PARTICIPATORY APPROACH TO CROSS-DISCIPLINARY WATER RESEARCH: INTRODUCING (HELP) INITIATIVE AND AUSTRALIAN PERSPECTIVE

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ABSTRACT

Internationally there is a major lag between research, and real world water policy and management. Most water management policy is based on outdated knowledge and technology. Hydrology for Environment, Life and Policy (HELP) is a joint initiative of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Meteorological Organization (WMO). UNESCO HELP initiative is aimed to bridge the gap between water policy, water resources management and scientific communities from the setting of research agenda to the free flow of information to be used in the day to day management and policy making processes. HELP is creating a new approach to integrated catchment management through the creation of a framework for water law and policy experts, water resource managers and water scientists to work together on water-related problems.

The broad objectives of HELP are to strengthen field-oriented experimental hydrology using drainage basins with scales ranging from 10^4 to 10^6 km^2 as the framework. Water related physical (hydrological, climatological, ecological) and non-physical (technical, sociological, economics, administrative, law) observations will be made in these catchments which address the most critical policy and management issues as perceived by "users" under different biophysical and socio-economic environments, taking into account the needs for sustainable development. The desire for this new programme to be truly "user-driven" will require the active involvement of research, university teaching, policy-making and facilitating (water and land resource managers groups) to set the policy agenda and ensure the scientific results will benefit societal needs through the revision of policy and management practices.

In Australia, the multilevel stakeholder engagement in urban and rural water research and development of management tools and policies in the Murrumbidgee catchment had helped it gain the status of reference catchment under the (HELP) programme.The

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competing water uses and environmental and economic concerns in the Murrumbidgee are typical of other arid catchments in the world. Both completed and ongoing hydrological projects are available that can be used to illustrate how communities, researchers and regulation bodies are involved in catchment management by developing appropriate geographic information system, irrigation management tools, hydrologic–economic and educational models. The approach has been very influential in bringing about change in land and water management and in informing and guiding regional policy.

Keywords: Hydrology, HELP, UNESCO, Participatory Water Management research, Catchment, Irrigation Management in Australia

1. INTRODUCTION

Gibbons et al. [1] distinguishes two approaches to knowledge production: traditional research is Mode 1, in which there are narrow fields of study and separate roles, with academics developing the knowledge and passing it on to the practitioners. In Mode 2, knowledge is produced by a transdisciplinary team that includes the practitioner, and the learning is immediate for all--it is part of the discovery process. The role of the practitioner is central to Mode 2 throughout the entire research process. The HELP initiative is encouraging Mode 2 knowledge production. HELP is a joint initiative of the United Nations Educational Scientific and Cultural Organisation (UNESCO) and the World Meteorological Organisation (WMO). HELP began following the 5th UNESCO/WMO International Conference on Hydrology in February 1999 and is led by the International Hydrology Program. HELP aims to address key water resource issues in the field and integrate them with policy and management needs therefore introducing a new approach to integrated catchment management. The new approach is to use real catchments, with real water related problems as the environment within which hydrological scientists, water resources managers and water law and policy experts can work together.

HELP is founded on a global network of catchments as shown in Figure 1. National or local authorities can suggest catchments to be included, which will need to fulfil the HELP criteria for baseline physical and socio-economic data exchange. A new catchment must also have adequate local capacity to increase sharing of expertise, to improve access to data and the findings from other HELP catchments, and to provide opportunities for funding and building capacity in water institutions.

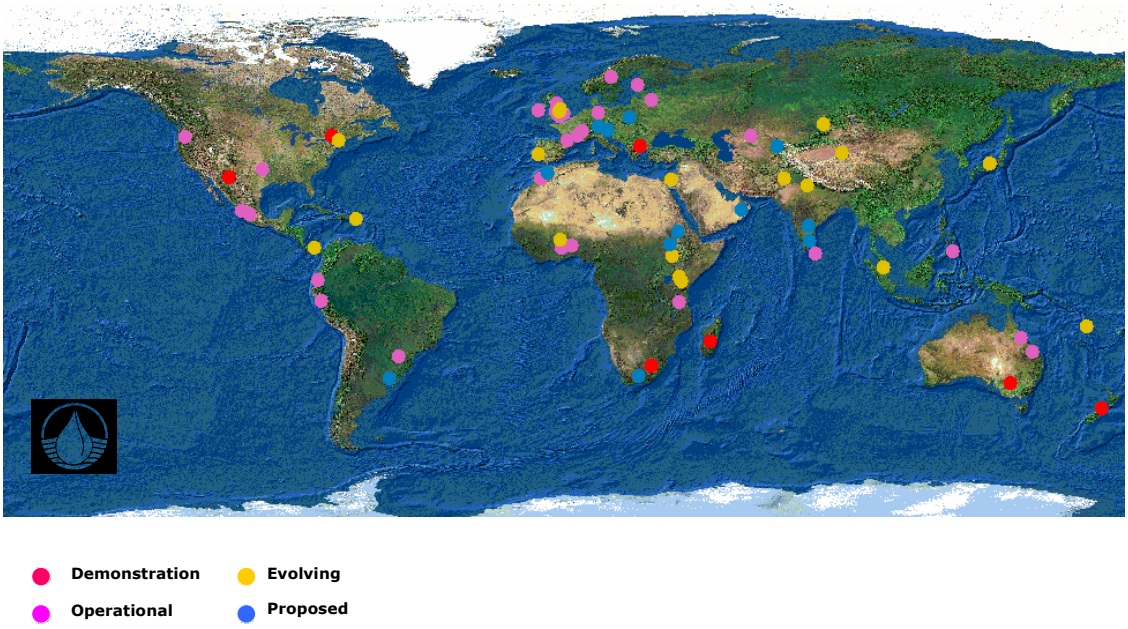

Figure1- Current UNESCO HELP Basins

The Demonstration and Operational basins each have several years of practical experience of working within the HELP framework. In some cases longstanding scientific programmes have been developing further through the application of sustainability and good governance practices. The HELP initiative provides them with international recognition of progress achieved in this new direction. The high proportion of Operational basins in Europe is a result of developments in the European Union. Many of these projects have benefited from EU funding, or national funding linked to EU legislation. Most projects in the South are linked to local recognition that water problems are best approached through Integrated Water Resources Management (IWRM). Further information about individual HELP basins can be found at www.unesco.org/water/ihp/help.

In the Murrumbidgee catchment, south-eastern Australia, a cooperative and practical approach by irrigation farmers, industry and researchers has been delivering research to address regional needs. This has lead to Murrumbidgeee gaining demonstration basin status within the HELP network. In the Murrumbidgee basin to bring about more effective management of the catchment, communities, researchers and regulation bodies are involved in developing a range of tools, including appropriate geographic information system databases and irrigation tools, hydrologic–economic and educational models. Management of water resources in the region requires a rigorous understanding and application of hydrology combined with economic, policy and legal aspects of water management.

2. HELP ACTION AREAS

HELP is designed to develop scientific research in the application of integrated water resources management (IWRM) through Hydrology for Environment, Life and Policy [2]. Examples of HELP success in active involvement of university teaching, policy-making and facilitating (water and land resource managers groups) to set the policy agenda and ensure the scientific results will benefit societal needs through the revision of policy and management practices in Australia are given by Khan [3].

HELP has currently six major action areas for promotion of Mode 2 science as described below.

2.1 WATER AND CLIMATE

The major research question into water and climate area is: "How can knowledge, understanding, and predictive modelling of the influence of global variability and change on hydrological variables and remotely sensed data can be used to improve the management and design of water resource, agro-hydrological and eco-hydrological systems?"

Subsidiary issues for this interest area include:

- How significant is the relationship between the statistics of hydrological variables and observable global phenomena, and how does this change with location?
- How can remote data capture, and advanced information transfer technologies best be applied to improve the management and design of water systems?
- How can predictions of seasonal-to-interannual variations be used to improve the management of water, including for disaster prevention (floods and droughts)?
- How significant are multi-decadal fluctuations in climate, and how can knowledge of such fluctuations be used to improve the design of water systems?
- What is the hydrological significance of potential anthropogenic climate change, and how can predictions of such change best be used to improve design of water systems?

2.2 WATER AND THE ENVIRONMENT

The level of environmental protection to be provided in any basin is a matter of political choice and commitment. Developing countries will usually be least able or willing to consider the issue of the water required for environmental protection – their first priority usually is to take care of the immediate, basic needs of their population. This HELP initiative is aimed to raise the awareness so that these two objectives are not contradictory and there are pathways to strike a balance. Major issues include the potential impacts on the environment of:

- population growth
- industrialisation and pollution
- land cover/land-use changes
- species extinction and introduction of new species perceptions and attitudes of society towards the environment

HELP research questions include:

- What role does the environment play in securing water resources?
- How do we place a value on the "natural" environment?
- How can we identify the impacts of environmental change on water resources?
- How do we minimise conflicting environmental and human requirements?
- What is the effectiveness of environmental law on water resources?

2.3 WATER QUALITY AND HUMAN HEALTH

This HELP objective aims to develop the necessary integrated view of how catchments work, in order to understand the relations between water quality and water quantity at variable spatial and temporal scales. There is need to understand how water quality is affected by varying land uses and management approaches – that is, to understand the basic evolution of water quality. The understanding of processes linked with contaminant transfer and temporary adsorption (or absorption) through the land system – before these enter into rivers and streams – is extremely poor. HELP aims to promote appropriate water-quality monitoring programmes in its network of basins.

2.4 WATER AND FOOD

The major HELP challenge in terms of water and food is "how can the efficiency with which water is used in agriculture be improved and how do the need, scope and methods for achieving this vary regionally and locally? "

HELP is aiming to facilitate research on some of the following questions:

- the most appropriate techniques for reducing water losses from agricultural fields due to surface runoff, soil evaporation and drainage;
- how much water could be saved by improving transpiration, and what techniques can be used to do this;
- how much water efficiency could be improved by using different crops and/or crop mixtures;

- the relative savings to be made in rain-fed and irrigated agriculture, and potential for the complementary use of water between the two;
- whether significant efficiency gains can be made through assessing the way water can be used in different places and at different times across an entire catchment;
- the downstream impacts of increasing water-use efficiency in agricultural areas;
- the reasons local farmers do not adapt apparently straightforward technologies for improving water-use efficiency.

2.5 WATER AND CONFLICTS

HELP includes a component on the role of hydrological data, information and process understanding in management of water resources, as well as in co-operation on water management and avoidance and resolution of conflicts.

HELP aims to promote development and application of Alternative Dispute Resolution (ADR) techniques to water management through:

- studying the role of hydrological information in creating the basis for rational management of water by a nation and among neighbouring countries;
- encouraging basic studies of conflict management integrated with a research programme that has the necessary databases linked with process hydrology.
- supporting studies of specific cases in selected river basins;
- conducting real-world simulations in support of joint management.

2.6 IMPROVING COMMUNICATIONS

HELP aims to encourage multilevel stakeholder engagement to:

- provide a reduced set of reliable and comparable information on the state of catchments;
- interpret science in a way useful to managers;
- include water resources, environment, social and economic criteria;
- capture the “essence” of the catchment in a few statistics;
- provide comparison between countries and regions;
- indicate trends over time and space;
- measure success (and failure) of catchment management, programmes and policies.
- ensure comparability between projects.

3. AUSTRALIAN HELP PERSPECTIVES

The lower Murrumbidgee catchment in the Murray Darling Basin has been selected as the first global reference basin in the HELP pilot phase and remains a demonstration basin in the operational phase since it provides an excellent example of community involvement in hydrological research and development of integrated catchment management policies using a range of tools. The lower Murrumbidgee Catchment is serving as an example catchment to illustrate water resources management under competing water uses and environmental and economic concerns in an arid zone which are similar to many other catchments in the world.

The Murrumbidgee River (Figure 2) has a catchment area of around 84 000 km2 and a length of 1600 km from its source in the Snowy Mountains to its junctionm with the Murray River. The total surface water resources of Murrumbidgee catchment are made up of average flow downstream of two damd (Burrinjuck and Blowering Dams) of around 4000 MCM. The system includes some major floodplain lakes, e.g. Lake Mejum near Narrandera and Yanga Lake near Balranald.

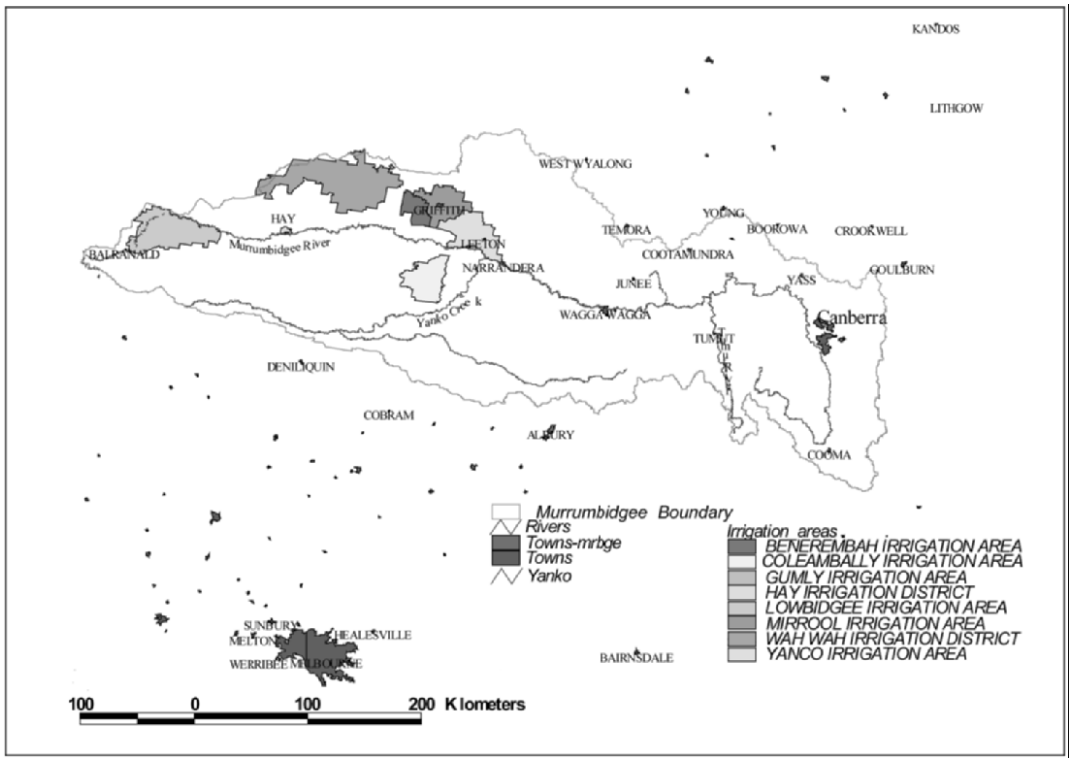

Figure 2. Murrumbidgee catchment and irrigation areas.

The Murrumbidgee catchment can be broadly divided into three major hydrogeological units:

- Upper Murrumbidgee Fractured Aquifers.
- Mid Murrumbidgee Alluvium.
- Lower Murrumbidgee Alluvium.

Downstream of Narrandera, unconsolidated alluvial deposits are collectively known as the Lower Murrumbidgee Alluvium. This alluvial system consists of three major aquifers. The estimated annual recharge to the Lower Murrumbidgee aquifer system is 335 MCM/year and a 'safe yield' is 270 MCM/year [4]. Although the reported groundwater pumping is still less than the 'sustainable yield', there has been a rapid increase in the use of groundwater since 1994/95 with an overall decline in groundwater level of the deeper aquifers between by 10–20 m over the main groundwater pumping area.

Figure 2 shows the location of main irrigation areas (IAs) along the Murrumbidgee River. In addition to these areas, the Lowbidgee is a floodplain area of 150 000 ha with 85 000 ha of irrigated grazing.

The key issues in the Murrumbidgee basin include:

- Water reforms and decline in water availability for irrigation
- Reduced water flows in the river
- Rising watertables and soil salinity in irrigation areas
- Declining pressure levels and contamination of aquifer in groundwater pumping areas
- Competition with downstream use (environmental flows and water quality)
- Increasing salinity in the river
- enhanced climate variability and change
- livelihoods issues

Several landmark changes in water reform policies have been formulated in recent times with the objective of striking a balance between the consumptive and environmental components of flows in Australian catchments. Some of the developments that affect irrigated agriculture include the Council of Australian Governments Reforms and the MDBC CAP on future water development.

These water reforms have had major consequences for irrigated agriculture as they have placed a moratorium on the issue of new surface and groundwater licenses, so further irrigation development is only possible through improving water use efficiency or purchasing water from an existing user. Implementation of the CAP and River Flow Rules has also had the effect of reducing water allocation to irrigators with a history of high use of their allocation. Furthermore, uncertainty of water supply has increased greatly, and it is often not until after the irrigation season is well underway that irrigators have a good estimate of how much water will be available. Thus, there is considerable risk associated with planting and crop establishment decisions.

The threat of cuts in water allocation and recurrence of droughts pose serious problems to the viability of the regional communities in the Murrumbidgee catchment.

Maintaining flows for irrigation is in competition with increasing flows in the river for all downstream users (who are demanding that irrigation allocations be reduced to increase flows and reduce salinity levels in river). Altered and lower flows in the river are key contributors to the decline in river health manifested in ways such as increasing algal blooms, a decline in native fish numbers and increases in exotic species, and a decline of wetlands (due to a lack of water in some instances and permanent inundation of others). There is also concern about groundwater depletion and the risk of contamination of these groundwaters.

Researchers with a range of disciplinary expertise from state and federal government organizations and private organizations, work with regulation agencies and farming communities to develop ways of linking the diverse information bases of the catchment. These groups are also active in promoting learning and management capability of land and water users and technical support people. Within this extended information and learning environment, researchers have developed a set of catchment and farm-level models to assist, assimilate and evaluate better management options. These tools, together with a participatory research and engagement approach, have helped further develop research priorities and management tools. This approach has been very influential in bringing about a change in land and water management and in informing and guiding regional policy that has delivered improved integrated catchment management.

Examples of completed and ongoing hydrological projects addressing some of the above issues are available. These projects are being used to illustrate under the HELP program how communities, researchers and regulation bodies are involved in catchment management by developing appropriate GIS, hydrological, hydrologic economic and educational models. A range of innovative hydrologic, integrated hydrologic economic and community education tools commonly known as SWAGMAN (Salt, WAter and Groundwater MANagement models) [5, 6] have been developed by CSIRO for natural resources management. These models and community participation activities are readily transferable to other parts of the world and can therefore promote technology transfer.

Some of the recently planned HELP related research activities with a strong community involvement include:

a. A framework to assess:

- potential water savings [7] (e.g. from system reticulation losses, channel seepage and on farm losses);

- water saving options [8] piping of flows, channel lining, alternative irrigation/cropping possibilities and

- local and regional economic and environmental benefits of increased water use efficiency at a range of scales

b. Improved understanding of salt and contaminant flows from irrigation areas and their interactions with the regional hydrological system (surface and ground water) [6,9];

c. Determine tradeoffs between on farm productivity objectives and regional ecological and hydrological targets in response to water management practices;

d. Develop tools to help change seasonality of river flows towards natural patterns for better ecological outcomes [10]. This will be achieved by spreading the irrigation demand through the optimum use of in stream, off stream and irrigation area storage facilities and by alternative cropping patterns;

e. A hydrologic economic framework to help inform infrastructure investment and rationalisation decisions for future irrigation systems considering current and future climate scenarios [11];

f. Improved participative research and management methods and tools (web based models, market based instruments and best management guidelines) that engender trust and understanding in the regional communities that would be impacted by such changes.

g. Market based instruments for trading net recharge credits in the Coleambally Irrigation Area

Recent development include Wagga Wagga Global Water Smart Initiative. Wagga Wagga is located in the middle of the Murrumbidgee catchment and has a history of creative water management including effluent reuse and salinity management which places it in prime position to become the urban demonstration city. The idea is to develop a city wide strategy for urban water management that will be complementary to the existing non-urban HELP activities occurring within the Murrumbidgee Basin.

This strategy includes issues such as management of local Lake Albert and the Murrumbidgee River for recreational purposes, smart water use within the urban area, reuse of effluent water, and management of urban groundwater including salinity management. The aim is that within 10 years (by 2015) Wagga Wagga is recognised internationally as a Global Water Smart City. There is great opportunity for other semi-arid cities around the world to share the sustainable water management experience gained under this project.

Stakeholders are involved through the steering committees of the planned and ongoing projects. A wider stakeholder involvement will be achieved through seminars and dedicated workshops.

There is a need to build institutional and local capacity in water resources managemnet. This will be achieved through on-the-job training of the personnel of related organizations in the use of tools and models. A dedicated environmental education programme is already underway in the Coleambally Irrigation Area. Arrangement for training environmental staff of other irrigation companies has been made. Some of the

other activities to be undertaken through cross-organization projects will include the following:

- development of appropriate educational curricula and training at undergraduate, postgraduate taught courses and PhD research;
- community engagement-representation and conceptualization of regional natural resource management;
- engagement of the general public in natural resource management through the arts and the media.

4. CONCLUSIONS

The HELP initiative has proved to be of widespread interest around the world, North and South. The Demonstration and Operational basins are practicing many aspects of good water governance and can share best practice experience with other basins.

The Murrumbidgee catchment (in Australia) illustrates that a cooperative and practical approach by irrigation farmers, industry and researchers has been delivering research which is sought and used. This work has required multiple stakeholder engagement due to pressures from multiple sectors for increased water to be used to rehabilitate and maintain the health of river ecosystems.

Murrumbidgee HELP initiative is already unlocking the paradigm locks between politicians, policy makers, water managers and researchers.

5. ACKNOWLEDGEMENT

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