crop Germplasm Resources, China Yunnan Academy of Agricultural Sciences, China
Project Budget	\$1,127,527
Project Duration	01/07/2003 to 30/06/2007
ACIAR Research Program Manager	Dr Paul Fox

Project background and objectives

The rain-fed dry areas of central western China are amongst the poorest in the country. For the people living in these areas sources of animal protein are expensive. The main dietary intake of protein comes from food legumes. Research into this area, however, has been limited, with a focus on cereal crops. Improved pulse varieties are displacing low quality wheat in recognition of increased market values placed on pulses. The role of pulses as both an important food source and a cash crop will become more vital as China's population increases. Estimates place this rise as high as 250 million people. Unfortunately there is no matching scope to increase the area of land under cultivation. Already cultivated land in western China is close to capacity, as well as often being degraded and low in fertility. Increased uptake of food legumes could benefit the farming systems used, increasing soil nitrogen and crop outputs.

Previous ACIAR-supported research has helped improve germplasm disease resistance and some agronomic traits for improved faba bean varieties. With food legumes of lesser importance than cereal crops, research into pulses such as faba and field peas has been minimal. Twenty per cent adoption of pulses in western China is expected once the improved disease resistance and frost tolerance varieties are released. These varieties are expected to provide a 20–30 per cent yield gain per hectare over current varieties, at no extra cost to the farmer. In addition, Chinese farmers may also obtain up to 30 per cent saving in nitrogen (N) fertiliser inputs to subsequent cereal crops. If these yield increases and cost reductions are realised, this would translate into improved incomes.

The genetic improvement of pea and faba bean crops in China and Australia is being undertaken through this project.

Project progress

Year 3 (01/07/2005–30/06/2006)

This project made progress in 2005–06, year 3 of the project, towards germplasm evaluation in both Australia and China, improvement of pea and faba bean breeding programs in China, introgression of Australian elite lines with drought tolerance and disease resistance traits into respective breeding programs in China, and molecular finger-printing of pea and faba bean landraces and elite lines for a comparison of gene pools and association mapping of markers with key phenotypic traits.

A joint China–Australia review of project progress was held in Yunnan in February 2006. This forum discussed project activities in each of the target provinces Yunnan and Qinghai, and Bashang county in Hebei, and planned project activities for 2006–07.

Goal 1. The collection and exchange of pea and faba bean germplasm. This was completed. In previous years ATFCC had supplied China with pea germplasm of a core collection of 210 accessions, 44 vegetable pea varieties, 111 wild relatives and 247 elite breeding lines, and for faba bean 44 elite lines from Australian breeders. China provided Australia with a pea core collection of 289 accessions representing geographically diverse origins, 56 pea and 64 faba bean landraces collected from Yunnan and Qinghai provinces, plus 30 pea breeding lines and nine faba bean breeding lines from Yunnan. Australian quarantine released them to the program in Australia over 2005–06. They are currently under further seed multiplication by ATFCC and faba bean programs at DPI NSW and University of Adelaide. Those accessions with a good supply of seed from quarantine are now in the ATFCC Base collection for long term conservation. A phenotypic comparison of both the Australian and Chinese germplasm will be made in both countries, for abiotic stress (salinity and frost tolerance), phenologic, biomass and yield expressions.

Goal 2, Improvement of pea and faba bean breeding programs in China.

Elite pea breeding lines and pea germplasm from Australia (total 650) were assessed in 2005 in each target region for use as parents and for placement in 2006 yield trials, with 37 lines selected for yield potential in Qinghai and 18 in Yunnan. Evaluation for disease reaction in Yunnan identified 29 pea lines for resistance to powdery mildew, and many elite lines for rust resistance—a disease currently not in Australia—and also for tolerance to reproductive frost, 50 germplasm each of pea and faba bean were assessed at different altitudes in Qinghai.

A field trial for an agronomic comparison of the ATFCC and Chinese pea core collections for locations in Qinghai, Bashang, Yunnan and Horsham Australia was designed and sown, except for Yunnan where it will be sown in November 2006. These core collections are also being compared for tolerance to salinity in a semi-controlled environment at Horsham.

DPI NSW assessed newly collected faba bean landraces for reaction to Bean Leaf Roll Virus with one out of 18 lines promising as a new source of resistance, and by University of Adelaide for reaction to *Aschochyta* with 50% promising as sources of resistance. These landraces also had lines resistant to rust and partial resistance to Bean Yellow Mosaic Virus. DPI NSW evaluated 32 pea landraces from Yunnan for reaction to Pea Seed Borne Virus, with six completely free. Confirmation trials for expressions of resistance are in progress in 2006. Shuttle breeding of two generations per year continued, with the Yunnan pea and faba bean breeding programs gaining an extra generation per year with an off-season nursery in Bashang, Hebei.

Goal 3. Molecular characterisation.

The characterisation of pea germplasm with 24 unique single band polymorphic markers was completed in 2005/6. The materials included 1200 Chinese landraces chosen to represent geographic diversity in the Chinese pea germplasm, 650 lines from Australia including the ATFCC core collection, elite breeding lines, vegetable peas and wild relatives, and nearly 300 additional varieties and breeding lines from other countries. The gels have all been rated, with a small number of analyses repeated. The 1200 Chinese landraces with geographic diversity will be reduced to a core set of 300, representing genetic diversity based on SSR diversity. The composition of this core will be compared with the geographic core of 298 Chinese landraces based on geographic diversity alone, which was also forwarded to Australia.

For faba bean AFLP analyses are mostly completed on 700–800 landraces from the Chinese germplasm and the elite breeding lines from Australia and China. Zong Xuxiao will undertake combined analyses of molecular and phenotypic diversity at University of Melbourne in October 2006. There is obvious scope to combine molecular and phenotypic data for association with genotype x environment interactions, and to initiate gene discovery for expressions associated with drought stress and specific abiotic stresses.

Goal 4. Training of Chinese staff.

In 2005–06 there were no visits of Chinese staff to Australia. In China, Mr He Chenbang of Qinghai, who visited Horsham in the previous year, began studies for an MSc at the CAAS Graduate School in Beijing. There were four visits of Australian staff to China, including the review/planning meeting held in Yunnan in February 2006, where three staff from Australia attended, and one came for the mid-term review in July 2005.

Goal 5. Production of a handbook for pea and faba bean diseases in China.

Photography and collation of photographs continued. This goal is on-target for production of 1000 handbooks (in Chinese only) in 2006–07.

CIM/2000/038: Use and improvement of sugarcane germplasm

Overseas Collaborating Countries	China
Commissioned Organisation	CSIRO Plant Industry, Australia
Project Leader	Dr Phillip Jackson Phone: 07 4753 8592 Fax: 07 4753 8600 Email: phillip.jackson@csiro.au
Collaborating Institutions	Yunnan Sugar Research Institute, China Bureau of Sugar Experiment Stations, Australia Guangzhou Sugarcane Industry Research Institute, China CSR, Australia
Project Budget	\$1,411,755
Project Duration	01/07/2002 to 30/06/2007
ACIAR Research Program Manager	Dr Paul Fox

Project background and objectives

The sugarcane industry is large and economically important in southern China, where sugarcane is currently the second most important crop and its relative importance is expected to rise in the future. Sugarcane industries continue to rely heavily on development of new and more productive varieties to maintain industry viability in increasingly competitive world markets. Sugar industries have invested heavily in breeding programs in the past to maintain a steady flow of more productive varieties. However, parent clones within industry breeding programs around the world trace back to the same relatively small number of key ancestors.

This small sample of genetic diversity in breeding programs, combined with an awareness that there are many desirable traits in exotic sugarcane-related germplasm, has led to strong interest in introgression of new sources of germplasm in breeding programs in Australia and China. In China, large-scale collection of sugarcane-related germplasm from the wild, especially from southwest China, occurred during the 1980s and 1990s, and most of this material is now housed in collections. Chinese and Australian sugarcane breeders expect that many of these clones will contain individual traits and genes of commercial value if these could be identified and recombined in other agronomically suitable genetic backgrounds.

This project is providing more productive sugarcane varieties to growers and sugar industries in China and Australia by assessing genetic diversity in sugarcane germplasm collections and using wild germplasm to develop improved sugarcane clones.

Project progress

Year 4 (01/07/2005–30/06/2006)

The project is proceeding in five linked activity areas, corresponding to each of the five objectives. Progress in these are summarised briefly below.

(i) To assess genetic diversity in germplasm collections and select a core set of clones for future breeding

Data collation needed to characterise genetic relationships among germplasm collected from China and other parts of the world is complete. A paper on characterisation of the diversity within *S. spontaneum* was presented at the ISSCT Sugarcane Breeding and Germplasm conference in Ecuador in May 2006. A manuscript for submission to a journal on these data is also being prepared. In summary, the results highlighted extremely high genetic diversity within *S. spontaneum* (in relation to *S. officinarum* and commercial sugarcane), and also showed two general groupings corresponding to clones collected in Southern India and Indonesia on the one hand, and northern India and China on the other.

A manuscript on characterisation of the genetic diversity within *Erianthus arundinaceus* is still in the early stages. As indicated in the previous annual report, the results from the *Erianthus* study showed that the Chinese representatives of this species are genetically diverse compared with material in the Australian collection; the latter material being mostly sourced from Indonesia. Within China, there is a clear general difference between clones collected in eastern versus western regions. A paper on the relationship of the Chinese species *E. rockii* in relation to other species in the *Saccharum* genus was published.

Following an agreement for exchange of basic germplasm clones between China (YSRI) and Australia (BSES–CSIRO) made in 2004, a selection of clones for exchange has been made and these have been placed in quarantine.

(ii) To develop improved clones derived from wild germplasm

As indicated previously this component has successfully produced a wide range of clones derived from wild germplasm, which are now being further evaluated and used within sugarcane breeding programs in China and Australia. This includes the first reports in the world of introgression of *Erianthus* spp. into sugarcane, which opens up new diversity to sugarcane breeding programs.

Field trials in China and Australia to evaluate progeny from *S. officinarum*/commercial sugarcane x *S. spontaneum* developed in this project were sampled and measured in 2006. These experiments have been successful, and the better clones from these trials will be evaluated further and used in further crosses with elite sugarcane parents. High correlations between families in the trials in Australia and China for stalk weight and sucrose content were observed—an important result. Apart from being the first report of genetic x country interactions in sugarcane, it also indicates that selection trial results in either country will be useful for predicting performance in the other, and has important implications for planning further cooperation to maximise mutual benefits from joint exploitation of the germplasm resources generated in this project in future years.

The evaluation, further breeding, and commercial extension of progeny from this component is required to realise commercial and social benefits from the success achieved in this area in the project. In both China and Australia, there is rapidly emerging interest in producing energy sources (especially ethanol) from sugarcane—especially in China, where it is emerging as a major national goal, for economic, environmental and national security reasons. Possible characteristics of some clones developed in this project (high dry matter yields, drought tolerance, strong ratooning ability, and other traits) may offer significant opportunities in this regard. Further discussions within the project team and with other parties will occur soon in relation to this, aiming to establish if any mutually beneficial R&D opportunities exist. It is worth noting that many poor regions in western China could benefit strongly from the emerging opportunities to produce ethanol from crops.

(iii) To evaluate DNA marker assisted introgression of exotic germplasm in sugarcane improvement
This component aims to assess and develop methods for marker assisted introgression in sugarcane through several case study breeding populations. Populations have been produced in prior years and were successfully established in replicated field trials in Yunnan, Guangzhou and Australia in 2004–05. In Yunnan, two populations derived from a *S. spontaneum* clone are being grown. One of these populations is also being evaluated in Australia. In Guangzhou, two populations derived from an *Erianthus arundinaceus* clone are being evaluated.

These populations were sampled in November to December, 2005, in China, and in July 2006 in Australia. Analysis of the results from China indicate that the data obtained are of good quality (high broad-sense heritabilities for key traits) and will provide a good basis for subsequent QTL analysis when collection of marker data is completed in 2007. Results from the Australian sampled trial are still being processed at the time of writing this report. Marker characterisation on these populations is well under way in YSRI and GSIRI, and will shortly commence in CSIRO.

(iv) To undertake GxE studies between China and Australia
Following transfer through quarantine, and two cycles of propagation in previous years in the project, clones selected for this component of the project were successfully established in five field trials in China in early 2006. The same clones were previously evaluated extensively in Australia. Comparison of results (to be obtained next year) will provide information about the usefulness of data collected in both countries for predicting performance in the other.

(v) To develop capability in YSRI and GSIRI in application of molecular marker technology and sugarcane breeding
As indicated in prior annual reports, molecular marker laboratories at both YSRI and GSIRI have been developed with assistance from Australian staff in this project, with both micro-satellite (SSR) and AFLP markers being run. Staff in China also received training in in-situ hybridisation methodology.

CIM/2002/093: Intensifying production of grain and fodder in Central Tibet farming systems

Overseas Collaborating Countries	China
Commissioned Organisation	University of Adelaide, Department of Agronomy and Farming Systems, Australia
Project Leader	Professor David Coventry Phone: 08 8303-7954 , 0417874534 Fax: 08 8303-7979 Email: david.coventry@adelaide.edu.au
Collaborating Institutions	Tibet Agricultural Research Institute, China
Project Budget	\$522,702
Project Duration	01/01/2004 to 31/12/2007 (Project extended from 01/07/2006 to 31/12/2007)
ACIAR Research Program Manager	Dr Paul Fox

Project background and objectives

Agriculture in the central area of Tibet Autonomous Region is mainly conducted on the floors and lower slopes of river valleys. Soils are fertile and average rainfall, mostly falling between July and October, sufficient to support cropping. Barley, wheat, rapeseed, faba bean, maize, vegetables, potato and fodder crops are all grown. The high altitude of the cropping zone means growing periods are characterised by high sunshine intensity and large divergence between daytime and night time temperatures. These characteristics require specific management practices for cropping. Current levels of grain production are close to achieving self-sufficiency but need to be further improved as importing of grain to so remote a region is costly. This shortfall in production also means that livestock are grazed on open grasslands rather than on more beneficial fodder. Livestock production is also a very important component of agriculture in Tibet Autonomous Region. Animal rearing provides opportunities for additional cash incomes, but growth rates are hampered by grassland grazing being the main form of fattening, rather than feeding using fodder crops. This poor nutrition remains an impediment to increased growth, restricting possible cash returns.

Intensifying overall cropping, both of grain and fodder production will result in improvements through the whole system, bringing cereal self-sufficiency closer and improving animal growth to allow access to income from their sale. This project is optimising the use of resources in cropping for the production of both food-grain crops and fodder crops in central Tibet, through careful matching of crop types to the agro-climatic environment.

Project progress

Year 2 (01/01/2005-31/12/2005)

The present project has three major objectives:

- i) to develop understanding of the agro-climatic environment and farmer practice in Central Tibet;*
- ii) to develop more intensive cropping systems delivering adequate food production and more fodder in Tibet;*
- iii) to strengthen the capacity of the project's Tibetan scientists to conduct agronomic research.*

During 2005, progress was again achieved against all of these objectives, with work particularly focused on the training of Tibet Agricultural Research Institute (TARI) staff and on intercropping research in Tibet and Australia. Two TARI staff members travelled to Australia (March–May) for 12 weeks training at the Roseworthy Campus of The University of Adelaide. As in 2004, training focused on spoken and written English development, research methodology and research writing. This now brings the number of TARI staff trained in Adelaide to five. The experience and skill of this core group of researchers will be fundamental to TARI's future efforts in participatory agricultural research in Tibet.

This year also saw an expansion of the project's research program in Tibet, with the Australian Research Officer travelling to Tibet for a further 12 weeks to help manage and analyse existing intercropping experiments. Experiments targeted the identification of optimal planting densities and sowing dates for intercrops of winter cereal (wheat or barley) with fodder legumes (vetch and lucerne). For these studies, winter cereals had been sown in late 2004 (the Tibetan autumn) at a range of different densities, with fodder legumes sown in inter-row spaces at different times during June and July this year (the Tibetan summer).

Data were then collected on cereal yields at time of cereal harvest (July–August) and on fodder production during the August–September period. While a number of problems were encountered in the work (for example, with heavy weed burdens, the harvest of fodder by stray livestock and unseasonably dry conditions at legume sowing times), results from the 2005 harvest were nonetheless encouraging. Where cereal establishment was good, satisfactory grain yields (around 5 tonnes/ha) could still be obtained at lower sowing densities in the presence of intercrop fodder plants. In addition, fodder yields around half those of pure fodder stands were produced via 50% fodder intercrops, with vetch producing approximately twice the dry matter of lucerne in the 6 months following establishment. Analysis of vetch sowing time data suggested that sowing vetch in early rather than late July is very advantageous from the perspective of fodder production. Although these results are preliminary, they suggest the intercropping system to have excellent productive potential in Tibet.

Other important activities undertaken in Tibet this year included ongoing involvement of project staff in FAO's fodder double crop research and extension work, and the establishment of further density and sowing time experiments for the 2005–2006 experimental season.

The Australian side of the project also saw significant progress during 2005, with further experiments conducted to examine the performance of two commonly grown Australian wheat varieties, Wyalkatchem and Frame, at different sowing densities, row arrangements and with different levels of available water and nitrogen. As in 2004, these experiments were conducted in part as a training exercise for the visiting Tibetans, but still yielded valuable information on the way morphologically distinct varieties perform at different row spacings and under different conditions of resource availability. Work was also done to multiply seed of 15 pigeon pea cultivars imported from India and to examine the suitability of pigeon pea for use as a perennial intercrop in southern Australian conditions. This work is ongoing, but first year results show pigeon pea plants established in 2004 to have survived and thrived during 2005. Data on pigeon pea fodder and grain production will be collected during 2006.

FST/1999/095: Improving the value chain for plantation-grown eucalypt sawn wood in China, Vietnam and Australia: Genetics and silviculture

Overseas Collaborating Countries	China, Vietnam
Commissioned Organisation	State Forests of New South Wales, Tree Improvement, Australia
Project Leader	Mr Michael Henson Phone: 02 6650 5703 Fax: 02 6651 5027 Email: michaelhe@sf.nsw.gov.au
Collaborating Institutions	Guangxi Forest Research Institute, China China Eucalypt Research Centre, China Queensland Department of Primary Industries and Fisheries, Australia Hunan Provincial Forestry Department, China Chinese Academy of Forestry, China Forest Science Institute of Vietnam, Vietnam
Project Budget	\$682,611
Project Duration	01/07/2005 to 30/06/2009
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

Global demand for high-value hardwood timber is growing. There are two available sources of supply; native forests and plantations. Supply from native forests is under increased pressure, with less available areas for logging and a greater emphasis on conservation. This diminishing number of native forests has seen a rise in plantations of short-rotation hardwood species.

One of the limitations in growing short-rotation plantations is the difference in timber quality. Native forests take longer to mature, resulting in bigger and more robust log sizes that stand up to the stresses of sawing and processing. Plantation-derived logs have smaller diameters making them more prone to splitting, bending and curving during processing and sawing. Many plantations provide wood as a source of short fibre pulp and increasingly as a replacement for native forest products when this timber is in short supply.

In China, Vietnam and Australia an increased emphasis on conservation has contributed to reduced logging of native forests. This has increased the use of plantation timber in processing. Improving the usability of this young timber depends on understanding the impacts of growth stresses on wood properties and how these contribute to problems in sawing and processing. Such an understanding would help in guiding the choice of eucalypts suitable for short-rotation use and in the silvicultural management of these species.

Improve the economic returns to growers and processors from eucalypt plantations by developing and implementing silvicultural and genetic strategies to optimise yields of high-quality timber from eucalypt plantations in China, Vietnam and Australia by improving wood properties.

Project progress

Year 1 (01/07/2005–30/06/2006)

The joint FST/1999/95 and FST/2001/21 project inception meeting was held in Zhanjiang, Guangdong, China in December 2006. It was held over two days to coincide with the ITTO/IUFRO meeting 'International Conference on Plantation Eucalyptus: Challenge in Product Development'. The meeting was attended by 34 people representing project partners and other interested stakeholders.

The meeting served two purposes:

- Updating the current state of knowledge: each project partner made presentations of their current research and development, as well as advancements in technologies for assessing wood quality.
- Detailed planning of project trial assessments and identification of training needs in each of the partner organisations.

After the inception meeting project partners were trained in two non-destructive wood property assessment techniques in a clonal trial in Dongmen Forestry Farm. A total of 61 trees representing 15 clones were assessed in the trial. The historical growth data along with this wood quality data were analysed to benchmark the single clone represented in Dongmen Experiment 84, a spacing and fertiliser trial that is the focus of the project's first main detailed wood quality assessment in China planned for September 2006. In support of the planned assessment Guangxi Forestry Research Institute and Dongmen Forestry Farm assessed growth and form in Experiment 84. These data were analysed and used to identify trees that will be sampled in the future wood quality assessment. At the inception meeting the private pulp and paper company Stora Enso Forestry Guangxi agreed to support the project by providing pulp wood assessment of trees harvested in trials E73 and E84. This will enable the project to evaluate the impact of silviculture on pulp wood production and quality in addition to the projects focus on solid wood.

Project work in Australia kicked off with the assessment of a *Eucalyptus pilularis* progeny trial, with support from Australia's Forest and Wood Products Research and Development Corporation (supporting drying and wood chemistry evaluation) and the CRC for Forestry (supporting molecular genetic work) the study will be the most comprehensive study into the genetic control of wood properties of *Eucalyptus* completed to date. Standing tree assessment of the trial was completed in June 2006 after approximately 9 months of field work. This project provided the opportunity to train two Chinese scientists in non-destructive techniques for the assessment of wood properties.

Dang Phouc Dai—a project scientist from Vietnam—was awarded a John Allwright Fellowship to study for a PhD at Southern Cross University. His studies will be on genetic variation in growth and wood properties in *Eucalyptus pellita* in Vietnam and Australia. Li Bohai, Chen Shaoxiong and Luo Jianzhong, all key members of the project team in China, will study for PhDs in Chinese universities. Their studies will directly be related to the project's activities and goals.

FST/2001/021: Improving the value chain for plantation-grown eucalypt sawn wood in China, Vietnam and Australia: sawing and drying

Overseas Collaborating Countries	China, Vietnam
Commissioned Organisation	CSIRO Forestry and Forest Products, Australia
Project Leader	Dr Russell Washusen Phone: 03 9545 2173 Fax: 03 9545 2133 Email: russell.washusen@ensisjv.com
Collaborating Institutions	Forest Science Institute of Vietnam, Vietnam China Eucalypt Research Centre, China
Project Budget	\$519,932
Project Duration	01/07/2005 to 30/06/2009
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

Traditional wood processing industries have utilised native forests for timber. As a result the industries in China and Vietnam, as elsewhere, have evolved processes for wood sawing that match the timber's used.

Increasing demand for timber has placed the burden of production on native forests, many of which are now in decline. Harvest restrictions are now being applied in China and Vietnam, limiting timber production from native forests. With these restrictions have come pressures on employment and a greater reliance on timber importation, creating trade imbalances.

A solution is planting eucalypts, together with other species as part of reforestation programs. Eucalypts primarily supply raw material for large industries: pulp and paper, fibreboard and chipping. Small-scale use in traditional industries is also undertaken, such as for furniture and joinery. Mainly small diameter (less than 30 cm) are used, but growth stresses are released when these are sawn using traditional approaches, splitting logs and rendering them useless. Such constraints and tendency of plantation-grown eucalypt wood to distort have discouraged use. The project objectives were to:

- improve the efficiency of processing of small diameter plantation grown eucalypt logs for solid wood products,
- increase returns to plantation growers;
- assist in the development of viable rural industries in China, Vietnam and Australia.

Project progress

Year 1 (01/07/2005–30/06/2006)

The project FST/2001/021 officially commenced with a joint inception meeting with FST/1999/095 in Zhanjiang, Guangdong Province, China in November 2005. These two ACIAR projects are closely linked using the same plantations and timeframe for research.

The inception meeting was conducted immediately after the IUFRO/ITTO 'International Conference on Plantation Eucalyptus—Challenge in Product Development' held in Zhanjiang. This conference was held as a final reporting session for a large ITTO project to develop processing of eucalypts in China. The inception meeting was attended by representatives of Ensis, CERC, FSIV, University of Melbourne, Queensland Department of Primary Industries, Forestry Tasmania, Forests NSW, Stora Enso, Guangxi Forestry Research Institute, Guangxi Dongmen Forest Farm, Hunan Provincial Department and Beijing University. The inception meeting identified/confirmed (partly through the experience of the ITTO Project) the technological limitations in sawmilling and wood-drying systems in both China and Vietnam that was recognised during project development. These identified limitations highlighted the importance of introducing or developing suitable technology and developing tree growing and processing skills in China and Vietnam.

Ensis attempted to overcome the deficiency in sawmilling technology with the assistance of Karasaw Australia. This assistance was additional collaboration unforeseen during project development. Karasaw Australia supply equipment in Australia that has been developed by Kallion Konepaja Oy (Kara) in Finland. Scientists from China were invited to Brisbane, Australia to inspect potential technology that may be introduced into China and Vietnam to develop small-scale sawmilling industries processing small diameter eucalypt logs from farm-based woodlots. Vietnamese and Chinese scientists also participated in trials processing 15–25 cm diameter *Eucalyptus fastigata* logs at the Timber Training Centre, Creswick, Victoria to test the suitability of a Kara PPS 500 multi-saw system imported into Australia from Finland. The trials indicated that the system may potentially meet this need with modification of the saws and mill design. Karasaw Australia is currently modifying the mill for potential processing of small diameter eucalypts in small regionally based sawmills in Australia, China and Vietnam.

In April 2006, five scientists from China and Vietnam attended a training session at the Timber Training Centre in Creswick, Victoria to train/upgrade skills in eucalypt timber sawing and wood drying, and were introduced to processing research procedures. While in Australia the scientists visited the University of Melbourne's Centre for Advanced Wood Processing and the CRC-Wood Innovations and were introduced to the microwave pre-treatment technology in solid wood processing. They also visited industrial sites in Victoria and New South Wales and intensively managed eucalypt farm forests in southern and northern Victoria.

In June–July 2006 the first of the larger scale processing trials were conducted in collaboration with Forests NSW and N.F. McDonnell & Sons in Victoria. This trial used four provenances of *E. nitens* with measured peripheral growth strain levels to assess the potential for a HewSaw R250 (or similar technology) to process eucalypts with a range of growth strain levels, and the potential for genetic improvement in resources developed for this processing technology. The HewSaw R250 is one of a number of sawing machines developed by the Viesto Group that applies chippers and saws in modern sawmill designs with potential to alleviate stresses that cause processing difficulties in eucalypts. Unlike the Kara PPS 500 the HewSaw R250 is a high throughput mill suitable for large scale industrial processing.

Assessment of the SilviScan technology in application for improvement in eucalypt resources for solid wood processing end uses has largely been completed. This work included an assessment of wood microstructure in a University of Melbourne, School of Forestry and Ecosystem Science *Eucalyptus globulus* silvicultural trial located in eastern Victoria. The effect of thinning and fertiliser application on wood microstructure was assessed and processing trials conducted in trees that represented the range in the variation found. Two draft reports have been prepared and two papers published in Wood Science and Technology and the proceedings of the IUFRO/ITTO Conference held in Zhanjiang.

FST/2001/086: Assessment of the potential of *Pinus radiata* for ecological restoration of the Yangtze River catchment in Aba Prefecture, Sichuan, China

Overseas Collaborating Countries	China
Commissioned Organisation	State Forests of New South Wales, Forest Research and Development Division, Australia
Project Leader	Dr Hui-quan Bi Phone: 02 9872 0168 Fax: 02 9871 6941 Email: huiquanb@sf.nsw.gov.au
Collaborating Institutions	Chinese Academy of Forestry, China Sichuan Forestry Academy, China Aba Forest Research Institute, China
Project Budget	\$150,090
Project Duration	01/07/2002 to 30/06/2007 (Project extended from 01/07/2004 to 30/06/2007)
ACIAR Research Program Manager	Dr Russell Haines

Project background and objectives

Severe erosion has contributed to massive flooding and excessive sedimentation on a number of catchments in China, particularly the upper catchment of the Yangtze River in Sichuan. Due to the extreme site degradation and the harsh, dry climate of much of the upper Yangtze catchment re-establishment of the natural forest and native species has been problematic, and the Chinese have tested a range of exotic tree species for their suitability as protection forests. *Pinus radiata*, a conifer widely used in Australia in commercial plantation, holds promise.

This project is deploying Australian expertise, in collaboration with Chinese scientists, to aid the introduction and testing of a better range of *P. radiata* germplasm in the Yangtze catchment. The biological risks of establishing the species in such a new environment are being assessed as is developing nursery, field and data management technologies to support the large expansion of plantings planned for *P. radiata*.

Project progress

Year 4 (01/07/2005–30/06/2006)

(1) *Assess the forest health risks to the long term success of *P. radiata* introduction in Aba*
After field inspections and assessments in 2004–2005 by both Australian and Chinese forest entomologists and pathologists, a forest health monitoring program was put in place. Over the 2005–2006 reporting period, forest health survey and assessments were conducted twice for the widely separated small plantations established for environmental purposes. Pest and pathogen species and their levels of infestation were recorded to evaluate the gradual loading of indigenous pests and diseases onto the newly introduced exotic species and detect early signs of pest or disease attack.

At the same time, the forest health literature on *P. radiata* and other *Pinus* species in China have been reviewed to identify both indigenous and exotic pathogens and pests that pose a potential threat to the long term success of *P. radiata* introduction. The full text of scientific papers, published and unpublished reports from various sources was read to extract relevant information. Historical records of pest and disease outbreaks in the coniferous forests of Aba prefecture and that of past forest health surveys in the area were examined in relation to the project objectives. Information was also gathered from personal communications with other forest health experts. This broad forest health literature and information review served as a good basis for the assessment of forest health risks to the long-term success of the species introduction in the dry river valley area.

Forest health information from the comprehensive review, field surveys and inspections in 2004–2005 and subsequent forest health monitoring was evaluated and analysed to produce a list of indigenous and exotic pathogens and pests that pose a potential threat to the long-term success of *P. radiata* introduction in the dry river valley area. For each pathogen or pest on the list the likelihood of an attack and the impact of the possible attack over the foreseeable future were rated as low, medium or high, based on the best available information and expert knowledge. Where both the likelihood of an attack and its impact are uncertain, it was marked as a gap of information to be filled by future investigations. A report on forest health risks to the long term success of *Pinus radiata* introduction in the dry river valley area is being prepared.

(2) Integrate site, climatic information and knowledge on growth performances elsewhere in the world through climate modelling to identify suitable areas for environmental plantings of P. radiata in southwest China in general and in the dry river valley area in particular

Our work on climate modelling has resulted in a scientific paper being accepted for publication in the international journal, Forest Ecology and Management. This paper describes a new climatic profile for *P. radiata* that identifies summer rainfall areas in southwest China where the species may be suitable for environmental planting on degraded lands to reduce soil erosion. The new climatic profile delineates the climatic requirements of *P. radiata* through six climatic factors. It includes the absolute minimum temperature as a measure of frost risk in the continental climatic environment and also has lower temperature and rainfall limits than profiles previously developed for commercial plantations. Digital elevation models are developed at both regional and national scales to provide a surrogate of the three-dimensional geographic space of the target area for the spatial interpolation of climatic data. Areas with climatic conditions that match the new climatic profile are mapped using ArcInfo GIS. A chi-square statistic is used to evaluate the influence of each climate variable in the profile in determining the spatial limit of the mapped area.

At the national scale, a climatically suitable area of more than 266 000km² across three provinces in southwest China is identified. Mean maximum temperature of the hottest month and the length of dry season appear to be the major factors limiting the spatial extent of matched areas at this broad scale. The results of climate matching for the Minjiang dry valley area in particular correspond well with the growth performance of experimental plantings in the field. At this regional scale, mean annual precipitation and mean minimum temperature of the coldest month are the major factors constraining the spatial extent of climatically suitable areas. The mapped areas can help define the working limits and serve as indicative zones for environmental plantings of *P. radiata* aimed at reducing soil erosion in southwest China. They will also enhance our understanding of the fundamental climatic niche and the potential geographical range of *P. radiata*.

(3) Establish a provenance experiment to systematically evaluate provenance performances over different sites in Aba

Following the successful establishment of the provenance experiment over three sites in 2004–2005, the maintenance of the three experimental sites became the major task over the reporting period of 2005–2006. Silvicultural treatments to control weeds and aid the early establishment of the planted seedlings were applied twice a year to each site, and survival and growth of seedlings assessed in late 2005. Individual seedlings were coded, tagged and mapped for all three experimental sites over a period of three months. The experimental sites were inspected at least twice a year to detect potential pest and disease problems as a part of the forest health monitoring program. In addition, a temporary guarding station was set up to protect the experimental site at Mao Xiao from animal browsing.

(4) Provide training to improve nursery techniques, methods of mycorrhiza inoculation, forest health assessment and stand management skills

The project component was successfully completed during the last reporting period.

(5) Develop and transfer technology such as database systems that are routinely used in Australia

Not enough forest growth and experimental data have been accumulated for *Pinus radiata* to warrant the development of a database up till now. So no significant project activities have taken place over the reporting period of 2005–2006.

HORT/1998/140: Postharvest handling and disease control in melons in China and Australia

Overseas Collaborating Countries	China
Commissioned Organisation	University of Sydney, Australia
Project Leader	Dr Robyn McConchie Phone: 02 9351 4332 Fax: 02 9351 4172 Email: r.mcconchie@usyd.edu.au
Collaborating Institutions	China Agricultural University, China Sydney Postharvest Laboratory, Australia Gansu Agricultural University, China Xinjiang Department of Agriculture, China University of Queensland, Australia Xinjiang Agricultural University, China
Project Budget	\$966,252
Project Duration	01/01/2002 to 30/06/2007 (Project extended from 01/07/2005 to 30/06/2007)
ACIAR Research Program Manager	Mr Les Baxter

Project background and objectives

Melons are one of the most important cash crops grown in the northern-central and north-west provinces of China, accounting for a large percentage of many farmers' incomes. Cultivation of melons in the Xinjiang and Gansu provinces increased from 247,570 ha in 1995 to 311,500 ha in 1998, while the tonnage grew from 5 million to just over 6.5 million. The main markets for melons, however, are not local, but are in the eastern coast cities such as Beijing, Shanghai and Guangzhou, some 1500 km away. In China, little has been done to control postharvest diseases or maintain melon quality, so very high losses (35–50 per cent) have been recorded, particularly when melons are sent over these long distances. Consequently, prevention of postharvest disease and maintenance of melon quality during transport have become major problems for the farmers and wholesalers.

Past ACIAR-supported research of postharvest melon handling systems in China identified the major agents responsible for losses; cultivar susceptibility to disease, rough handling after harvest, inadequate packaging and temperature management, and long transport times. This also showed that significant control of postharvest diseases of melons in China was possible. With continuing pressure for the withdrawal of postharvest fungicides (benomyl is already withdrawn) and ongoing problems with quality maintenance, new options are needed. A range of novel treatments, including fungicides and chemicals which boost the natural defence mechanisms in plants, may help. In the earlier ACIAR project shelf-life of rockmelons was extended to three weeks which would enable them to be exported to the Hong Kong and Singapore markets by sea-freight. However, further work is required to assess the efficacy of compounds that elicit systemic resistance in melons, and to fine-tune application strategies in relation to environmental stressors such as heat- or water-stress.

This project is examining these to improve postharvest disease control, handling and market quality of melons and other cucurbits, and improve returns to growers in China and Australia.

Project progress

Year 4 (01/01/2005–31/12/2005)

A review of PHT/1998/140 was held in June 2005. The following is an abstract of the review report.

‘The project was clearly well conceived, managed and executed by the project research teams in China and Australia, and also by ACIAR staff from Canberra and Beijing. The research team members worked closely within and across countries. They generated a large amount of new and important information, much of which has already been collated and analysed, and is either published or about to be published.

The most obvious success of the project was development and extension of supply-chain relationships in China. Farmers in two melon-growing regions of China became acutely aware of marketing issues and their role and responsibility in meeting consumer needs and forging strong links and good relationships with other supply/value chain members. As a direct result of this project, the melon farmers from the Gansu site now work more closely together—adopted branding of their fruit, drafting quality management guidelines, and developing a (partial) cold chain. They now appreciate the importance of total quality management, particularly fruit and foliage disease control.

A further very tangible area of success for the project teams was development and/or demonstration of relatively novel and socio-environmentally sound postharvest disease management technologies, such as heat and iodine treatments and cool-chain benefits. These technologies were of great interest to both Chinese and Australian melon growers. One Australian melon grower has already installed an iodine-treatment plant. One group of Chinese growers, with potential support from Rotary (Australia), hope to build a pre-cooling facility and another is raising support to do likewise. The commercial benefits (in yield and fruit quality terms) of an effective integrated pre- and postharvest disease management strategy were demonstrated clearly by the research teams.

The ‘jewel in the crown’ of this project, however, is the parallel work conducted in China and Australia on treatments with environmentally benign chemical (e.g. Bion or BTH) and biological (e.g. biological extracts) elicitors of natural plant defence reactions. This research work has shown that elicitors can be used to reliably manage both leaf (viz. powdery mildew) and fruit (i.e. rot) of hami, honeydew and rockmelons. In addition to demonstrating the applied commercial efficacy of such treatments, the teams have elucidated the biochemical mechanisms involved. These include up-regulation of defence enzymes (e.g. chitinase) and structural defence compounds (viz. lignin).

An extension of 2 years (from July 05 to June 07) was recommended, sought and approved in December 2005. Research results were published and ongoing research continued during this approval period.

HORT/1999/081: Reducing spoilage and contamination risks of fresh vegetables in China and Australia

Overseas Collaborating Countries	China
Commissioned Organisation	Department of Primary Industries, Victoria, Institute for Horticultural Development, Australia
Project Leader	Dr Robert Holmes Phone: 03 92109222 Fax: 03 98003521 Email: robert.holmes@dpi.vic.gov.au
Collaborating Institutions	Food Science Australia, Australia Institute of Vegetables and Flowers, China China Agricultural University, China China National Green Food Industry Company, China
Project Budget	\$717,775
Project Duration	01/07/2004 to 31/12/2007 (Project extended from 01/07/2007 to 31/12/2007)
ACIAR Research Program Manager	Mr Les Baxter

Project background and objectives

Population growth in China and the expansion of urbanisation have increased pressures on vegetable growers to meet demand. Peri-urban vegetable production has been promoted as a means of increasing the availability and diversity of fresh vegetables in the growing urban centres. Spoilage of vegetables remains a problem, being caused by a range of factors. Peri-urban vegetable production systems are land- and pesticide-intensive. Competition for land and other inputs is at a premium, resulting in pressures on production, handling and marketing systems. High postharvest losses caused by fungal and bacterial pathogens are common. Inadequate washing, grading and packing facilities contribute to this, as does limited options for disposing of wash-water and waste. Limited fresh water, together with water and sewage pollution from inadequate infrastructure, result in poor quality irrigation inputs—sometimes utilising raw sewage. These also contribute further to pollution as they enter water courses as run-off. Vegetables are also often washed in these same water sources prior to sale.

Advances in the detection and monitoring of risk factors have been developed for vegetables, using polymerase chain reaction (PCR) technologies. These are applicable to monitoring of both vegetables and wash-water. Such technologies can also be used throughout the supply chain to detect human pathogen transmission risk factors. Much is known about the range of risk factors, how to prevent these spreading and how to improve systems management, inputs and monitoring. Some of this has been developed for Australian systems but is also applicable to China.

The project is analysing production and handling systems to determine risk factors leading to spoilage and contamination. Efficient strategies are being developed—to decontaminate wash-water and introduce hygienic postharvest washing systems for vegetables, and to improve monitoring of human pathogen contamination risks during fresh vegetable handling and marketing.

Project progress

Year 2 (01/07/2005–30/06/2006)

1. Analysis of production and postharvest systems to determine risk factors leading to spoilage and contamination and development of recommendations for risk management

In the second year, work on this objective investigated:

- The influence of plant nutrition during production on the susceptibility to postharvest disease and quality.
- The concentration of human pathogens and faecal indicator organisms on vegetables in the supply chain and levels of these organisms in the farm environment.

Calcium and nitrogen have critical roles in plant structure and function which influence the plants' resistance to spoilage. DPI scientists conducted hydroponic experiments to observe the influence of these minerals and their interaction on the development of postharvest rots in pak choi (a leafy vegetable) and tomatoes (a fruiting vegetable). Pak choi plants given low nitrogen/high calcium treatments, better resisted attack by the spoilage bacterium *Erwinia carotovora* and maintained their quality longest during a shelf life test. However tomatoes from plants fed with moderate and high doses of nitrogen were less susceptible to rotting by *Botrytis cinerea*.

An experiment was also conducted to observe the effect of the irrigation water source on postharvest quality. Iceberg lettuce irrigated with river water, reclaimed water and a mixture of the two was assessed for quality after storage and simulated marketing. The lettuce irrigated with river water had more severe rot development. Work is continuing to investigate the reason for this.

A comprehensive microbiological contamination audit on pak choi, carrots and tomato from three representative farms is being completed in China by CAU. The audit collected samples of produce at three points of the supply chain (harvest, after washing and retail) and sampled five environmental sources (soil, organic fertiliser, irrigation water, clean wash water and post-wash water). Samples were analysed for total plate counts, *E. coli*, coliform, and enterococci populations. Vegetables from retail were also tested for the presence of pathogens (*Salmonella* and *Listeria monocytogenes*). With the exception of clean wash water, all samples were positive for *Enterococcus* spp. and *E. coli*, suggesting potential faecal contamination of the vegetables.

2. Development and testing of strategies for decontaminating wash-water and introduction of hygienic postharvest systems for vegetables

IVF scientists are completing experiments to investigate the influence of washing and sanitising on rot development of carrot, tomato and pak choi. Experiments investigated the impact of washing method, sanitiser type and contact time on the incidence and severity of rot. Results to date demonstrated that:

- 100 ppm sodium hypochlorite (NaOCl) is the best sanitiser for carrots cleaned by brushing, whilst clean water is sufficient for hand washing carrots (small farmer practice)
- Sanitised water was better than tap water for washing pak choi—the optimal treatment was soaking for 1 minute then agitating for 5 seconds in 5 ppm ClO_2 .

An experiment on tomato is under way.

3. Improved monitoring of human pathogen contamination risks during fresh vegetable handling and marketing

DPI has been testing the hypothesis that enterococci may persist longer on vegetables than *E. coli*, and would therefore make a better sanitary indicator. Inoculated Cos lettuce was stored at 4, 21 and 37°C, over a period of 3 weeks. The persistences of both species were similar whilst the lettuce was in a marketable condition. An experiment on tomatoes is nearing completion. CAU have conducted complementary work which has shown after selective growth enrichment enterococci and *E. faecalis* were detected more frequently on fresh vegetables than *E. coli*.

FSA have developed individual *Enterococcus* (genus specific) and *E. faecalis* (species specific) PCR methods. These have been further developed into a multiplex PCR which enables the simultaneous detection of both *Enterococcus* and *E. faecalis* in one single test. The multiplex PCR has been tested on a selection of reference *Enterococcus* spp. and closely related non-*Enterococcus* cultures (*Streptococcus thermophilus*, *Aerococcus viridans* and *Listeria monocytogenes*). The project has collected a further 15 reference enterococci from (BCCM™), 22 *Enterococcus* wild-type cultures obtained from sampling in 2004–05 and a further 97 putative wild-type *Enterococcus* cultures isolated from vegetable, soil and irrigation water samples. These cultures will be used for the further validation of the multiplex PCR. The *E. faecalis* specific PCR has been used by CAU scientists for specific detection of *E. faecalis* in vegetable and environmental samples in China.

4. Development of technical capacities for hygienic handling of fresh vegetables and human pathogen contaminant monitoring

There were three exchange visits made by project staff in the reporting period and these have enabled learning through collaborative research, in-depth discussion of experimental methods and statistical design and comparative analysis of the vegetable supply chains of both Australia and China.

The most significant training event was a workshop conducted in Beijing on 8 and 9 December 2005. This was hosted by IVF CAAS and conducted in collaboration with project team members from DPIV. The main focus was on quality and contamination risks and ultimately the development of a framework for good agricultural practice (GAP). The participants were the potential users and trainers from leading organisations.

HORT/2002/016: Improving the implementation of integrated crop management in brassica vegetables through a decision-support toolkit based on end-user needs in China and Australia

Overseas Collaborating Countries	China
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Extension, Australia
Project Leader	Ms Bronwyn Walsh Phone: (07) 5466 2222, mobile 040 8747 342 Fax: (07) 5462 3223 Email: Bronwyn.Walsh@dpi.qld.gov.au
Collaborating Institutions	University of Queensland, Centre for Biological Information Technology, Australia Zhejiang University, Department of Plant Protection, China Zhejiang Department of Agriculture, Zhejiang General Plant Protection Station, China
Project Budget	\$398,771
Project Duration	01/07/2003 to 31/10/2006 (Project extended from 01/01/2006 to 31/10/2006)
ACIAR Research Program Manager	Mr Les Baxter

Project background and objectives

Brassica crops in tropical and sub-tropical environments are difficult to manage. Pests and diseases are common, requiring farmers to make complex management decisions. Chemical spraying is the main option chosen, being relatively simple to implement. Pests are, however, becoming resistant to chemicals and residues in produce are a major issue of concern from a consumer perspective—as is farmer health and management from exposure to chemicals. In China, brassica vegetables account for about 50 per cent of total vegetable production and consumption. Controls against insect pests and diseases are in the form of chemicals. Changes in farm organisation from collective to individual farms have weakened the extension networks and diminished the flow of information for decision-making. Where previously extension officers interacted with collectives, today the onus for decision-making is on individual farmers who have little if any contact with extension networks and who are mainly familiar with chemical controls, rather than alternatives.

One alternative approach is integrated crop management (ICM), relying on management practices based on utilising the right information. Concerns about safety in vegetable production and of residues in produce have prompted all levels of government in China to implement integrated crop management. In Australia much research has been conducted on the subject, with ACIAR-supported research being conducted overseas. This has developed a range of information, but to date this has not been packaged into a manageable toolkit. A multi-media approach to developing such a package is being undertaken to substantially improve information flows.

The objectives of the project are to:

- identify the key constraints to ICM implementation amongst decision-makers, and clarify where information can address these constraints. This will be done in both China and Australia.
- overcome adoption constraints by developing information tools such as diagnostic keys and 'best practice' management options. These will be developed in two languages (Mandarin and English) in conjunction with the decision-makers, according to the outcome of the needs analyses and tool identification. An additional part of the tool development is to form a commercialisation strategy for China and Australia for the tools identified, allowing for scaling out for wider use of prototype tools developed in the project.
- field-test the prototype information tools.
- make a detailed evaluation of the impact, i.e. the extent to which the tools improve practical implementation of ICM.

Project progress

Year 3 (01/07/2005–30/06/2006)

There has been exciting progress as the beta prototype of the Chinese and English toolkits have been finetuned through on-going information development and field testing with our end-user groups in both China and Australia. The level of enthusiasm was evident to the Australian project leader when she visited China and attended a development workshop with Chinese extension officers (end-users). In Australia the toolkit developers and end-users enjoyed a dynamic workshop to review the version of the prototype.

Development of information tools

Adjustments were made to the information tools based on end-user feedback. The changes included formatting the fact sheet template to be more readable, inserting common names as the primary reference point, increasing the number of fact sheet topics, providing links to websites with related information such as chemical permits, accessing more images, debugging software and fine-tuning pathways in the diagnostic key tool. Collaboration with another project will mean there are added tools as well as delivery of the decision-support toolkit prototype to be developed, tested and distributed to the Australian brassica industry.

Field testing of prototypes

A third and fourth cycle of testing the English beta prototype took place this reporting period. Similarly, fine-tuning has meant the Chinese toolkit is close to release. The field guide has also been used further in field days and training activities in China.

Evaluation of impact

Evaluation indicates that the toolkit is on track in providing end-users with a decision support mechanism for use on their farm or for their clients.

LPS/1998/026: Lucerne adapted to adverse environments in China and Australia

Overseas Collaborating Countries	China, Laos
Commissioned Organisation	South Australian Research and Development Institute, Plant Research Centre, Australia
Project Leader	Dr Geoff Auricht Phone: 08 8303 9498 Fax: 08 8303 9607 Email: auricht.geoff@saugov.sa.gov.au
Collaborating Institutions	Department of Agriculture, Western Australia, Australia University of Tasmania, Australia Gansu Agricultural University, China Shandong Academy of Agricultural Sciences, China Beijing Forestry University, China Chinese Academy of Agricultural Sciences, China Gansu Grasslands Ecological Research Institute, China
Project Budget	\$1,283,864
Project Duration	01/01/2001 to 31/12/2006 (Project extended from 01/01/2005 to 31/12/2006)
ACIAR Research Program Manager	Dr Bill Winter

Project background and objectives

Sustainable agricultural production is vital for China. As the country develops, demand for animal products is increasing. However, the country faces a severe shortage of forage, as well as many environmental problems such as increasing soil salinity, acidity and erosion. The vast grassland areas are not very productive, partly due to inappropriate management but also because of unimproved pasture plants and deforestation. Australia also has related problems of salinity and waterlogging caused by a lack of deep-rooted perennials plants to keep watertables low. Part of the solution to these problems may come from lucerne, which is a nutritious, productive perennial forage legume, with the potential to improve animal production and soil stability, and lower watertables. Interest in lucerne is growing, often in places where it was previously considered unsuitable.

Currently, lucerne is sown in 14 provinces in China, and covers 1.33 million ha. It also grows wild in other regions of the country. However, it could be grown far more widely. But the current lucerne is under-utilised, because of the poor performance of the cultivars grown, coupled with a lack of suitable technology and quality seed. A diverse base of germplasm is already available for lucerne, with a range of tolerances to adverse soil and climatic conditions. But research is required to develop lucerne germplasm specifically adapted for the situations in China and Australia. This large project is targeting salt, waterlogging, acid/aluminium and cold tolerance, by developing new screening techniques and using them to identify tolerant genotypes.

The project aims to produce lucerne varieties that are adapted to environmental stresses relevant to China and Australia through the development of germplasm and novel screening techniques.

Project progress

Year 5 (01/01/2005–31/12/2005)

1. Acquisition and field testing of germplasm

Germplasm characterisation (project germplasm and that from project-supported collection missions) was completed and seed produced ready for distribution. Measurement and assessment of trials have continued at all sites in China and Australia, using the revised measurement protocol. All the Chinese field trial results have now been collated in Adelaide for further analysis. Further trials were established in Laos with the collaborators establishing eight trials across two provinces, three districts and six villages.

2. Developing novel screening techniques

Aluminium screening continued with the several generations of progeny now selected and tested against the parent material. The results of these experiments were exciting—each subsequent generation has increased tolerance over the previous generation. Further selections are continuing, with the aim of releasing a cultivar in 2007. Evaluation continued of the material in pot experiments with acid soil, as well as of field trials with the early acid-tolerant progeny. The acid/aluminium screening method has been adapted to screen both plants and rhizobia for nodulation at low pH. This is an important advance, since acid-tolerant rhizobia are important for the success of lucerne in acid soils. Salinity work continued in Tasmania, with a range of parameters measured to characterise the response to salt stress of genetically diverse plant material. Material from different genetic backgrounds appears to have different tolerance mechanisms, and this may reflect adaptation to differing levels of salt stress. Christiane Smethurst had her PhD thesis accepted.

3. Delivering well-adapted germplasm to seed producers and breeders

With the extension of the project imminent it was decided to continue trial measurement for another year before making recommendations. The aluminium tolerance screening has already supplied material to breeding programs and retested the progeny of this material. Further selection cycles will continue in 2006. Early generation progeny were included in evaluation trials in 2005.

4. Training Chinese researchers, publishing lucerne improvement findings, and conducting extension course

The 5th project meeting was held in Beijing in May. As in the past, part of the meeting was devoted to methodological considerations, theoretical and practical issues involved in trial measurement. Adjacent to the project meeting, a short course was held on lucerne breeding methodology. The result of this course was the development of a breeding strategy for each of the collaborators. The Beijing meeting was followed up with discussions at the project trial sites during the field visits. A number of project-related papers were published in Chinese journals. Another paper was published from the screening work. Project research was also presented at the International Plant Nutrition Colloquium in Beijing. Project activities and research have featured in a number of articles in Australian electronic and print press. Funding was again sought from the DEST China–Australia fund to support an extension workshop that would result in the publication of a book on lucerne use in China. The Australian model for this publication, *Success with Dryland Lucerne*, was translated into Chinese.

LPS/2001/094: Sustainable development of grasslands in western China

Overseas Collaborating Countries	China
Commissioned Organisation	Charles Sturt University, Australia
Project Leader	Professor David Kemp Phone: 02 6360 7525, 0409 443 451 Fax: 02 6365 7590 Email: dkemp@csu.edu.au
Collaborating Institutions	Gansu Grassland Ecological Research Institute, China Gansu Agricultural University, China NSW Department of Primary Industries, Australia Inner Mongolia Agricultural University, China Chinese Academy of Agricultural Sciences, China University of Queensland, Australia Research Centre for Rural Economy, China
Project Budget	\$649,721
Project Duration	01/01/2005 to 30/06/2008 (Project extended from 01/07/2007 to 30/06/2008)
ACIAR Research Program Manager	Dr Bill Winter

Project background and objectives

China's western grassland regions provide the basis of the livelihoods of around 40 million people. The per capita incomes of Gansu, Xinjiang and Inner Mongolia are amongst the lowest in China, in part due to the poor productivity of the grasslands. A severe climate combined with overgrazing limit production, however it is land degradation that is the main problem. Almost 90 per cent of the approximately 300 million hectares of grasslands are considered degraded. Dust storms, siltation of the Yellow River and declining biodiversity are all contributing. There is an acceleration in frequency and severity of dust storms.

Rehabilitating these grasslands is a focus of Chinese Government policy and supporting international programs. Grasslands management, concentrating on livestock farming systems, aims to identify better strategies to overcome degradation and improve smallholder incomes.

The project is working to provide research support and training at a range of levels (including scientists, policy makers and extension staff) to contribute to the development and adoption of a systems approach to pastoral management. Achieving this will raise farmer incomes, while sustaining or enhancing the productivity of the resource base, and will help in identifying the priorities for research and development and Government programs by developing:

- a framework for grassland farming systems that integrates the major components that influence grassland use, and
- a suite of policy/regulatory approaches and on-farm strategies that impact positively on farmer incomes and grassland rehabilitation (using the farming systems framework).

Project progress

Year 1 (01/01/2005–31/12/2005)

Progress was made in the following activities:

To develop a framework for grassland farming systems that integrates the major components that influence grassland use.

A workshop on the analysis framework was held in Orange, NSW during February 2005 with the key personnel from four organisations in Gansu and Inner Mongolia. That workshop considered the methodology to be used and developed an initial list of the key questions that need to be analysed within the project—broadly grouped within the areas of policy, grassland management, animal management, ecology and economics. Each collaborating organisation in Gansu and Inner Mongolia identified a county/banner from which data would be collected on typical farm structures based on representative villages. Initial data collection was done during 2005.

The framework developed for analysis of the grassland livestock farm systems includes a Stage 1 Feed Balance Analyser and a Stage 2 Biophysical/Economic analysis. The Stage 1 models aim to achieve a reasonably realistic description of what is occurring on the farms and to resolve inconsistencies etc. in the data available. The Stage 2 models use biophysical data (including quantity and quality of forage sources), enterprise budgets and linear programming to identify the optimal combination of resources for alternative farm strategies. The outputs from this framework aim to rank the choices available for research and for farm improvement. Further discussions on these topics were held with project personnel during the International Grassland Congress in Ireland in mid-2005.

Describe the livestock production systems in the target regions, and develop realistic production functions for biophysical elements on-farm.

Workshops were held during November/December 2005 by David Kemp (USyd / CSU) and Randall Jones (NSW DPI) with the collaborating organisations in Gansu and Inner Mongolia to work through the survey data collected, build an initial series of models and to identify further data needs. Additional tools were developed to help resolve key parameters such as estimating grassland growth rates and Chinese experiment data was analysed to derive estimates of animal production relationships.

The Stage 1 models developed for the typical farms within each survey village have all quantified the chronic shortage of forage/feed from autumn through mid spring with only small surpluses in summer. This result occurs across farms of all sizes in both Gansu and Inner Mongolia. During summer the forage supply is often in excess of animal demand, but subsequently 100% of the grassland forage is rapidly utilised. That level of utilisation is excessive, leading to grassland degradation. For comparison research done in the native grassland of Queensland (northern Australia), has shown that if utilisation levels exceed 20% then the grassland will degrade.

Appropriate levels of utilisation to rehabilitate and then sustain the grasslands of China are uncertain. Estimates of the herbage mass, i.e. the quantity of standing forage/ha, are rarely > 0.5 t dry matter (DM)/ha and close to zero through much of the year. This is well below general standards required to ensure grassland survival and where soil erosion/dust storms can be controlled. Estimates for Inner Mongolia are that a grassland herbage mass of 0.8 t DM/ha is required at the end of summer to minimise soil erosion/dust storms the following spring. These levels of utilisation and herbage mass occur where animals are restricted in the time they can graze, e.g. typically to half their daily requirements, or less, which then leads to severely restricted productivity. These initial analyses confirm that the number of animals on the grassland exceeds that required for sustainable grasslands.

The workshops held in late 2005 included discussions on the strategies that could be adopted to improve grasslands and farm incomes. It is evident that the current markets do not yet provide a strong incentive for herders to reduce animal numbers. Herder incomes still depend more on the number of animals sold, than the quantity and quality of animal product – whereas payments for the latter do apply in the more affluent cities. Better payments for animal products e.g. meat or wool, could prove a valuable incentive to produce similar amounts of product from fewer animals, thereby reducing animal numbers on the grassland.

Changing sheep breeds offers opportunities for better levels of animal products and higher incomes. For small breeds of sheep (Tan) lambs are sold at weaning for skin values, whereas larger breeds (Han) can produce more valuable quantities of meat and our (Stage 2) analyses to date would suggest are far more profitable.

Within this project we will consider social factors that influence the decisions being made by herders. In the surveys we asked herders about their attitudes to change. Some appeared reluctant to change practices even though their current practices result in lower incomes. Ways of accommodating attitudes and achieving better outcomes need to be found.

Analyse the current policy/regulatory and market settings, their implementation and impacts on farmers and the grasslands.

Parallel to the framework development an analysis of grassland policies on protection, development and utilisation and the implementation of these policies is being done by the University of Queensland (Colin Brown and Scott Waldron) in collaboration with the Research Centre for Rural Economy. This involves interviews with officials at national, provincial, county/banner and village levels. In July 2005 a visit was made to Inner Mongolia and to two of the more degraded grassland leagues; Balinyou County in Chifeng League in eastern Inner Mongolia where grazing bans have forced herders to pen livestock for most or all of the year and Wushen Banner in E'erdusi League where maize is now being grown on fenced desert steppe to support more intensive livestock systems, including fine wool sheep and cashmere. Interviews were held with officials from the Grassland Inspection Centre, Animal Husbandry Bureau, Environmental Protection Bureau, Vertical Integration Office and many other agencies at Central, provincial, league, banner and sumu administrative levels, as well as a cast of enterprise managers, herders, dealers and association heads.

Most of the fieldwork focused on the development and implementation of the new Grassland Law and associated grassland regulations. However, these were examined in context with the myriad of other policies and regulations that impact on the grasslands including livestock production, marketing, local organisation and development policies. A detailed understanding of the various policies and their interactions will enable analysis and recommendations on how to improve policy co-ordination and design.

To develop a suite of policy/regulatory approaches and on-farm strategies that impact positively on farmer incomes and grassland rehabilitation (using the farming systems framework).

Initial interviews and analyses are being done to contribute to this objective.

To build the capacity of research and extension personnel to analyse and determine key intervention strategies into grassland farming systems.

The workshops held to date have been building capacities among grassland scientists to analyse grassland farming systems. Each group in Gansu and Inner Mongolia have a copy of the Feed Balance Analyser for their target village, developed at the December 2005 workshop. They will report on this at the Annual Review meeting in early May 2006. An additional workshop was held with personnel from Gansu Agricultural University to work through the modelling structures being used.

This project involves many key grassland researchers and agencies in China, and has established linkages with the World Bank Pastoral Development program (three project personnel are also involved in the World Bank program) in Western China, with CIDA programs and with other groups who are working on related projects. These linkages will enable the project to have influence at a range of levels, from policy to local government rules through involvement, training and workshops.

LPS/2002/104: Increasing milk production from cattle in Tibet

Overseas Collaborating Countries	China
Commissioned Organisation	NSW Department of Primary Industries, Australia
Project Leader	Dr John Wilkins Phone: 02 6938 1837, 0413232748 Fax: 02 6938 1809 Email: john.wilkins@agric.nsw.gov.au
Collaborating Institutions	Tibet Academy of Agricultural and Animal Sciences, China Tibet Livestock Research Institute, China
Project Budget	\$422,669
Project Duration	01/07/2004 to 30/06/2007
ACIAR Research Program Manager	Dr Bill Winter

Project background and objectives

Dairy products, notably milk and butter, are traditionally important foods in the Tibetan diet. Demand for these products, particularly milk, continues to rise, driven by changing consumption patterns and, secondly, population growth. Local supply has fallen well behind demand; in winter as much as 60 per cent of butter consumption is of imported products. Milk production has also grown, by 20 per cent over the last four years. Milk production has traditionally relied on yaks grazed in pastoral lands outside central Tibet Autonomous Region. The mixed crop-livestock zones of central Tibet Autonomous Region's valleys produced around 35 per cent of milk production in 2003. Recently yak numbers have begun to decline, with cow's milk taking up much of the gap left by lowered supply of yak's milk. Production in pastoral areas has also declined with an increased expectation that central Tibet Autonomous Region's crop-livestock zone will continue to fill the gap from declining pastoral production.

A specialist dairy sector would help boost production by an estimated minimum of 20 per cent. This can be achieved by improved feeds with greater nutritional value being made available to cattle. Livestock are largely fed crop residues (straw) and crop by-products and grazed on grasses and weeds, along with crop regrowth. These provide poor nutrition limiting milk production. Improved feeding systems based around the effective utilisation of crop residues and by-products, better silage management practices, information on yearly feed availability and knowledge of responses to different feeds should achieve the 20 per cent boost in dairy production needed to meet supply and establish a specialist dairy sector.

The project is, through introducing improved nutrition options, increasing milk production and hence farm income from cattle on mixed crop/livestock farms in the valleys of Tibet Autonomous Region. There are ready markets for milk and milk products as local production cannot meet the current demand for these products.

Project progress

Year 2 (01/07/2005–30/06/2006)

This period saw the start of the on-farm data collection for the benchmarking of feeding, milk production and reproduction for the smallholder dairy producers in a sample of the livestock/cropping areas of Tibet. There are currently 36 family-operated on-farm sites participating in this monitoring phase. This information is vital to establishing the current state of production—to identify the constraints and thereby the opportunities to improve productivity and household income. Following the benchmarking phase, it is proposed to devise annual feed budgets and the strategies to supply the forages and other feeds to meet the animal production requirements.

A visit was made to the project site in March 2006 by Colin Griffiths and John Wilkins to assess progress with the project. Considerable modifications to the information collection and storage processes were necessary to improve the field operations and entry of the data to computer files. While it is far too early to report any data or recommendations, there were clear indications in the field records of nutritional restrictions as reflected by low birth weights of calves and low milk production. This visit was timed to coincide with the final stages of the AYAD (Australian Youth Ambassadors for Development) mission of Amanda Mather (NSW DPI, District Agronomist, Berry), who spent 5 months at Lhasa working with many of the ACIAR project team at TLRI, other TAAAS staff and NGOs in examining the structure and function of extension in Tibet. Amanda made valuable contributions to the ACIAR project during her time in Lhasa, and kept in frequent contact with the Australian team throughout her stay. She also provided the visiting Australians with many contacts through the network she had established during her investigations into extension. This led to specific extension-oriented meetings and discussions with various people from TAAAS and other organisations involved in current and future development of extension services.

Training of the Tibetan scientists as part of the capacity-building aims of the project was provided by two exercises. Three of the Tibetan scientists (Dr Tsamyu, Mr Aosiman, and Mr Basang) visited Australia in September/October 2005 for 2 weeks, on a brief study tour covering dairy production systems, forage production, silage production, animal house design, laboratory methods for feed evaluation, ultrasound scanning for monitoring reproductive status and methods for determining digestibility of feeds in sheep and cattle. During April–June 2006, Dr Tsamyu (nutrition specialist) returned to Australia for 9 weeks at NSW DPI Agricultural Institute at Wagga Wagga. The purpose of this mission was to further her experience in nutrition research, and in particular the design, management, operation and analysis of animal house experimentation, as well as the associated laboratory procedures for assessment of feed quality. The visit was timed for Dr Tsamyu to participate in the experiment to evaluate silages in the Australian research component (described below). These skills will be vital to the ongoing research, within this project and beyond, that will be possible with the provision of an animal house facility at TLRI, Lhasa, as part of the project. The animal house at TLRI was nearing completion at the end of this reporting period and will soon be ready to be tested for functionality and to commence the first experiments.

The Australian research component of the project is aimed at optimising animal production from conserved (silage) cereal and cereal/legume crops. The crops were sown in June 2005—seven cereals (three wheat, two barley, two oats), grown alone or with vetch. They were harvested in spring 2005 at various stages of development, and silage made. The silages were then fed to steers in the animal house in an experiment during April–June 2006 to evaluate their quality, and samples were analysed for routine nutritional parameters. The results and analyses of the animal performance data and the laboratory measures of feed quality were not available at the time of reporting.

LWR/2002/018: Regional impacts of re-vegetation on water resources of the Loess Plateau, China, and the Middle and Upper Murrumbidgee Catchment, Australia

Overseas Collaborating Countries	China
Commissioned Organisation	CSIRO Land and Water, Australia
Project Leader	Dr Tim McVicar Phone: 02-6246 5741 Fax: 02-6246 5800 Email: tim.mcvicar@csiro.au
Project Web Site	http://www.eoc.csiro.au/aciarc/book/index.html ; http://www.clw.csiro.au/research/catchment/modelling/ ; http://www.eoc.csiro.au/aciarc/book/index.html ; http://www.clw.csiro.au/ReVegIH/
Collaborating Institutions	Chinese Academy of Sciences and Ministry of Water Resources, Institute of Soil and Water Conservation, China
Project Budget	\$723,379
Project Duration	01/01/2003 to 30/06/2007 (Project extended from 01/01/2006 to 30/06/2007)
ACIAR Research Program Manager	Dr Ian Willett

Project background and objectives

Western China's Loess Plateau is a unique combination of soil type, slope and rainfall intensity. Much of the land is too steep for farming. Average farm sizes are small, often as little as 1.5 hectares. The distant and remoteness from potential markets, mainly on the eastern seaboard, eat up any profits in expensive transport costs. Low levels of productivity mean smallholders relying on farming are amongst the poorest in China. The most far-reaching problem for these farmers is soil erosion. Traditional tillage practices have served to further, rather than limit, erosion. Low levels of perennial vegetation and intense monsoonal summer rains, which dump more than half of the annual fall, also exacerbate the problems.

The large level of rainfall, low vegetation and high erosion all contribute to excessive water runoff. This transports both water and soil sediment into groundwater systems. The most important of these is the Yellow River, its name taken from the colour of the river once the sediment enters it. Revegetation of the Plateau should alleviate many of the erosion and water/soil losses, but the impacts on hydrology are not clear. Hydrology and erosion interactions are also elements found in the Murrumbidgee catchment in Australia. Understanding these interactions and their impacts at the system level requires complex data interpretation, which is best handled by computer modelling.

The project is working to optimise the impact of large-scale revegetation on the water resources of the coarse sandy hilly region of the Loess Plateau of western China, and in the middle and upper Murrumbidgee Catchment of southeast Australia by developing software tools to predict the impact of revegetation strategies on the two regions.

Project progress

In Year 3, over 90% of the project team's (Chinese and Australian) time was spent completing the Chinese study, focused on the Coarse Sandy Hilly Catchments (CSHC) of the Loess Plateau, which drain the main south flowing branch of the Yellow River. Specifically we finished: (1) calibrating a global steady-state land-use/water-balance framework to local conditions; (2) spatially modelled the suitability of 38 species of trees and shrubs used in the re-vegetation program; (3) determining the location of target and priority areas for undertaking re-vegetation activities; (4) developing the bi-lingual decision support system (DSS) called ReVegIH (Re-Vegetation Impacts on Hydrology), including writing a bilingual user-guide; and (5) fully documenting the processing of the datasets underpinning ReVegIH. The importance of each is briefly discussed.

(1) *Locally calibrating the steady-state land-use/water-balance framework:* Facilitating scenario planning of the impact of implementing China's re-vegetation program on water resources in the study area entailed calibrating a previously implemented land-use/water-balance framework to local conditions. The framework was previously developed using a global dataset, and when used to estimate run-off at our study site gave poor results when validated against real streamflow data. To improve this we regionalised the framework parameters using the database of 36 hydrology stations that went through a quality control process in Year 2. We then needed to ensure a suitable relationship was in place to extend past the geographic area of the 36 stations and cover the entire CSHC. This was performed using meteorological datasets developed in Year 2. This resulted in a locally calibrated land-use/water-balance framework suitable for illustrating the steady-state impact on water resources following implementation of the re-vegetation program, i.e., for scenario planning.

(2) *Spatially modelling vegetation suitability:* To ensure that ReVegIH (see below for fuller explanation) was useful to managers involved with implementing the re-vegetation in the CSHC, we developed suitability maps for 38 species covering the site. The maps encompassed five variables that govern plant suitability (precipitation, air temperature, landform, and soil pH and nitrogen). This mapping heavily utilised the spatial datasets developed in Year 2 of the project.

(3) *Determining target and priority areas:* As the vegetation suitability mapping results were fairly general, we developed a series of rules to define target and priority areas for trees, shrubs and grasses in the landscape. Target areas are the locations where optimal growth of different vegetation types occurs, whereas the priority areas are those target areas that have the highest potential to reduce soil erosion. Priority areas are adjacent to, and lower than the steep slopes and gullies that characterise the CSHC. Re-vegetating the priority areas first focuses the initial planting on a smaller area (thereby minimising the reduction in run-off) and this is expected to most effectively reduce the amount of soil entering the stream network.

(4) *Completing the bi-lingual decision support system called ReVegIH:* We developed a bilingual computer simulation tool that could be distributed to environmental managers in the CSHC free of charge on one CD. The tool, called ReVegIH provides a means for users to: (a) determine where priority (and target) re-vegetation activities should be undertaken; (b) ascertain what species are suitable for a specific location; and (c) simulate the related hydrological impact. The spatial resolution of the first two functions is provided at 100 m, while the third is at the catchment (or county) level for the 113,000 km² CSHC. ReVegIH has an easy-to-use bilingual interface that includes some basic GIS functions. All electronic help is bilingual, as is the user guide which fully documents ReVegIH and also provides answers to frequently asked questions.

(5) *Documenting the underpinning datasets:* The systematic quality control and development of the databases underpinning ReVegIH was performed with many errors successfully corrected and best-practice methods used. The project team ensured that the datasets and underlying processing was fully documented, thereby recording the lineage of the data and ensuring that all processing could be performed independently by all organisations involved in the project. Completing this component of the project successfully means that the final datasets are of high quality to perform the model validation underpinning ReVegIH (which is critical to project success), and that both partners have the skills to generate these datasets.

LWR/2002/094: Promotion of conservation agriculture using permanent raised beds in irrigated cropping in the Hexi Corridor, Gansu, China

Overseas Collaborating Countries	China
Commissioned Organisation	University of Queensland, Australia
Project Leader	Dr Jack McHugh Phone: 61 7 4987 9336, mobile: 0409 148 367 Fax: 61 7 4987 933 Email: mchughjack@optusnet.com.au, d.auchettl@bigpond.com
Collaborating Institutions	China Agricultural University, China Gansu Academy of Agricultural Sciences, China Gansu Agricultural Mechanisation Bureau, China
Project Budget	\$600,000
Project Duration	01/07/2005 to 30/06/2009
ACIAR Research Program Manager	Dr Ian Willett

Project background and objectives

Gansu is a north western Chinese province in the Yellow River Upper Drainage Basin. Between Gansu and neighbouring Inner Mongolia lies a distinct valley, the Hexi Corridor. In the past, reliable snowmelt water from the adjacent Qianlian Mountains has sustained the irrigated agricultural areas along the length of the valley. In more recent times, reduced snowmelt water has led to significant reductions in available surface water, whilst over extraction and decreased recharge has lowered water tables in groundwater-driven systems. As a consequence, severe water restrictions are being placed on farmers (up to 50 per cent reduction in allocations).

Although delivery losses are being reduced, through better channel lining, few practical solutions are being offered to farmers to cope with the policy-driven cutbacks in water allocations, water price increases and pumping costs. Other food production issues associated with water restrictions, such as small farms, low levels of mechanisation, high inputs, conventional tillage, low incomes and the loss of young men to the cities, are placing further pressure on farmer livelihoods.

Therefore this project is examining conservation agriculture, using practises such as zero tillage and permanent raised beds (PRB), to reduce irrigation water use, maintain farm yields and improve farmer incomes. Project objectives are:

- to develop and test conservation agriculture machinery designed around the 20 hp tractors to mechanise PRB in wheat/maize systems.
- To demonstrate the effectiveness of permanent raised beds in improving crop, nutrient, residue and water management in wheat/maize systems of the Hexi corridor.
- To assess the cost benefit of PRB farming systems.
- To extend conservation agriculture using PRB technology across the Hexi Corridor.

Project progress

Year 1 (01/07/2005–30/06/2006)

Develop and test conservation agriculture machinery designed around the 20 hp tractors to mechanise PRB in wheat/maize systems

The Zhangye Mechanisation Institute, under the supervision of the China Agriculture University designed and constructed a prototype bed-former and planter for the project this last winter. Subsequently new machines were tested under field conditions in March 06 with varying degrees of success. In general, planting wheat with a new machine into three different field configurations; permanent raised beds, freshly raised beds and zero till, was not achieved without considerable delays caused by frozen soil, breakages, adjustments, and modifications.

A comprehensive assessment of the mechanisation development for the project was essential and key to the success of the new farming system. Dr Jeff Tullberg of CTF Solutions Australia was engaged to carry out the assessment in April 2006. His comprehensive report and significant recommendations are included with this report. In brief, he recommends a planter redesign, which incorporates bed forming and planting in one pass, bed surface depth control, advanced seed metering device, improved seed fertiliser separation at the delivery point, round-shouldered beds and a capacity for simple adjustment to plant in differing field configurations. Other suggestions included the modification of an existing plot harvester in Zhangye, as opposed to the design and construction of a tractor-mounted harvester.

Demonstrate the effectiveness of permanent raised beds in improving crop, nutrient, residue and water management in wheat/maize systems of the Hexi corridor

Site establishment at the Zhangye research station commenced at the end of the 2005 cropping season. The focus was on residue management in preparation for the following in-project cropping regime and the design and local manufacture of irrigation water measuring devices. Calibration and testing of the new V-notch weirs were conducted following intensive training on their use and irrigation water management. Initial problems with the operation of data-logging instruments and bypass flow during the post harvest and pre-winter irrigations have been overcome by ongoing training and refurbishment of water supply channels. The 2006 cropping season commenced with the preparation of the eight comparative fields, which included removing permanent raised beds in six of the eight fields and establishing traditional, zero-till controlled traffic and fresh bed fields, four configurations in all in two replicates. The majority of the field conversion was done by hand to minimise compaction, retain residue, and reduce soil moisture loss.

Instrumentation of the research site was conducted in three phases. Phase one was intensive on-site training of GAAS personnel in the use and assembly of a weather station, enviroscans, salinity probes, tensiometers, soil temperature probes, soil moisture meters, and an array of 48 full-stop wetting front detectors. Phase two was installation of the instruments followed by familiarisation with data acquisition, data management and fault diagnosis. Phase 3 included an introduction to irrigation models with specific training in Hydrus 2D, Swagman destiny, Sirmod, Infiltr and FAO56 evapotranspiration model. The team members were trained in data acquisition, instrument layout, and spreadsheet design and data management for the separate models. During the establishment phases, soil sampling was conducted for soil moisture characteristics, biotic activity, and instrument calibration. The team was trained in the use of new and locally manufactured sampling tools.

The current approach to spring wheat production in Hexi is of concern, as it would appear to over use nitrogenous fertiliser. Dr Tullberg's report also asks why the use of N fertilisers is 5–6 times that of Western Nations. Preliminary measurements suggest that considerable over-watering in traditional farming could be leaching nutrients well below the root zone, hence the need for more fertiliser.

Assess the cost benefit of PRB farming systems

Dr Tim Sun of the University of Queensland and Professor Tian of CAU conducted an economic bench marking survey in 2005. The survey was conducted in Shandan county to the east of Zhangye city and will form the basis of the cost benefit analysis of PRB

Extend conservation agriculture using PRB technology across the Hexi Corridor

GAMB has established the first of three demonstration sites for the Hexi corridor in Huan Zhuang Village, Shandan County. Three adjacent 5800 m² fields will compare permanent raised beds, zero-till and conventional farming practices. V-notch weirs have been installed to measure irrigation water and assess crop performance by intensive plant mapping. All field inputs are also being compared. To assess changed farming practices on a commercial farm scale, site management and decisions on inputs are based on those used at the Zhangye research station.

During November and January (05–06), three Chinese project team members attended the 45 day capacity-building tour in Australia. They travelled from central Queensland to southern NSW, visiting a wide variety of farming enterprises and institutions. Another tour will be scheduled for September–October 2006 to coincide with the Controlled Traffic Conference in Ballarat.

LWR/2003/039: Improving the management of water and nitrogen fertiliser for agricultural profitability, water quality and reduced nitrous oxide emissions in China and Australia

Overseas Collaborating Countries	China
Commissioned Organisation	University of Melbourne, Department of Agriculture and Resource Management, Australia
Project Leader	Dr Deli Chen Phone: 03 8344 8148 Fax: 03 8344 4665 Email: delichen@unimelb.edu.au http://www.cardnoacil.com/
Project Web Site	
Collaborating Institutions	Shanxi Academy of Agricultural Sciences, China Chinese Academy of Sciences, China Cardno Acil Pty Ltd., China Office, Australia Chinese Academy of Agricultural Sciences, China China Agricultural University, China
Project Budget	\$1,627,827
Project Duration	01/04/2005 to 31/03/2009
ACIAR Research Program Manager	Dr Ian Willett

Project background and objectives

In China irrigated cropping demands careful management of water resources and other inputs. Wheat and maize are the two main irrigated crops grown in western provinces. Water-use efficiency in these areas is often low despite water being a critical resource. The intensive nature of the cropping that is practised demands the use of fertilisers. Nitrogen fertiliser is the main type used but, as with water, its use is often inefficient and wasteful. The combination of water used inefficiently with more fertiliser than is needed creates environmental problems, beginning with nitrogen-rich runoff. Volatilisation of ammonia contributes to nitrogen loss, in turn requiring more fertiliser use. This also results in greenhouse gas emissions.

A Water and Nitrogen Management Model (WNMM) developed in past ACIAR research should help determine changes needed to improve current management practices. By working with the model and its associated decision-support system in two AusAID projects in Inner Mongolia and Hebei provinces, better practices are being identified and then disseminated to farmers through the existing project channels.

The project is improving the management of water and N fertiliser to increase farm incomes, improve environmental quality and reduce N₂O emissions from agriculture. Under study are irrigated maize and wheat cropping systems and intensive vegetable farms in the western Yellow River basin of northern China, and intensive irrigated pasture and maize, and rain-fed wheat systems in Australia.

Project progress

Year 1 (01/04/2005–31/03/2006)

Most of the planned activities and milestones outlined in the project proposal for the first year (of a 4-year project) have been achieved, and summarised as follows:

China:

1. A comprehensive experimental and data collection protocol for the project was developed and distributed to all the project members.
2. Four experimental sites were selected: (a) irrigated maize system in the western part of the Inner Mongolia Autonomous Region (IMAR) in collaboration with AusAID project of Alxa League Environmental Rehabilitation and Management; (b) three sites in Shanxi province; the northern site at Yuci in the Taiyuan Basin, the southern site at Yongji near the edge of the North China Plain and the Hongtong site which lies in between. Both Yuci and Yongji sites were extensively instrumented to measure all key water and N fluxes.
3. Farmer socio-economic survey, field experiments for quantifying efficiencies of irrigation and N fertiliser using ^{15}N labelled urea, and collection of soil and plant samples for N dynamics have been completed.
4. Sophisticated instruments have been installed at Yuci and Yongji, including micrometeorological Eddy correlation facilities, automatic soil moisture instruments and automated chambers with gas chromatography (GC) for N_2O (Yuci site), and microplots receiving fertiliser enriched with stable ^{15}N isotope to trace the fate of fertiliser N.
5. First year comprehensive water and N balance measurements have been completed at Yuci, most of the collected soil and plant samples have been analysed.
6. Targeted farmers socio-economic survey was completed in Fengqiu county to study the reasons for low adoption rates of water saving techniques recommended in a recently completed ACIAR project. Based on the survey data and the data from this previous ACIAR project, a conceptual module of the economic component has been established for water and nutrient management model (WNMM).
7. Chinese Academy of Sciences has approved 3 million RMB (A\$500,000) co-funding to support this project (Prof Zheng Xunhua of Atmospheric Institute of Physics) to establish a state of art auto-chamber system for N_2O and NO_x measurements at the Yongji site.
8. The Shanxi Agricultural Comprehensive Development Office (SACDO) has agreed to fund 750,000 RMB (A\$125,000) to implement the research outcomes of the project by establishing demonstration farms in all three counties in Shanxi.

Australia:

The Australian component of the project is complementary to projects funded through the CRC-Greenhouse Accounting, Australian Greenhouse Office (AGO) and GRDC, and mainly focuses on model development.

1. The GIS interface of the WNMM has been converted to ArcGIS 9.x from ArcView GIS 3.x. The WNMM has been significantly modified and improved for Australian conditions and was adopted by CRC-GA for simulating water and N dynamics, and N_2O emissions, for rain-fed wheat in Victoria and Western Australia and irrigated pastures in Victoria; N dynamics and NH_3 volatilisation for south Korea, and water and N dynamics for an irrigated maize and wheat system in the Yaqui valley, Mexico by scientists from Stanford University, and legume systems in China by scientists from the Institute of Soil Science, Chinese Academy of Sciences.
2. Soil N dynamics in irrigated maize systems impacted on by N and stubble management at Griffith, NSW were studied.
3. A prototype of a handheld-based agricultural decision support system has been developed for advising farmers about N fertiliser use for wheat cropping in Australia. The concept and the developing protocol may be adoptable in the Northern China region to extend the agricultural research results by this ACIAR project to the farmers who are very keen to hear and to adopt BMPs for social, economic and environmental benefits.

PLIA/2005/123: Trends in world agriculture to 2030, implication for developing countries

Overseas Collaborating Countries	China, India
Commissioned Organisation	Centre for International Economics, Australia
Project Leader	Dr Andrew Stoeckel Phone: (02) 6245 7800 Fax: (02) 6245 7888 Email: astoeckel@thecie.com.au
Collaborating Institutions	N/A
Project Budget	\$30,000
Project Duration	01/11/2005 to 29/12/2006 (Project extended from 30/06/2006 to 29/12/2006)
ACIAR Research Program Manager	Dr Jeff Davis

Project background and objectives

China has become the 'OPEC of the world on the demand side' for commodities, and India looks set to take off and follow. Together, they have the potential to alter world agriculture markets greatly. Analysing these developments, and understanding the importance of these and other global drivers, is crucial for sound strategic planning in rural industries. The overall objective of this research is to analyse the major drivers behind the trends in world agricultural production and consumption to 2030. This will be undertaken in two parts; firstly a scoping study to define the project in light of other world research. This will involve workshops in China and India to crystallise the issues, identify other partnering institutions, and specify the drivers affecting world agricultural markets in 2030. Secondly, the information gathered will be disseminated through publications, seminars, meetings and conferences.

Project progress

As at October 2006 the first progress report is forthcoming.

PLIA/2005/152: Australia-China linkage for improved rice cold tolerance

Overseas Collaborating Countries	China
Commissioned Organisation	NSW Department of Primary Industries, Yanco Agricultural Institute, Australia
Project Leader	Dr Russell Reinke Phone: (02) 6951 2516 Fax: (02) 6955 7580 Email: russell.reinke@dpi.nsw.gov.au
Collaborating Institutions	Liaoning Academy of Agricultural Science, China , Australia Diversity Arrays Pty Ltd, Australia CSIRO Plant Industry, Australia Guangxi Academy of Agricultural Science, China
Project Budget	\$99,796
Project Duration	1/05/2006 to 30/06/2008
ACIAR Research Program Manager	Dr Jeff Davis

Project background and objectives

This small research activity will support important collaboration between Australian and Chinese rice breeders in the development of cold tolerance in rice varieties for both countries. This is a very high priority issue for Australia and very important in China. In addition it will transfer new molecular marker technologies to China from Australia which will have an impact on their cold-tolerant activities and all plant breeding activities in China. Cold-tolerant varieties will lead to prevention of substantial yield losses in cold years in both countries and also allow farmers to significantly reduce water applications to crops.

Project progress

Year 1 (01/05/2006–30/04/2007)

The project only started in June 2006 but progress is as planned. A rice cold tolerance workshop is to be held in Australia December 4–8 2006. An organising committee has been formed and a tentative program of lab visits and formal presentations outlined for the week-long workshop. Additional funding (approximately \$15,000) has been obtained from the Rural Industries Research and Development Corporation to support the participation of three rice cold-tolerance researchers from Japan and South Korea.

SMCN/2005/059: Modelling water and solute processes and scenarios for optimisation of permanent raised bed systems in China, India, Pakistan and Indonesia

Overseas Collaborating Countries	China, India, Indonesia, Pakistan
Commissioned Organisation	CSIRO Land and Water, Australia
Project Leader	Dr Freeman Cook Phone: (07) 3214 2840, Mob: 0409 613 932 Fax: (07) 3214 2855 Email: freeman.cook@csiro.au
Collaborating Institutions	
Project Budget	\$70,000
Project Duration	01/04/2006 to 30/09/2006
ACIAR Research Program Manager	Dr Christian Roth

Project background and objectives

Permanent raised beds are being used to minimise the effects of water logging, reduce irrigation water and improve the biological and physical health of the soils; all these factors leading to increased productivity of crops. Design criteria for permanent beds in terms of infiltration and drainage are not well developed and are usually driven by machinery specifications. Fertiliser placement for nutrient and solute management and the risk of build-up salts are additional criteria to be addressed by country partners. This project is underpinning existing ACIAR projects by: helping develop design criteria for optimising bed design from analytical and numerical modelling of water and solute transport; designing fertiliser placement strategies to maximise fertiliser usage and minimise leaching to ground water; determining whether salinisation` is likely with time in some soil/bed configuration/climate/water quality scenarios. It will do this using two-dimensional water and solute modelling.

Project progress

First progress report due in 2007.

ADP/2004/044: Economic analysis of technical barriers limiting agricultural trade of China

Overseas Collaborating Countries	China
Commissioned Organisation	International Food Policy Research Institute, USA
Project Leader	Dr David Orden Phone: 1 202 862 8160 Fax: 1 202 467 4439 Email: d.orden@cgiar.org
Collaborating Institutions	Australian National University, Research School of Pacific and Asian Studies, Australia Renmin University of China, Department of Agricultural Economics, China
Project Budget	\$175,921
Project Duration	01/07/2005 to 31/12/2007 (Project extended from 01/01/2007 to 31/12/2007)
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

World Trade Organization rules include regulations to protect human, plant and animal health. Some of these regulations act as technical barriers to trade (TBT)—those designed as legitimate means to protect against the spread of diseases, contaminants and the like. These TBT measures should be based on objective scientific evidence and minimise trade distortions. Some TBTs impose undue costs and requirements on developing countries adopting sanitary and phytosanitary measures to promote trade. These SPS measures, set by trade partners as entry requirements for agricultural produce, have created challenges for many developing countries. In cases where these may be used as an unjustified barrier to entry WTO processes allow for both informal and formal procedures of appeal and settlement. The onus is on the appellant to prove they meet these requirements. One element that can strengthen the argument of developing countries is designing production systems that meet international standards. These must engage producers throughout the system, from large scale to smallholders.

China has registered six informal challenges to TBTs from other countries, with growing concern within the country that SPS regulations are being used to restrict its trade options. Helping China better place itself both to assess technical barriers and develop strategies to meet these, together with the use of risk assessment in assessing production-process requirements for its own producers, should result in increased opportunities for trade.

To improve the performance of China’s regulatory regime concerning technical barriers to agricultural trade, the project is improving agricultural export performance in labour-intensive, high-value products by enhancing knowledge of the technical barriers China faces and the opportunities that exist for expanding trade.

Project progress

Year 1 (01/07/2005–30/06/2006)

During the first 12 months of the project, progress has been made in four dimensions. First, field research has been initiated to compile an inventory of technical barriers facing agricultural exports from China that may be alleviated by changes of regulations or by adoption by exporting firms of new technologies or compliance procedures. Second, the basic methodology proposed for the study has been specified conceptually as an economic model, converted into computer programs for empirical analysis, and an analysis related to those to be undertaken in the project for specific cases of Chinese exports has been completed. Third, an assessment of the impacts of existing and potential North American SPS regulations on the importation of fresh apples from China has been initiated. A background literature review was prepared and an investigation made of the phytosanitary regulations for exporting fresh apples from China to Canada. Fourth, the basic methodology and related empirical application has been presented at several international conferences and in related papers.

ADP/2004/045: Exploring alternative futures for agricultural knowledge, science and technology (KST)

Overseas Collaborating Countries	China, India
Commissioned Organisation	International Food Policy Research Institute, USA
Project Leader	Dr Mark W Rosegrant Phone: 1 202 8625621 Fax: 1 202 4674439 Email: m.rosegrant@cgiar.org
Collaborating Institutions	Australian Bureau for Agricultural and Resource Economics, Australia Center for Chinese Agricultural Policy, China World Bank, USA National Council of Applied Economic Research, India
Project Budget	\$590,209
Project Duration	01/06/2005 to 30/06/2008
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

How agricultural knowledge, science and technology (KST) reach end-users, particularly farmers, remains poorly understood. While technologies have introduced a variety of improvements and science continues to deliver new knowledge, innovations likely to help many farmers, fishers and others have yet to reap benefits. The gap between the developed and developing worlds can, in part, be narrowed through agricultural productivity improvements reaching poor farmers. In many developing countries, however, the means to increasing production has failed to reach poor farmers, with KST not delivered in a suitable format. An increasing level of uncertainty stemming from a variety of factors; changing socio-political environments, shifts in public and private investment, population and economic growth and avenues or pathways to adoption, mean future delivery of KST will need to be well understood.

Of these factors it is the last—avenues or pathways to adoption of KST—that this research seeks to illuminate. Alternative development pathways to agricultural KST adoption will be developed, catering to likely future trends. The implications of these on policy options and investment strategies, including economy-wide trade and subsidy policies, will be examined. Descriptive narratives to support these scenarios will be used, along with modelling of these scenarios. This will be undertaken in close collaboration with the two year International Assessment of Agricultural Science and Technology for Development (IAASTD) initiative.

The project is providing policymakers with options of alternative policies and investments for agricultural knowledge, science and technology (KST) based on the analysis of alternative development paths and their implications for food security, rural development, and environmental sustainability.

Project progress

Year 1 (01/06/2005–31/05/2006)

The project goal is to provide policy makers with options of alternative policies and investments for agricultural knowledge, science and technology (AKST) based on the analysis of alternative development paths and their implications for food security, rural development, and environmental sustainability. Project objectives are: 1) to develop 4–5 alternative development paths or scenarios for agriculture and related KST policies out to 2050; 2) to develop quantitative scenario results using the models proposed for this project; 3) to analyse the results of both quantitative and qualitative scenario outcomes and to develop implications for investment based on these outcomes; 4) to analyse the economy-wide implications of trade and subsidy policies within these scenarios; 5) to disseminate research results.

The project is being implemented in close collaboration with the 2-year IAASTD initiative (www.agassessment.org). Objectives 1–3 are implemented closely with IAASTD, whereas 4 and 5 are carried out independently with ACIAR project partners in China, India, and Australia. Moreover, the project focuses more on the quantification of scenarios than development of storylines. Outputs under Obj. 1 and 2 were scheduled to be achieved during the first reporting period; moreover, Obj. 5 is ongoing throughout the project period.

Activities under Obj. 1 relate to a) development of storylines, b) development of alternative KST policies; and c) testing of scenario plausibility and quantification. Specific outputs include:

- a) drivers for agriculture and AKST policies identified; scenarios developed.
- b) KST policies developed for each of the alternative scenarios.
- c) four to five plausible, internally consistent, challenging, novel, substantial and relevant agriculture scenarios in the form of narratives describing distinctly different pathways from 2005 to 2050 for agriculture productivity growth, food security, livelihoods and environmental sustainability—and the role of science and technology in shaping the pathway.

These outputs have been achieved. However, the four scenarios developed to date are yet to go through two rounds of review, after which they will be further refined and updated. Instead of a separate 5th scenario, changes for two of the other scenarios will be developed so as to allow these scenarios to get closer to the targets of the MDGs. Macro-economic drivers are based on those used in the Millennium Ecosystem Assessment (MA). Other outputs include development of conceptual frameworks for scenario analysis; finalisation of chapter outlines; and decisions on drivers.

Obj. 2 focuses on a) quantification of drivers and development of productivity and growth trends; b) adaptation of models; c) implementation of model simulations; d) readjustment of model parameters based on feedbacks; e) readjustment of descriptive scenarios based on modelling results. Specific outputs include:

- a) quantitative relationships for alternative scenarios for the models
- b) models adequately address quantifiable scenario components
- c) model results quantifying paths of agricultural production, consumption and trade by scenario
- d) improved scenario results in iteration with scenario narratives
- e) improved scenario narratives in iteration with model simulations

During the first reporting period, Outputs 2.a–2.c have been achieved. Feedback loops/iterations among models have not yet been implemented, however. They will be realised in the first half of the second reporting period.

The research activity under Obj. 5 that relates to the first year of implementation is to hold coordination meetings and consult with collaborators. Given the complexity of this research project, a lot of emphasis has been accorded to meetings—significantly more than the originally envisioned four meetings.

Concluded projects

30 June 2006

Bilateral

- CIM/1996/006 Wheat improvement in Sichuan Province: application of modern breeding technologies
- LPS/1998/035 Ruminant production in the red soils region of southern China and in northern Australia
- LWR/1998/130 Water resources and salinity management in agricultural areas of inland Northern China and Northern Australia
- PHT/1998/137 Integrating effective phosphine fumigation practices into grain storage systems in China, Vietnam and Australia

Multilateral

- ADP/2002/114 Rural poor and smallholders in western China under WTO: A regional and community level analysis
- ADP/2005/041 Trade and agricultural development in developing countries—China, India
- LWR/2000/030 Growing more rice with less water: Increasing water productivity in rice-based cropping systems

Project CIM/1996/006: Wheat improvement in Sichuan Province: application of modern breeding technologies

Overseas Collaborating Countries	China
Commissioned Organisation	University of Southern Queensland, Australia
Project Leader	Associate Professor Mark Sutherland Phone: 07 4631 2360 Fax: 07 4631 1530 Email: marksuth@usq.edu.au
Collaborating Institutions	University of Queensland, Australia University of Sydney, Australia Sichuan Academy of Agricultural Science, China Chinese Academy of Agricultural Sciences, China Queensland Department of Primary Industries and Fisheries, Australia
Project Budget	\$1,431,185
Project Duration	01/07/1999 to 30/04/2006 (Project extended from 01/01/2006 to 30/04/2006)
ACIAR Research Program Manager	Dr Paul Fox

Project background and objectives

Wheat is the second most important crop (after rice) in China's Sichuan Province. About 2.3 million ha are planted each year, and this yields about 7.85 million tonnes of grain. The grain is used mainly for making noodles and bread. However, the quantity does not meet the needs of the current population of 89 million people and the Government is anxious to improve its grain output. It is important that the province improve the efficiency of its wheat-breeding efforts. The quality of the grain is also often inadequate for the products it is being used for. Yellow alkaline noodles, a popular food in Japan, China and elsewhere, look unattractive when made with wheat of the incorrect quality. The relevant attributes could be improved with genetic manipulation.

Although the climatic conditions play a part in limiting the yield (inappropriate rain and periods of cold and low light intensity), there are other factors. Firstly there is disease (principally the fungal disease stripe rust); then there is the problem of the premature germination of the wheat grains while still on the stalk, which is faced in Australia as well as Sichuan. Known as sprouting, it is promoted by rainfall coming just before the harvest. Certain wheat varieties—white-grained ones—are inherently more susceptible to this problem. Sprouting resistance exists in some varieties but it is currently difficult to select for in a breeding program because there are no easy markers for it.

Another problem is the intermittent sterility occurring in some wheat types in Sichuan. This could be related to low light intensity because of a naturally cloudy climate, and to cold periods, but resistance genes for this exist. CIMMYT (the International Maize and Wheat Improvement Centre) has been trying to upgrade the productivity of wheat grown in Sichuan by providing elite germplasm and training. However, some of this germplasm, when grown in Sichuan, suffers from intermittent sterility.

The project worked to strengthen wheat breeding capacity in Sichuan and to develop better wheat varieties for the province, and also to provide a better understanding of wheat improvement for noodle quality and sprouting resistance for similar environments in Australia.

Project outcomes

Analysis of three years of yield trial data for 14 Australian, Chinese and CIMMYT wheat lines grown across 10 sites in Sichuan, together with analysis of 10 years of Sichuan Provincial Trial data, has

yielded important information concerning the range of wheat-growing environments in the province and the number of trials and trial sites required to assess varieties. This information will inform long-term breeding strategies and wheat variety deployment across Sichuan.

Investigations into quality characteristics for high quality fresh white noodles, studying both Australian and Sichuan wheats, have provided useful information about relative performance of these lines and identified attributes in the Chinese and Australian materials that may be suitable for crossing into the relevant adapted germplasm for each country. Taste panel evaluations indicated that genes controlling grain hardness are linked to noodle texture, while colour preference tests indicate that the market has a preference for noodles of creamy white appearance, whose quantitative parameters can be selected by breeders using a Minolta colour meter. Chinese lines with resistance to grain blackpoint have been identified and are being evaluated in Australia, while testing to eliminate lines with high levels of late maturity α -amylase has now been adopted in Sichuan.

Stripe rust, caused by *Puccinia striiformis* is currently a major foliar disease of wheat throughout China. The introduction of near-isogenic lines (NILs) and trials conducted in Sichuan by Prof Bob McIntosh during this project indicate that major single genes for resistance are very vulnerable to breakdown in the Sichuan environment. Multiple minor effect genes that give adult plant resistance in the field are much more likely to result in durable resistance and this approach is now being adopted by some Sichuan wheat breeders in the hope of developing new varieties with effective and durable resistance in the Sichuan environment. A young Chinese plant pathologist has received training in the assessment of disease severity in the field, both in Australia and Sichuan.

Germination of grains still in the head following rain at harvest time is a major cause of economic loss in both countries. Markers for major genes conditioning embryo dormancy in Chinese and Australian lines have been identified and published. These markers will assist the selection of lines with resistance to preharvest sprouting. As well chromosomal regions conditioning the expression of low polyphenol oxidase activity, a desirable characteristic for noodle colour stability, have been identified and a biochemical test is available in Chengdu to determine breeding lines carrying this trait.

During the project, trials were conducted to determine the factors which lead to intermittent reproductive sterility in some wheats in Sichuan. Results indicate that lower temperature at flowering was the major factor in the overcast spring conditions of Sichuan, and some locally-derived varieties had much better tolerance to the lower temperature than materials developed elsewhere. This information is now being widely used for parental selection in breeding programs in Sichuan. Genetic analyses suggest that the very high fertility of the local variety *Chuanyu 12* is controlled by two complementary dominant genes. Work to locate molecular markers for gene(s) for intermittent reproductive sterility, using the technologies transferred during the project, is currently under way in Chengdu.

Chinese participants received training in recently developed breeding technologies, equipping them to produce improved wheat varieties that target a range of growing environments and respond to a plurality of market demands. Trainees also gained experience in the use of methods for determining flour and noodle sheet colour, and for measuring dough characteristics on a farinograph. They have also learned techniques for small-scale noodle production, conducted taste panel analysis and measured embryo dormancy, polyphenol oxidase levels and late maturity α -amylase.

Project LPS/1998/035: Ruminant production in the red soils region of southern China and in northern Australia

Overseas Collaborating Countries	China
Commissioned Organisation	CSIRO Livestock Industries, Australia
Project Leader	Dr Bob Hunter Phone: 07 4923 8142 Fax: 07 4923 8222 Email: Bob.Hunter@csiro.au
Collaborating Institutions	CSIRO Sustainable Ecosystems, Australia Jiangxi Agricultural University, China Department of Rural and Social Development, Jiangxi, China Chinese Academy of Agricultural Sciences, China
Project Budget	\$1,038,185
Project Duration	01/07/2001 to 30/06/2006 (Project extended from 01/01/2005 to 30/06/2006)
ACIAR Research Program Manager	Dr Bill Winter

Project background and objectives

The red soils region of central southern China covers an area the size of Western Australia (2.6 million km²) to the south of the Yangtze River. The region is characterised by high and soil erosive rainfall in spring, high evaporation rates in summer and cold winters. Almost half of this area has become seriously eroded as a result of excessive deforestation. There is increasing pressure to develop these soils for agricultural production, due to population pressure and economic growth. Three previous ACIAR projects have delivered technologies for establishment and persistence of pasture forages to help control erosion. The challenge for this project is converting these adapted forages into economic benefits for farmers, by developing a forage-based ruminant production system that integrates well with other activities of smallholder farmers.

The provincial government in Jiangxi, through the Ministry of Science and Technology and Planning Commission, had allocated 150 million Yuan (A\$34 million) for the development of forages to increase ruminant production. In China technology development is focusing on 'cut-and-carry' systems of beef production, to avoid the negative effects that free-range cattle would have on the soils and farming infrastructure. Education and training in feeding strategies are also being made easier with stall-fed animals.

The project aimed to develop economically viable pasture-based beef production systems in the degraded red and yellow soils regions of southern China, in order to meet the rapidly expanding domestic beef market in China and to reduce erosion. It focused on strategies for using forages, crop residues and by-products. Computer software packages to predict animal performance in China and tropical Australia were developed through the project.

Project outcomes

In China the team gathered and collated data about reproductive efficiency, growth rates, mortality, herd structure, age and weight at sale from around 240 households in three counties in Jiangxi and 300 in three counties in Hunan. These data became the benchmarks for later assessment of productivity gains.

The team also completed an inventory of available feed resources, identifying suitable local feedstuffs and by-products. Crop residue feed resources included straws from rice, peanut, sweet potato, and soybean, together with corn stalks. Crop by-products (energy/ protein rich meals) available in Jiangxi include rice bran and cottonseed meal while only rice bran was readily available in Hunan.

A list of recommended perennial summer growing grass species was drawn up for commercial use by smallholder farmers. Research showed that these species are advantageous due to their superior dry matter production in this environment, over-wintering capabilities and a growth habit more suitable for harvesting in a cut-and-carry system. Annual grass species were successfully integrated into rice-growing with beef production where fresh forages were used as the feed resource. The majority of the legumes tested were low yielding and considered to be of marginal suitability for beef production. A spin-off has been their suitability as ground cover for inter-rows in citrus orchards grown on slopes. In this situation they have met with success to control soil erosion and as a source of nitrogen for the fruit trees. Ammonia treatment of rice straw was successful, and in some areas this may be a preferred alternative to silage for winter feed.

Fourteen cattle growth experiments were completed during the project. Based on the results from these studies, the team developed and validated technologies for year-round feeding of beef cattle. This technology delivers annual liveweight gains of 100-200 kg. The team produced seasonal calendars on CD-ROM, integrating land requirements, fodder production and dietary alternatives for cattle production. As well a household economic model, incorporating data from the village surveys and also forage evaluation and animal feeding studies conducted in China, has been developed for a smallholder crop-forage-livestock system. These data include the use of higher nutritive value forage resources (fresh forages and treated straws) based on the forage year profiles, and improved liveweight gain and feed conversion ratios from the project experiments.

The team in Australia studied molasses supplementation, determining the relationship between amount of supplement and frequency of molasses ingestion on intake of forage and the substitution effect. More is now known about rumen function and rumen dynamics with differing amounts of supplement and the consequences for forage intake, also the effect of high molasses intake on drinking water intake and fluid kinetics. Other areas of better understanding include digestion of dietary components, the effect of molasses inclusion rate on forage (fibre) digestion, level of supplementation, interaction with forage quality and liveweight gain. In the study of grazing cattle, researchers determined how level of supplementation affected grazing behaviour, spatial distribution of cattle within paddocks, and liveweight gain.

Two decision support software models—CamBeef and GrazFeed—were evaluated. But these models do not predict feed intake of forage and molasses diets with the required degree of precision. Negotiations are in progress to enable modification of the CamBeef software to accommodate diets with substantial inclusion rates of molasses.

Project LWR/1998/130: Water resources and salinity management in agricultural areas of inland Northern China and Northern Australia

Overseas Collaborating Countries	China
Commissioned Organisation	CSIRO Land and Water, Australia
Project Leader	Dr Ali Riasat Phone: (08) 9333 6329 Fax: (08) 9333 6211 http://www.clw.csiro.au/
Project Web Site	
Collaborating Institutions	Changchun Institute of Geography, Chinese Academy of Sciences, China Ningxia Bureau of Geology and Mineral Resources, China
Project Budget	\$993,358
Project Duration	01/01/2001 to 30/09/2005 (Project extended from 01/01/2005 to 30/09/2005)
ACIAR Research Program Manager	Dr Ian Willett

Project background and objectives

As a result of its extensive use of irrigation to expand agricultural activity over the last few decades, many areas of Northern China now suffer shortages of domestic and irrigation water supplies; an expansion of water-logged areas; the development of alkaline, sodic or saline soils; depletion and contamination of groundwater; increasing saline discharges to lakes and rivers; and nutrients and pollutants contaminating surface soil and water. Western Australia's Ord Bonaparte project is poised to increase its irrigated area from the current 13,000 ha to 60,000 ha. To manage such a large irrigated area sustainably, and prevent similar problems, planners will need reliable data and a good understanding of the entire catchment region.

This project developed a holistic understanding of the surface and groundwater hydrology of three regions:

1. the Yinchuan Plain, in Ningxia province, where agriculture is sustained by irrigation from the Yellow River and most of the cities and villages rely on groundwater aquifers;
2. the Songnen Plain, in Jilin and Heilongjiang provinces, where the climate is semi-arid and agriculture relies on irrigation from the Songhua River and from groundwater; and
3. the Ord River Irrigation Area in Western Australia, also in a semi-arid zone and now being developed to use the water flows from the Ord Dam.

The project sought to establish the appropriate amounts of water that could be pumped from different aquifers in irrigated areas of northern China and the Ord River (WA) without depleting them or endangering water quality with salinity.

Project outcomes

Using the existing and newly collected data and remote sensing, detailed digital maps of the Yinchuan Plain in China and ORIA in northern Australia were prepared showing the extent of current salinity hazard.

Chinese scientists received intensive training and have now the capacity to design, develop and conduct research experiments in surface and groundwater hydrology, salinity and drainage. They can use surface and groundwater models, salinity and geochemical models and GIS to simulate the local and regional hydrological processes. They can also construct advanced databases that can be linked to models. The outputs achieved by this project were only possible due to this training.

The project identified areas that are at higher risk of salinity and shallow groundwater level development in the Yinchuan Plain. Excessive seepage from irrigation and drainage network was

found to cause the development of saline shallow water tables. Then excessive evaporation due to shallow water tables resulted in the accumulation of salts in the soil surface layers.

There is widespread pollution of groundwater from nutrients, pesticides and salts. Shallow groundwater in more than 50% of the Yinchuan Plain has been polluted. It was found that pesticides and fertilisers are the most dominant sources of pollution of surface water resources of the region. But field trials and geochemical modelling revealed that up to 50% shallow groundwater can be mixed with surface water for irrigation without any significant losses in the crop productivity. Reduction in crop yield is expected if groundwater alone is used for irrigation.

Field experiments and modelling suggested that by replacing flood irrigation with furrow irrigation about 35% of the irrigation water can be saved without sacrificing productivity. Deep open drains are effective for lowering the shallow water tables and reducing soil salinity.

Evaluation of the water resources capacity of the Yinchuan Plain for irrigation, domestic and industry uses led to recommendations that in some areas around Yinchuan city the groundwater abstraction from first confined aquifer should be reduced to avoid leakage and pollution from shallow groundwater. The surface water levels in Sand Lake should be lowered by 0.5 m to help arrest the spread of salinity in the surrounding areas.

Irrigated rice production has led to excessive sodium and other salt build up and higher pH in the shallow groundwaters of the Dongdapao area of the Songnen Plain. Here it is not feasible to mix shallow groundwater with deep groundwater (irrigation water) for irrigation of the rice fields. An efficient drainage system is strongly recommended to remove excessive surface and shallow groundwater from the Dongdapao closed depressions. Models suggested that the optimum spacing of production wells in the Dongdapao area ranges from 180 to 200 metres.

In the ORIA there is evidence of excessive recharge to the groundwater through seepage from the irrigation and drainage network and monsoonal rains. Excessive runoff from irrigation water overuse carries salts and nutrients that pollute the surface water resources of the region. Irrigation and salinity modelling suggested that up to 30% water can be saved without any sacrifice in the crop productivity and risk of salinity. Modelling suggested that the water levels in some of the water bodies should be reduced to help keep groundwater at appropriate levels. Such models also indicated the likely effectiveness of the deep drainage systems in lowering groundwater levels in those areas where they have risen closer to the soil surface.

Project PHT/1998/137: Integrating effective phosphine fumigation practices into grain storage systems in China, Vietnam and Australia

Overseas Collaborating Countries	China, Vietnam
Commissioned Organisation	Queensland Department of Primary Industries and Fisheries, Farming Systems Institute, Australia
Project Leader	Dr Patrick Collins Phone: 07 38969433 Fax: 07 38969446 Email: pat.collins@dpi.qld.gov.au
Collaborating Institutions	Zhengzhou Grain College, China State Administration of Grain, China Guangdong Institute of Cereal Science Research, China Postharvest Technology Institute, Vietnam Chengdu Grain Storage Research Institute, China Ministry of Agriculture and Rural Development, Vietnam
Project Budget	\$897,566
Project Duration	01/01/2001 to 31/12/2005 (Project extended from 01/07/2004 to 31/12/2005)
ACIAR Research Program Manager	Dr Greg Johnson

Project background and objectives

Australia (about 25–30 million tonnes), China (495 million tonnes) and Vietnam (30 million tonnes) produce significant grain harvests each year, including rice, wheat, maize and other grains. Each country fumigates about 80 per cent of this grain with phosphine. Due to the combined advantages of low cost, ease of use and acceptance as a residue-free treatment, this fumigant will remain the central component of insect pest management for the foreseeable future in Australia and throughout Asia. However, scientists in an earlier ACIAR project identified that resistance in target pests threatens the continued viability of this fumigant. It also became apparent that several other factors, in addition to resistance, were contributing to control failures with phosphine.

To ensure the continued viability of phosphine technical innovations to enhance the efficacy of phosphine and the development of management strategies to control several psocid species are needed. These have developed as a major problem in stored grain in China. Psocids have also emerged as a major problem in Australia, and initial work here has shown that resistance to phosphine is an important factor, but ecological aspects may also be important.

This project will formulate and verify national fumigation standards for China, Vietnam and Australia, improve fumigation practice in China and Vietnam by undertaking training programs, investigate potential innovations to enhance the efficacy of phosphine fumigation, and determine the key factors preventing effective control of psocids with phosphine.

This will protect and enhance the utility of phosphine as a fumigant for grain and to more fully integrate it into pest management in grain storage systems.

Project outcomes

Objective 1. To formulate and verify national fumigation standards

National fumigation standards for various storage types, aimed at controlling strongly resistant insects and including best management practice, were established in each participating country. The standards were based on broad surveys of insect populations to identify resistant phenotypes, laboratory characterisation of resistance levels and extensive field trials of proposed protocols.

- National standards for modern grain storages and bag-stack fumigations were established and published by Chinese State Administration of Grain.

- In Australia, research has under-pinned an extensive review of phosphine registration. New registration labels for cylinder-based formulations have already been published and label changes for solid formulation aluminium phosphide are currently being negotiated between APVMA and registrants.
- In Vietnam officers of Plant Protection Department prepared procedures for effective phosphine fumigation and submitted them to MARD for incorporation into the National Fumigation Standard.

Objective 2. To improve fumigation practice in China and Vietnam by undertaking training programs

China: In 2001 QDPI&F and Grainco staff trained about 40 key scientists and storage managers in safe, effective use of phosphine and in adult education (extension) and implementation techniques. Chinese project participants then conducted training workshops for more than 3500 grain storage personnel with support from the State Administration of Grain.

Vietnam: Early in the project, staff of VIAEP completed a national survey of insect infestation rates and pest management practices undertaken by farmers, cooperatives and central storages in Vietnam, and the potential of fumigation with phosphine. This information was used to develop appropriate extension strategies and provided a baseline for measuring changes seen as a result of the project.

Objectives 2/3(a) Decreasing losses to stored food suffered by poor farmers by researching, and extending improved household storage techniques.

Surveys of the farm grain storage system revealed that fumigation with phosphine is, in most cases, not appropriate for farmers because of potential health risks. They therefore realigned their extension and research effort to emphasise other management techniques.

In Vietnam the VIAEPHT project team delivered 11 training courses, each for about 70 farmers, in seven provinces in the north and centre of the country. Topics covered: insect pest detection and damage, results of field trials, use of practical, effective cleaning, drying and storage methods. The team also produced a practical IPM manual for farmers. Experimental trials were set up in farm households and villages to introduce and demonstrate new technologies including storages and grain dryers. This team focused on introducing appropriate improvements to the lives of ethnic minority people living in mountainous regions where postharvest losses are typically 20% and can reach 40%. They trialled drying and storage methods that were affordable and compatible with village lifestyle and successfully reduced insect damage to about 5%.

Objective 3. To investigate potential innovations to enhance the efficacy of phosphine fumigation

In China scientists at the Chengdu Grain Storage Research Institute defined levels of CO₂ required for control of a wide range of storage pests. They also demonstrated the utility of applying phosphine as a split application and the use of CO₂ to improve the efficacy of phosphine (by limiting sorption).

In Australia researchers at QDPI&F completed extensive experiments and field trials characterising the influence of fumigation temperature, phosphine concentration and exposure period on the effectiveness of phosphine against resistant *Rhizopertha dominica* and *Sitophilus oryzae*. Resistance to phosphine has also been characterised in *Tribolium castaneum* and *Oryzaephilus surinamensis*—both resistances can be controlled with newly developed protocols.

Phosphine fumigations of grain in bag-stacks and in small bins generally result in exposure of insects to changing concentrations of gas rather than the more constant concentrations experienced in large storages. In Australia, a series of experiments undertaken at QDPI&F showed that the efficacy of changing concentrations of phosphine can be predicted from results from assays using constant concentrations. This result will allow a shortening of fumigation times

Objective 4. To determine the key factors preventing effective control of psocids with phosphine

Students at Henan University of Technology contributed outstandingly to the knowledge we have of psocid biology, ecology, distribution and resistance to phosphine. This work is a highlight of the project.

Multilateral

Project ADP/2002/114: Rural poor and smallholders in western China under WTO: A regional and community level analysis

Overseas Collaborating Countries	China
Commissioned Organisation	International Food Policy Research Institute, USA
Project Leader	Dr Shenggen Fan Phone: 1 202 8625677 Fax: 1 202 4674439 Email: s.fan@cgiar.org
Collaborating Institutions	Chinese Academy of Sciences, Centre for Chinese Agricultural Policy, China Chinese Academy of Agricultural Sciences, Institute of Agricultural Economics, China Gansu Agricultural University, College of Economics and Trade, China
Project Budget	\$398,930
Project Duration	01/07/2003 to 30/06/2006
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

Since December 2001 China has been part of the World Trade Organisation (WTO). The impact of the Chinese economy as a whole will be positive, but distribution of these benefits across regions and sectors of the economy is likely to be patchy. Sectors and areas engaged in agricultural and other production where China does not have a comparative advantage stand to gain very little or even lose. One area likely to be in this situation is western China, a region that accounts for more than 70 per cent of China's total poor. It is characterised by poor infrastructure and resources and is mainly an agricultural producer. The Chinese government has identified development of this region as a top medium to long-term priority. With WTO accession policymakers will need to re-evaluate current policies to ensure smallholders are not disadvantaged.

Agricultural growth is a key driver of poverty reduction. Policies will need to cater for investment options that help build infrastructure, strengthen outputs and address barriers to smallholders gaining from this by way of increased productivity or migrating to non-farm sectors. Infrastructure, education and health spending is low, entrenching many of the barriers to non-farm migration and current agricultural practices. WTO entry could aggravate this situation unless a clear understanding of its impacts is understood.

The project explored future policy options, particularly public investment policies, for Western China to achieve both economic growth and poverty reduction and buffer adverse shocks under WTO.

Project outcomes

The project began with a review of existing literature and secondary data. The team collected the data on county-level financing and spending data from 1980 to 2003, and made numerous field trips in western China (Guizhou and Gansu provinces) to investigate the major issues related to public policies and poverty reduction. Team members then designed survey forms at the county, township and village levels for investigating the effects of public policies at the different government levels on rural poor and smallholders in western China.

Based on the data collected, analyses were conducted at county, village and household level. At the county level, the analysis focused on how decentralisation of fiscal system leads to different outcomes on growth and regional inequality and how central government transfer affected inequality within-province and within the western poor sector of China. The village-level study analysed how public provision, governance and their resources endowments determine per capita income of smallholders.

Local government and communities: China has a politically centralised government structure with strong top-down mandates. On the other hand, the country has a very highly decentralised fiscal system. Local governments and communities are responsible for providing most local public goods and services. Large differences in economic structures and revenue bases exist, however, causing the implicit tax rate and fiscal burdens in support of local government functions to vary significantly across jurisdictions, particularly between coastal and western China.

Coastal China, initially endowed with a broader non-farm tax base, does not need to rely heavily on new and existing firms to finance public goods provision to create a healthy investment environment in support of non-farm sector growth. In contrast, local governments in western China, where smallholder agriculture is the major economic activity, spend the majority of their resources on their own operating costs, leaving little for public investment. Because of the relatively high transaction costs associated with collecting taxes from the agricultural sector, local governments tend to levy the existing non-farm sector heavily, thereby greatly inhibiting its growth. Due to lack of resources, local governments and communities are not able to provide much needed support for agricultural production. For example, extension services often lack funds for travel, training, and purchase of improved seeds and breeds.

As a result, regional differences in economic structures and fiscal dependent burdens may translate into widening gaps in equality between western and coastal China. The positive aspect is the rapid development of private and farmers' initiatives in bringing new technologies, practices and market information to individual smallholders. These initiatives are particularly active in the livestock sector.

The government has introduced numerous policies trying to narrow the regional development gaps and to help the smallholders in western China to increase their income, particularly through central government transfers. However, our country-level analysis shows that fiscal equalisation policies, though in favour of inland areas, didn't work well in reducing the inland gap between poor and non-poor counties. The smallholders have benefited very little through these transfer and development programs. This has important policy implications.

While the central transfer is important for narrowing the regional gap, the efficient use of these funds, particularly targeting these funds to public provisions for smallholders instead of covering local government's operation, should be a pre-condition for future increase of the transfers. In particular, public provisions in infrastructure, education and health, and agricultural technology should be in the top priority list. In addition, various institutional and policy barriers that hinder the market integration between western and coastal China should be removed, so smallholders can either migrate to coastal areas or engage in non-farm activities in their own communities, and private investment will flow to western China. The rapid rising of coastal China also provides huge market opportunity (particularly for high-value produce) for smallholders in western China. Again, the central government transfer should be geared for reducing the transaction costs for smallholders.

Village level: The team used within-village inequality analysis using the census type survey (all households in a village) for the first time in China. This groundbreaking work provided new insights on the extent of village inequality and the determinants of inequality among households within the same villages, where a majority of farmers are smallholders. These findings have important implications for promoting development in lagging regions and for poverty reduction. While the overall economic development will be the main instrument to bring the majority poor out of poverty, a targeted approach is increasingly crucial to help poor villages and households. It is critical to understand why these villages and households cannot participate in the growth process, and how development programs and various transfer programs help them to overcome their constraints.

Project ADP/2005/041: Trade and agricultural development in developing countries—China, India

Overseas Collaborating Countries	China, India
Commissioned Organisation	International Food Policy Research Institute, Market and Structural Studies Division, USA
Project Leader	Dr Ashok Gulati Phone: 1 202 862 5600 Fax: 1 202 467 4439 Email: a.gulati@cgiar.org
Collaborating Institutions	
Project Budget	\$150,000
Project Duration	01/06/2004 to 31/12/2005
ACIAR Research Program Manager	Dr Ray Trewin

Project background and objectives

Assessing agricultural policies and levels of protection or disprotection for selected Asian developing countries, particularly India and China, since the inception of the WTO Uruguay Round negotiations in 1985, will help refine approaches to ensuing WTO benefits agriculture. The conceptual and empirical issues that arise when calculating such measures as market price support (MPS) or producer support estimates (PSEs) for developing countries need to be more clearly understood. Two reports have been produced (Mullen, Orden and Gulati, *Agricultural policies in India: PSEs 1985–2002*, <http://www.ifpri.org/divs/mtid/dp/papers/mtidp82.pdf>; Cheng and Orden, *Exchange rate misalignment and its effects on agricultural PSEs: empirical evidence from India and China*, <http://www.ifpri.org/divs/mtid/dp/papers/mtidp81.pdf>).

Project outcomes

The overall purpose of the project was to assess agricultural policies and levels of protection or disprotection for selected Asian developing countries, particularly India and China, since the inception of the WTO Uruguay Round negotiations in 1985. Attention focused on the conceptual and empirical issues that arise when calculating such measures as market price support (MPS) or producer support estimates (PSEs) for developing countries. The two reports, were produced:

Mullen, Kathleen, David Orden and Ashok Gulati. *Agricultural Policies in India: Producer Support Estimates, 1985–2002*, MTI Discussion Paper 82, International Food Policy Research Institute, Washington D.C., February 2005, 128 pages.

Cheng, Fuzhi and David Orden. *Exchange Rate Misalignment and Its Effects on Agricultural Producer Support Estimates: Empirical Evidence from India and China*, MTI Discussion Paper 81, International Food Policy Research Institute, Washington D.C., February 2005, 82 pages.

The report on agricultural policies in India reviewed the substantial economic policy reforms undertaken since 1991. The protection and support versus disprotection of agriculture were evaluated by examining market price support for 11 crops (accounting for nearly half of agricultural production value) and budgetary expenditures for fertiliser, electricity and irrigation subsidies. Key domestic and international cost adjustments are incorporated into the analysis by drawing on the extensive price-comparison data sets and assessments developed previously by Ashok Gulati and his co-authors, often using disaggregated analysis for representative surplus and deficit states.

Our results indicate that support for agriculture in India has been counter-cyclical. Support for agriculture rises when world prices are low (as in the late 1980s and 1998–2002) and falls when world prices strengthen (as in the early and mid 1990s). Budgetary payments (for input subsidies) have increased in recent years. Yet for key commodities and in the aggregate, when incorporating both price support and budgetary expenditures, the counter-cyclical dimension of agricultural policy dominates a clear trend from disprotection toward protection over the period 1985–2002.

The counter-cyclical pattern of support for agriculture in India has an important interpretation in the context of the WTO Doha Round agriculture negotiations. India has used border protection to insulate its farmers from low world prices in a manner and timing that corresponds to the increased subsidies provided in the United States and other developed countries when world prices fall. Disciplines on both of these instruments will be required to achieve an agreement that is effective at increasing world trade opportunities and stabilize world price levels.

The magnitudes of estimated support for agriculture obtained in our paper are important for several additional reasons. The estimates confirm that high levels of subsidies (in the range of 35–50 per cent) were required for India to export wheat or rice in recent years, a conclusion reached by several other studies. However, we report less disprotection of Indian agriculture in the 1990s than in earlier published studies. Part of this difference is explained by the differences in our approach, like the modified procedure for choice of a reference price.

In the second paper, on exchange rate misalignment and its effects on PSEs, modern time series econometric techniques are used to identify determinants of the equilibrium real exchange rates for India and China. Our findings show that, due to poor external sector performance and depletion of foreign exchange reserves, the actual real exchange rate of the Indian rupee was overvalued in the years leading up to the financial crisis in 1991, but has since then move closer to the equilibrium. The Chinese yuan also experienced periods of misalignments which mostly consist of undervaluation. Rigid nominal exchange rates, low inflation rates, and strong economic fundamentals in recent years have driven up the gap between the actual and equilibrium value of Chinese currency, causing an undervaluation of about 20 per cent.

The results presented in the two papers have increased knowledge about the policies that have caused protection or disprotection of agriculture in India and China, and the magnitudes of these effects. The results have been presented at conferences in China, Pakistan, at FAO, and at meetings of the American Agricultural Economics Association, and will be presented in other professional settings and in discussion with policy-makers.

Project LWR/2000/030: Growing more rice with less water: Increasing water productivity in rice-based cropping systems

Overseas Collaborating Countries	China
Commissioned Organisation	International Water Management Institute, Sri Lanka
Project Leader	Randolph Barker Phone: 94 1 867404 Fax: 94 1 866854 Email: R.Barker@cgiar.org
Project Web Site	http://www.clw.csiro.au/research/agriculture/irrigated/help/ ; http://www.irri.org/ipswar/about_us/ipswar.htm
Collaborating Institutions	CSIRO Land and Water, Australia Wuhan University of Hydraulic and Electric Engineering, China International Rice Research Institute, Philippines
Project Budget	\$1,008,357
Project Duration	01/07/2001 to 31/12/2005 (Project extended from 01/07/2005 to 31/12/2005)
ACIAR Research Program Manager	Dr Ian Willett

Project background and objectives

Rice is a vital food staple in China with a large part of the population dependent on rice production. Most of this rice is produced using irrigation, using valuable water resources. Water use in China is rising, prompting China to promoting water-saving irrigation (WSI) techniques. Such techniques must not reduce yields, which must remain at a high level to produce sufficient food. One of these techniques is alternate wetting and drying of rice paddies, rather than the traditional method of continuous flooding. In the Zhanghe Irrigation System (ZIS), a part of the Yangtze River Basin, authorities are balancing demands for irrigation against increased demand for hydro-power. Farmers operating within the reaches of the system rely on rainfall, with surface ponds used to store water. Irrigated supplies supplement this source of water and are used to overcome water scarcity during rice cropping. Managing the conflict between farmers and the hydro-power sector is the task of ZIS authorities. A second system, the Liu Yuan Kuo Irrigation System (LIS), in the Yellow River Basin contrasts that of the ZIS by being water-poor, that is, rainfall is insufficient to match demand.

Field experiments in China have shown that in most of the rice cropping systems WSI is a potential solution to such conflict. It does not reduce the yield of the rice, but does reduce the irrigation input to rice fields by about 10–15 per cent compared to continuous flooding. This has led to questions about the nature, success, and adaptability of the alternate wetting and drying technique, and how it can aid water managers in systems such as those of the ZIS and LIS. Also can this technique be transferred to other areas. Australia is facing problems similar to those of China. The declining water availability, increasing water prices, and environmental degradation of agricultural lands and riverine ecosystems are driving the demand for water savings.

Past research has indicated that there is a potential to save irrigation water by using alternate wetting and drying and saturated soil culture. However, because these techniques lead to changes in irrigation demand, the potential benefits to river flow patterns have yet to be determined.

The project aimed to address these issues by linking Chinese and Australian laboratories to promote water management techniques in rice-based irrigation systems that reduce water consumption and do not decrease crop production. In particular this project aims to further investigate the technique of alternate wetting and drying, and to compare it to the techniques of saturated soil culture and aerobic rice in China.

Project outcomes

Water saving irrigation using alternative wetting and drying is a viable option for farmers in the Zhanghe Irrigation System (ZIS). Studies confirmed that alternate wetting and drying can be practiced without yield losses, while saving significant irrigation water. Farm surveys revealed that at the farm level the maintenance of yields does not affect profitability. The key finding was that farmers will practice water saving only by default. At the catchment level the artificial creation of water scarcity will prompt farmers to adopt water saving irrigation without reducing yields or profits, providing farmers know how to implement such techniques.

The main source of water loss from fields is water seepage through bunds. These bunds separate fields but can be reinforced to reduce seepage. However, the adoption of alternate wetting and drying has been shown to reduce standing water and with it the opportunity for seepage.

All of these findings were confirmed through use of the ORYZA2000 crop model. The model was used to assess water saving irrigation under differing water management scenarios, notably differing hydrological conditions and the use of aerobic rice. Testing at the ZIS catchment level revealed that limited flows out of the basin are present, but field level management is very effective. These findings revealed that surface outflow cannot be further exploited without impinging on water availability downstream. Through this project the Tuanlin Research Station in the ZIS has become a centre for irrigation and water saving research excellence. To date an estimated 1.5 million hectares of farming land is now under alternate wetting and drying.

Findings for the Lin Yuan Kuo Irrigation System were different, due largely to the diversity of characteristics. Unlike the ZIS catchment where evaporation and rainfall are almost equal, in the LIS evaporation demand is greater than rainfall. The shortfall in rainwater and the lack of places to store water result in more water scarcity. Aerobic rice, that does not require flooding, was trialled resulting in a yield reduction. Despite this farmers indicated in surveys that aerobic rice has value, reducing labour inputs by up to 50 per cent with the benefit of not needing sufficient water to flood fields.

At the catchment level hydrological-economic analysis determined water savings could be achieved by pumping groundwater through canals. Lining the canals to prevent seepage was needed. Redistributing irrigation water from nearer the river to those fields further from the river, in concert with groundwater pumping for those farmers closer to the river helped more farmers' access sufficient water. Farmers nearer the river could be aided in utilising groundwater pumping through a subsidy scheme to install pumps.

The institutional arrangements and policies practices in the ZIS are more conducive to water savings than those of the LIS. In the LIS farmers pay a flat rate for water, with managers having to return savings to the Yellow River. The lack of incentives contrasts to the ZIS, where farmers pay a volumetric rate for water consumed. This encourages water savings at the farm-level, on-farm storage and a willingness to try new techniques. System managers too benefit through savings by being able to allocate water for non-agricultural uses.

Aligning system objectives and incentives to save water so that all users are working together helps create a culture of efficiency. The policy ramifications are clear for the LIS, which has moved to work this approach into its 11th five year planning for the modernisation and rehabilitation of the system.

In Australia's Murrumbidgee Irrigation Area methodologies for tracking accounted for water flows have been developed as a result of this research. Modelling to quantify water savings at the farm and system levels was conducted revealing potential savings that have a net benefit of between \$64 to \$344/mega litres saved each year. Water savings identified will be adopted to guide infrastructure investments in the Murrumbidgee catchment, and will provide inputs into the National Water Initiative, aimed at introducing irrigation and other water efficiency improvements to recapture 500 giga litres.

Projects under development

at 1 October 2006

Bilateral

ADP/2002/092	Free trade agreements in East Asia - their effects on agricultural trade
ADP/2005/070	Trade liberalisation and other sectoral changes impacts on small-holder incomes, employment, productivity and public good needs in Indonesia and China
CIM/2005/111	More effective water use by rainfed wheat in China and Australia
LPS/2005/129	Mineral response in Tibetan livestock
LPS/2006/119	Integrated crop and dairy systems in Tibet Autonomous Region
LPS/2006/175	Economic analysis of development options for rural households in Tibet
LWR/2006/076	Improving livelihoods and water productivity through rainwater harvesting for agriculture in northwest China
PLIA/2006/135	Trends in world agriculture to 2030 in India, China and Indonesia
PLIA/2006/150	Links between Avian Influenza research on transmission via wild birds in China
PLIA/2006/151	Establishment of beef on red soils in China
PLIA/2006/152	Dwarf elephant grass adoption in China

China consultations

11–12 October 1999

Priorities for collaborative agricultural research between Australia and China were discussed on 11–12 October 1999 at a consultation between ACIAR and representatives of relevant Chinese Government Ministries, departments and research organisations.

These priorities are not to be considered as officially sanctioned priorities of the Government of China. They are priorities expressed by participants at a consultation at a particular point in time. ACIAR will use them as a framework when assessing proposals for collaborative projects to be supported by ACIAR, subject to further advice and information from China.

Researchers intending to seek ACIAR support for collaborative research projects with Chinese counterparts should, in the first instance, approach one of ACIAR's Research Program Managers.

At the consultation, consensus was achieved on several overarching priority issues. These were the need to manage scarce water resources efficiently; the need to raise farmers' incomes; the need to raise the quality of agricultural products; the opportunities offered by new genetic and information technologies; and the need to deliver benefits to less developed regions in north-western and south-western China.

The following priorities are listed under ACIAR Program areas for convenience.

Agricultural Development Policy and Agricultural Systems Economics and Management

- Agricultural policy studies. market-oriented water pricing policy, price premium for quality grading, grain trade policies; impacts of WTO on relative competitiveness of different sectors, and implications for prices and markets; agricultural and marketing information systems; farm-level [micro-level] impacts of various policies; linkages between agricultural technology development [research], urbanisation and poverty alleviation; and research on how to involve resource users and stakeholders in designing and implementing resource management studies).
- Technology impact assessment. (This includes the impact of developed technologies supported by ACIAR and other sources; methodology development for impact assessment; potential impact assessment of proposed/required technologies; and farmers' reaction to technologies).
- Rural finance mechanisms (functions of rural banks and credit companies; roles of micro-finance; and roles of farmers' organisations).
- Rural social security and insurance (livestock and crop insurance; disaster relief; and medical care and pensions).

Animal Sciences

- Ruminant production from forage systems in North West and South West China
- Grazing management and protection of the grasslands (socioeconomic and policy issues, pasture /livestock management, rodent control, improved forage production in arable[agricultural] areas).
- Livestock feed production, conservation and utilisation
- Crop by-products, including the use of microorganisms to improve the nutritional value of crop by-products, feed and livestock production simulation, and modelling for efficient management and production.
- Livestock products, processing and marketing (including early stage fine wool processing, and meat quality (beef and mutton grading) and marketing)
- Specific livestock production constraints (including animal health protection and disease prevention, vaccines and disease diagnosis, particularly using biotechnological and molecular techniques, parasite control in sheep and cattle, and information systems for animal production and disease control strategies, processing and marketing).

Crop Sciences

- Design and development of productive and sustainable farming systems for arid regions through a systems approach, assisted by systems simulation and modelling.

- Integrated development of legume crops for semi-arid regions, including variety improvement, development of new uses, improvement of soil fertility, provision of seed supplies, and integration into crop rotations.
- Improvement of quarantine systems, through provision of information and training, and tools for risk analysis and decision making.
- Development of improved germplasm of potato, tomato and brassicas, through conventional and molecular techniques, with resistance to diseases and pests and improved quality.
- Reduction of chemical input in crop production through improved approaches for pests and nutrition management, e.g. development and better use of biological agents, breeding of resistant varieties, etc.

Forestry

- High value products from eucalypt plantations, through improved germplasm and cultivation techniques and optimised processing and utilisation techniques
- Sustainable forest management in sub-tropical areas, through development of sustainability indicators for different management levels, models of productivity and environmental impact of plantations, and breeding strategies for plantation species (e.g. Southern pine).
- Rehabilitation of degraded forest eco-systems for improved community benefits in southwest China, in particular through the use of shelterbelt systems, multiple purpose trees species, and establishment of appropriate infrastructure and monitoring and evaluation systems
- Effective re-forestation technologies for key catchment areas in the Yangtze and Yellow Rivers, the desert area in Xinjiang, and the Taihang mountains, for flood control and improved management of groundwater, with an emphasis on developing tree planting methods for water saving

Land and Water Resources

- Soil fertility improvement and efficient use of chemical fertilisers
- Soil chemical degradation related to nutrient and organic matter depletion, acidity and sodicity
- Farm-scale water-saving technology
- Irrigation system management
- Crop residue management, including alternatives to burning
- Water quality improvement, including impacts of aquaculture
- Other areas of priority included adaptation of precision farming to Chinese conditions; land use policy including economics, pricing systems and tenure; grassland and wetland management; water resource management at the basin scale; soil erosion, salinisation, and desertification; and management of wastes from intensive animal production systems

Postharvest Technology

- Grain quality assessment, including index of deterioration, grading technologies and separate storage, specification of processing quality, and mycotoxins
- Farmer scale technologies for grain storage, including storage structures & technology, pest and moisture management, extension and training
- Postharvest technology for fruit and vegetables, including disease resistance and control, quality maintenance in transport and storage, farmer scale technologies and packaging, and melons in Western China
- Postharvest technology for roots and tubers, including washing systems, bacterial breakdown, and animal feed use.

Two topics for support from other donors for scaling-up of outputs from previous research were also identified. These were Integrated Pest Management in fruit and vegetables to reduce pesticide residues, and pesticide residue and mycotoxin monitoring and regulation. Four priorities for economics and policy research were identified: grain marketing; implications of WTO access; fruit and vegetable marketing and processing; and meat marketing and quality assurance.

ACIAR publications

This list is a selection of titles from ACIAR's range of scientific publications that are relevant to China's agricultural research and development sector. Hard copies are available by emailing comms@aciar.gov.au, or may be requested through ACIAR's China office. Publications may also be downloaded from ACIAR's website, www.aciar.gov.au.

Impact Assessment Series

- 04 Raw wool production and marketing in China: ACIAR project 8811
- 08 Australian tree species selection in China
- 10 Conservation tillage and controlled traffic
- 13 Breeding and quality analysis of rapeseed
- 15 Use of management of grain protectants in China and Australia
- 23 Improved methods for the diagnosis and control of bluetongue in small ruminants in Asia and the epidemiology and control of bovine ephemeral fever in China
- 26 Impact assessment of ACIAR-funded projects on grain-market reform in China
- 28 Water and nitrogen management in wheat–maize production on the North China Plain
- 30 Eucalypt tree improvement in China
- 32 Shelf-life extension of leafy vegetables—evaluating the impacts
- 33 Research into conservation tillage for dryland cropping in Australia and China
- 35 Review of the returns to ACIAR's bilateral R&D investments
- 39 Benefits to Australia from ACIAR-funded research

Monographs

- 32 Working with mycorrhizas in forestry and agriculture
- 37 Detection and treatment of mineral problems in grazing sheep
- 46 The distribution and importance of arthropod pests and weeds of agriculture and forestry plantations in southern China
- 48 Nutrient disorders of sweet potato
- 54 Survey toolbox of livestock diseases: practical techniques for developing countries
- 57 Haemorrhagic septicaemia
- 58 Understanding animal health in Southeast Asia
- 62 Developing forage technologies with smallholder farmers: how to select the best varieties to offer farmers in Southeast Asia
- 74 Nutrient disorders in plantation eucalypts
- 84 Regional water and soil assessment for managing sustainable agriculture in China and Australia
- 94 Survey toolbox for aquatic animal diseases
- 96 Rats, mice and people: rodent biology and management
- 97 Effects of globalisation and economic development on the Asian Livestock Sector
- 100 Field methods for rodent studies in Asia and the Indo Pacific
- 111 High-yielding anthracnose-resistant *Stylosanthes* for agricultural systems
- 116 China's agricultural and rural development in the early 21st century
- 119 Guidelines for surveillance for plant pests in Asia and the Pacific
- 120 Better-practice approaches for culture-based fisheries development in Asia
- 121 Planters and their components: types, attributes, functional requirements, classification and description

Proceedings

- 38 Forages on red soils in China
- 44 Bovine Ephemeral Fever and related rhabdovirus
- 48 Australian tree species research in China
- 57 *Leucaena*: opportunities and limitations
- 62 Mycorrhizas for plantation forestry in Asia
- 63 Matching trees and sites
- 66 Bluetongue disease in the Asia-Pacific region
- 73 Mineral problems in sheep in northern China and some other regions in Asia
- 97 *Hypsipyla* shoot borers in Meliaceae
- 105 Postharvest handling of fresh vegetables*
- 111 Eucalypts in Asia
- 116 Water in agriculture
- 119 Agriproduct supply-chain management in developing countries
- 120 Spiny lobster ecology and exploitation in the South China Sea region
- 123 Agricultural water management in China

Technical Reports

- 25 Economic aspects of raw wool production and marketing in China
- 32 Production of fine wool in northern China: effect of nutrition and helminth infections
- 43 Grain market reform in China: global implications
- 49 *Chukrasia*: biology, cultivation and utilisation
- 57 Trials of cold-tolerant eucalypt species in cooler regions of south-central China
- 60 Building economic decision-making capabilities of Chinese wool textile mills

Working Papers

- 05 Project development assessment: mineral elements limiting sheep production in China (Project 8911)
- 28 Project development assessment: an economic evaluation of the potential benefits of integrating apomixis into hybrid rice
- 33 A qualitative assessment of the research capacity and community impacts of three randomly selected ACIAR-sponsored projects
- 40 Socioeconomic study on farmers' adoption of integrated pest management (IPM) strategies in brassica vegetable crops in China
- 41 Developing forage technologies with smallholder farmers: how to monitor and evaluate impacts
- 55 Forages for the red soils area of China
- 56 Agricultural research and poverty alleviation: some international perspectives
- 59 Survey of the mineral status of livestock in the Tibet Autonomous Region of China