ACIAR
Australian Centre for International Agricultural Research

PROJECT PROFORMA

SECTION 1. Project Outline

Project title:	Regional impacts of re-vegetation on water resources of the Loess Plateau, China and the Middle and Upper Murrumbidgee Catchment, Australia
Proposal stage:	Full
Proponent's name:	Dr Tim McVicar
Phone:	(02) 6246-5741
Fax:	(02) 6246-5800
Email:	Tim.McVicar@csiro.au
Proponent's organisation:	CSIRO Land and Water
Commissioned organisation:	CSIRO Land and Water
Project type:	Bilateral Large
% funding to IARC	0
Focus area:	"Better environments from better agriculture"
ACIAR Research Program Area:	Land and Water Resources 1
Project Number:	LWR1/2002/018
Geographic Region/s:	North Asia
Country/ies:	China

Funding request (not included in this publically available Web-version

Project Duration: 3 years
Proposed Start Date: 1 January 2003
Proposed Finish Date: 31 December 2005

Key Contacts

Project Leader: Australian Commissioned Organisation / Commissioned IARC

Title and Name	Dr Tim McVicar
Position	Senior Research Scientist
Organisation	CSIRO Land and Water
Phone	61-2-6246-5741
Fax	61-2-6246-5800
Email	Tim.McVicar@csiro.au
Postal Address	GPO Box 1666, Canberra ACT 2601 Australia
Street Address	Clunies Ross St, Acton, Canberra ACT 2601 Australia

Administrative Contact: Australian Commissioned Organisation

Title and Name	Mr Phillip Fletcher
Position	Project Management Accountant
Organisation	CSIRO Land and Water
Phone	(02)-6246-5704
Fax	(02)-6246-5800
Email	Phillip.Fletcher@csiro.au
Postal Address	GPO Box 1666, Canberra ACT 2601 Australia
Street Address	Clunies Ross St, Acton, Canberra ACT 2601 Australia

Project Leader: Partner Country

Title and Name	Professor Li Rui
Position	Director
Organisation	Institute of Soil and Water Conservation, Chinese Academy of Sciences and Ministry of Water Resources
Phone	86-29-701-2061 (Work) / 86-29-701-8123 (Home) Mobile (Beijing) 139-1071-9961 / Mobile (Yangling) 139-9281-2012
Fax	86-29-701-2210 (ISWC)
Email	lirui@ms.iswc.ac.cn
Postal Address	No 26, Xinong Road, Yangling, Shaanxi Province, PR China, 712100
Street Address	As above

Abbreviations used in the proposal

1. Organisational – China

BMUR	Bureau of the Middle-Upper Reaches of YRMC
CAS	Chinese Academy of Sciences
ISWC	Institute of Soil and Water Conservation (of CAS and MWR)
MWR	Ministry of Water Resources
YHRBMC	Yanhe River Basin Management Committee
YRMC	Yellow River Management Committee

2. Organisational – Australia

CLW	CSIRO Land and Water
CRC_CH	Cooperative Research Centre for Catchment Hydrology
CSIRO	Commonwealth (of Australia) Scientific and Industrial Research Organisation
DLWC	Department of Land and Water Conservation (NSW State Government)
MDBC	Murray-Darling Basin Commission

3. Study Site - China

LP	Loess Plateau (667,000 km^2)
CSHR	Coarse Sand Hilly Region (a subset of HR) is (134,050 km^2)
HR	Hilly Region of LP (180,000 km^2)
TR	Tableland Region of LP (31,000 km^2)
YDA	Yan'an Demonstration Area (707 km^2)
YGC	Yanggou Catchment (47 km^2)
YHB	Yanhe Basin (7,673 km^2)
ZFGC	Zhifanggou Catchment (8.27 km^2)

4. Study Site - Australia

MDB	Murray-Darling Basin (1,100,000 km^2)
MUMC	Middle and Upper Murrumbidgee Catchments (26, 863 km^2)

5. Scientific / Project Terms

AVHRR	Advanced Very High Resolution Radiometer, a sensor onboard the US Federal Agency NOAA series of satellites (NOAA = National Oceanographic and Atmospheric Administration)
DEM	Digital Elevation Model
ESS	Earth System Sciences (a CSIRO initiative to support modelling the coupled land –atmosphere system)
ETa	Evapotranspiration – Actual
ETp	Evapotranspiration – Potential
GIS	Geographic Information System
LAI	Leaf Area Index
PDP	Post-Doctorial Project (in the context of LWR1/2002/108, this CSIRO ESS funded project plans to make AVHRR data readily available for all Australia. Dr Tim McVicar is one of the two Principal Investigators.)
RS	Remote Sensing
T-GIS	Temporal-GIS
TM	Thematic Mapper, a sensor onboard the Landsat series of satellites, not Tim McVicar (TMcV), abbreviations used for all staff involved in LWR1/2002/018 are provided in Section 3.5
VBA	Visual Basic Applications (a programming language)
WWW	World Wide Web

Project summary

The Loess Plateau, in western China, is a water limited agricultural region with deep erodable soils. It is a heavily dissected landscape that is, inparts, too steep for cropping, and is remote from China's developing markets on the eastern seaboard. In combination, these factors mean farmers relying solely on agriculture are among the poorest in China. The low proportion of perennial vegetation cover and intense summer monsoon rainfall largely contributes to severe soil erosion problems on the Loess Plateau. A solution to this agricultural problem is large-scale re-vegetation using perennial plants (grasses, shrubs and trees). The aim of the re-vegetation programme in the Loess Plateau is to reduce soil erosion and thus improve water quality of the Yellow River. Re-vegetation is widespread in China; the Chinese Central Government has enthusiastically implemented the "Clean River: Green Hills" policy to run from 2000 until 2050. As LWR1/2002/018 will be conducted during the initial stages of the 50-year policy, potential influence from LWR1/2002/018 on the overall policy implementation is maximised. Australia's agricultural areas are facing environmental degradation issues of salinity and waterlogging. Here, re-vegetation is seen as a solution to reduce excess water entering regional groundwater systems; to 'dry' landscapes and hence reduce the deleterious impacts.

However, in both countries the impacts of large-scale re-vegetation on broad scale hydrology are poorly understood. The project aims to further develop regional ecohydrologic process understanding and to impact mid to senior policy makers by developing spatial scenario modelling tools. In China, the objective is to develop a suitable spatially distributed model that can be used by policy makers. This will be developed for the entire Coarse Sandy Hilly Region and a key demonstration area within the Loess Plateau and made available via a Web-based delivery system. In Australia, the objective is to determine the buffering capacity of re-vegetation to episodic groundwater recharge given Australia's high climate variability; this research will be performed in the Middle and Upper Murrumbidgee Catchment (MUMC), a key agricultural catchment within the Murray-Darling Basin (MDB). The proposed collaborators are Chinese Academy of Sciences (CAS) and Ministry of Water Resources (MWR) Institute of Soil and Water Conservation (ISWC), Yangling City, Shaanxi Province and CSIRO Land and Water, Canberra.

In China, the approach will be to develop a spatial information system using interpolated meteorological surfaces, landscape position derived from a Digital Elevation Model (DEM), and remotely sensed information of land-cover. These databases will be used to validate a suitable regional water balance model run at an annual time-step for the entire 134,050 km^2 Coarse Sandy Hilly Region (CSHR), an area that contributes 73% of the sediment to the Yellow River. We will validate a monthly flow model for the 7,673 km^2 Yanhe Basin (YHB). The YHB lies within the CSHR and fully contains the Yan'an Demonstration Area (YDA), a key re-vegetation demonstration area for western China. Results from re-vegetation in the CSHR, YHB and YDA will be the backbone for re-vegetation schemes applied to the entire Loess Plateau. Hence, developing a readily available spatial scenario modelling tool during the initial re-vegetation planning stages will have a large impact on the entire 667,000 km^2 Loess Plateau. The ecohydrological modelling will assess the cumulative impact from the time of re-planting perennial plants (grasses, shrubs and trees) in different areas of the landscape. The re-planting could be actual (as observed in the land cover maps derived from remote sensing) or potential (as in scenario modelling for planning purposes). The cumulative impact will be assessed using Boolean logic and weighted overlay techniques

readily available in Geographic Information Systems (GIS). This will be extended to include time, hence a Temporal-GIS (T-GIS) will be developed. The T-GIS will allow both prospective modelling and retrospective monitoring of the ecohydrological impact of re-planting. The modelling will be based on validated monitoring. Within the spatial modelling environment, the imperative to avoid re-vegetating the high agricultural productive lands will be accounted for.

For China, the output will be the development of software that will allow high-level agricultural policy makers to develop different scenarios for re-vegetating the YHB. The policy makers are already aware of the proposed project and their involvement in design of the Web-based spatial modelling system will be formally solicited in meeting within the first three months of project commencement. They will again be involved in another workshop conducted at the same time as the mid-term review. Finally, mid and senior policy makers from appropriate local, provincial and national organisations will attend a third workshop held toward the end of the project in YHB. The Web-based spatial modelling system will be served by ISWC. Additionally, a CD version will be posted to all identified parties. The software will be written so that new areas will be able to be modelled once suitable spatial-temporal databases are available. For example, if databases become available, the modelling could be conducted for the entire Loess Plateau.

In the MUMC, Australia, similar monthly datasets will be developed as in YHB. Higher-temporal frequency measurements of the ecosystem dynamics, specifically remote measures of Leaf Area Index (LAI) and actual evapotranspiration (ETa), will be used. Acquiring spatially-dense rasters of these two variables will allow the regional water balance to be 'closed' with a great degree of confidence. As with China, we will develop spatial modelling software and will conduct similar scenario modelling to assess ecohydrologic change as a function of proposed land-use change. This will include pine and eucalypt plantations and changing annual pastures to deep-rooted perennials such as lucerne. In Australia, this proposed project would be a partner project of the Cooperative Research Centre for Catchment Hydrology (CRC_CH). Again, software will be developed to allow regional agricultural policy makers access to the model to run scenarios with the developed software. This model will be included in the CRC_CH "Toolkit". It is expected that developing regional hydrologic models using as much measurement as possible will greatly benefit agricultural communities wanting to reduce the impact of salinity and those relying on access to water resources within the MUMC. The developed method could be extended to other areas within the entire MDB, and all agricultural areas in southern Australia.