FRIEND: an international network for bridging the gap between research and practice

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Abstract The paper summarizes the key global issues of the twenty-first century, including population growth, environmental change, management of increasingly scarce resources, international development and environmental policy. The FRIEND (Flow Regimes from International Experimental and Network Data) programme is a global research network with over 75 participating countries. Examples of practical FRIEND research outputs are presented, together with a number of constraints and opportunities for transferring research to the user community. The FRIEND network is in a strong position to bridge the gap between research and practice but this will require developing closer partnerships with the user community and more actively implementing the process of technology transfer.

Key words water resources; livelihoods; technology transfer; networks

THE GLOBAL CONTEXT

Freshwater is a finite and precious resource and, of course, is essential to sustaining life. With an increasing global population, the challenge of managing water resources grows. The need to manage competition between different users is becoming more apparent. In many regions of the world, problems of access to sufficient quantities for consumption and production purposes are now widespread. With the long-term impact of climate change only beginning to be understood, patterns of availability in the twenty-first century may well be substantially altered. As a consequence, the risks and uncertainties will be greater. Water is already a contested resource: in many regions of the world the lack of freshwater has reached crisis proportions and it is now a potential cause of outright conflict between people and nations. The challenge for the international community is considerable: how to manage this increasingly scarce resource to ensure that the global goal of poverty elimination can be achieved within safe and secure human environments.

Water issues are not confined to developing countries. In Europe, for example, groundwater is polluted by nitrate, pesticides, heavy metals and hydrocarbons, leading to eutrophication, toxic impacts in other parts of the water environment and possible effects on human health. Increased surface and groundwater abstraction has led to reduced river flows and degraded aquatic ecosystems whilst lowering of water tables has caused degradation of wetlands and saltwater intrusion into coastal aquifers. With urban development in flood plains there has been an increase in the population at risk from flooding, a public perception that both the frequency and magnitude of floods is increasing and less tolerance to flood-induced human suffering and economic damage.

FLOW REGIMES FROM INTERNATIONAL EXPERIMENTAL AND NETWORK DATA

Under the auspices of UNESCO, FRIEND (Flow Regimes from International Experimental and Network Data) is one of the tools being employed by the nations of the developed world in partnership with the nations of the developing world to meet the above challenges. FRIEND was based on the premise that the potential in the results from the large number of experimental and representative basins, which had been established globally in the 1960s and 1970s, had not been fully realized or the results implemented operationally. In 1985 work was started by a small international team in Europe to establish the methodology for realizing the potential in the results from representative and experimental basins in northern Europe. The outcome of this work attracted a considerable amount of attention and its merits ensured that FRIEND evolved through several phases to a worldwide (Fig. 1, Table 1) regionally-based study (Gustard & Cole, 2002). Today FRIEND is established as a cross-cutting theme in the current phase of the International Hydrological Programme (IHP-VI) which runs from 2002 to 2007.

FRIEND is organized through regional FRIEND groups. Participants are drawn from operational agencies responsible for water resources planning and management, from universities and research institutes and the programme of work is designed to meet the regional priorities identified by the participants. Through this mechanism FRIEND has a problem solving, solution driven approach and has led to studies into low flows, floods, variability of regimes, rainfall/runoff modelling, processes of streamflow generation, sediment transport, snow and glacier melt, climate change and land-use impacts. In the developing world, such science is set against the practical need for hazard mitigation and poverty alleviation, particularly through training and capacity building.

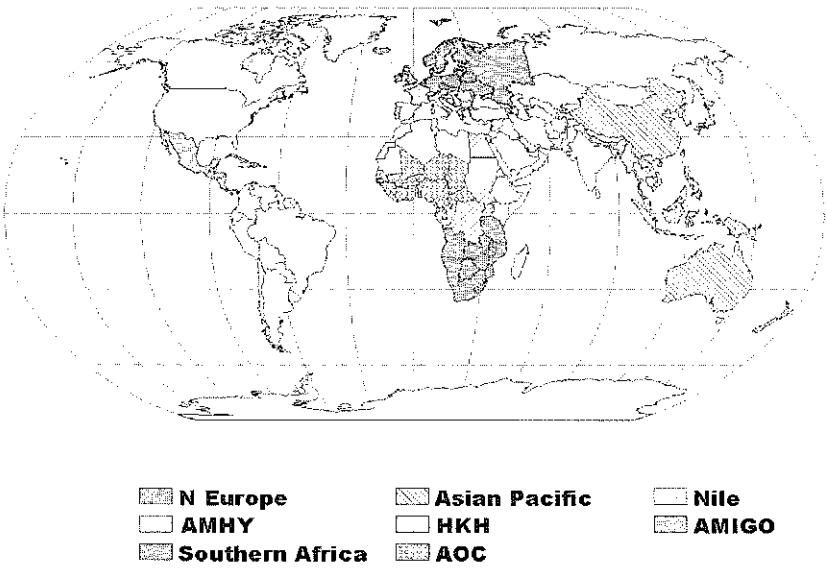


Fig. 1 Regional FRIEND groups (acronyms are explained in Table 1).

Table 1 Establishment of regional FRIEND groups.

Date	Group	Region
1985	Northern European FRIEND	Twenty-four countries from northern Europe
1991	Southern African FRIEND	Twelve countries of the Southern Africa Development Community (SADC) region
1991	Alpine and Mediterranean Hydrology (AMHY) FRIEND	Seventeen countries from southern Europe and northern Africa
1994	FRIEND AOC	Sixteen countries in central and western Africa
1996	Nile Basin FRIEND	Ten countries of the basin involved
1996	Hindu-Kush Himalayan (HKH) FRIEND	Eight countries in the HKH region
1996	Asian Pacific FRIEND	Thirteen participating countries from China to New Zealand
1999	Mesoamerican and Caribbean FRIEND (AMIGO)	Mexico and Caribbean Islands

FRAMEWORK FOR TECHNOLOGY TRANSFER

Within the FRIEND programme there has been a number of successful research projects providing practical solutions to a wide range of environmental problems. In the case of low flow hydrology, for example, these include: resource estimation at the European scale (European Environment Agency, 1998); impact of environmental change on low flows in The Netherlands, Norway and UK (Querner *et al.*, 1997); application of regional low flows to hydropower estimation in the Himalayas (Rees *et al.*, 2002); estimating whether droughts have become more severe or frequent (Hisdal *et al.*, 2001) and development of regional simulation models for water resource assessment in southern Africa (Hughes & Metzler, 1998). Although there has been some uptake by operational agencies of the knowledge and tools produced by these and other FRIEND outputs, there is considerable potential for increasing this uptake.

Key elements and impediments for transferring research to the practitioner are the institutional framework in which this takes place, the scale (global, regional, national, local), the issue, the propensity to accept new concepts and techniques and finally, the skill and resources of both the researcher and practitioner. These present formidable challenges to both operational and research agencies even where the problem is well defined, for example, reducing the risk of flooding to urban areas or agricultural land. These challenges are magnified by the need to integrate water resource management, both floods and droughts; surface water and groundwater; quality, quantity, ecology; physical and socio-economic sciences; and institutional reform. By training and culture the researcher tends to be a specialist but for his skills to be of use to mankind, he must work in a holistic environment. Pressures on the researcher are limited data, hypothesis testing, innovation, scientific rigour, peer review, understanding, explanation and funding. In contrast, the practitioner, through experience, is risk aversive and "conservative". Pressures include use of best practice, consistency, participation, transparency, understandable methodology, assessing impacts, risk analysis and decisions that directly affect people's lives. Can FRIEND bridge this gap?

At the global level the FRIEND project operates within a number of institutional frameworks. For example, sustainable access to safe water for drinking, and water for

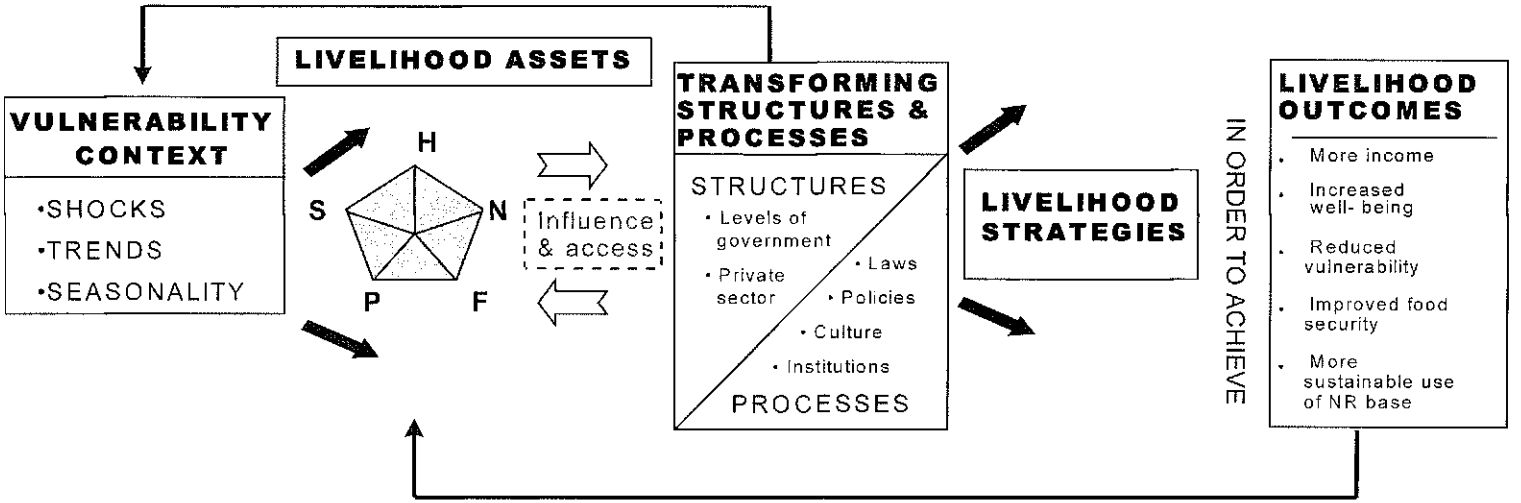
agriculture and the environment, play an important part in achieving a number of the key UN targets. FRIEND can contribute to meeting these development targets. At the regional level the European Water Framework Directive (WFD), with the objective of achieving good ecological status in all surface water and groundwater, is the most significant piece of European water legislation for over 20 years and provides a key framework for FRIEND research in Europe.

To meet these policy objectives, research must be directed towards problem-solving. However, advancing knowledge alone is not enough to bring about change, there is a need to convert knowledge to practical tools. Furthermore, enabling individuals to use knowledge requires planning, training and capacity building. Universities and other higher education institutes should ensure that recent advances in knowledge and skills are transferred to future practitioners by updating the content of curricula. Institutions involved in water resource management will have a primary responsibility for identifying research priorities, in encouraging interdisciplinary approaches to water resource management, in using and disseminating research outputs and establishing "best practice". These are supported by a number of international initiatives which are giving stakeholder participation and research dissemination a high priority, including the HELP (Hydrology for Environment, Life and Policy) programme of IHP, the HOMS (Hydrological Operational Multipurpose System) programme of WMO and the "toolbox" of the global water partnership for advancing horizontally and vertically integrated water resource management.

RESEARCH TO PRACTICE

The UK has actively contributed to and benefited from the low flow research programme of FRIEND. One practical application of this has been estimating low flows at ungauged sites (Young *et al.*, 2000). Initially focused on long-term flow statistics, this now includes seasonal statistics, the estimation of artificially influenced low flows and the integration of local data into estimation procedures. This has been delivered to the UK water industry through a series of software tools, the most recent of which is LOWFLOW 2000. The institutional framework for this is the European Water Framework Directive and the Environment Agency of England and Wales Water Resource Strategy. This embraces the Catchment Abstraction Management Strategy (CAMS) whose objective is to manage water sustainability, considering the needs of abstractors, fisheries, navigation, recreation, water quality and conserving the aquatic environment. The LOWFLOWS 2000 software based on a national low flow research programme provides a key operational tool for enabling Environment Agency staff to deliver CAMS.

One useful context in which to position the FRIEND research programme, particularly in developing countries, is within a livelihoods framework (Department for International Development, 1999). The livelihoods approach (Fig. 2) is a way of thinking about the objectives, scope and priorities for development, based on the capabilities, assets (including both material and social resources) and activities required for a means of living. Water is cross cutting and is both a physical capital and natural capital. Figure 3 illustrates in more detail one example of the role of the hydrologist in



where:

H represents **human capital**: the skills, knowledge, ability to labour and good health important to the ability to pursue different livelihood strategies;

P represents **physical capital**: the basic infrastructure (transport, shelter, water, energy and communications) and the production equipment and means which enable people to pursue livelihoods;

S represents **social capital**: the social resources (networks, membership of groups, relationships of trust, access to wider institutions of society) upon which people draw in pursuit of livelihoods;

F represents **financial capital**: the financial resources which are available to people, whether savings, supplies of credit or regular remittances or pensions and which provide them with different livelihood options;

N represents **natural capital**: the natural resource stocks from which resource flows useful for livelihoods are derived (e.g. land, water, wildlife, biodiversity, environmental resources)

Fig. 2 Sustainable livelihood approaches to poverty elimination (Department for International Development, 1999).

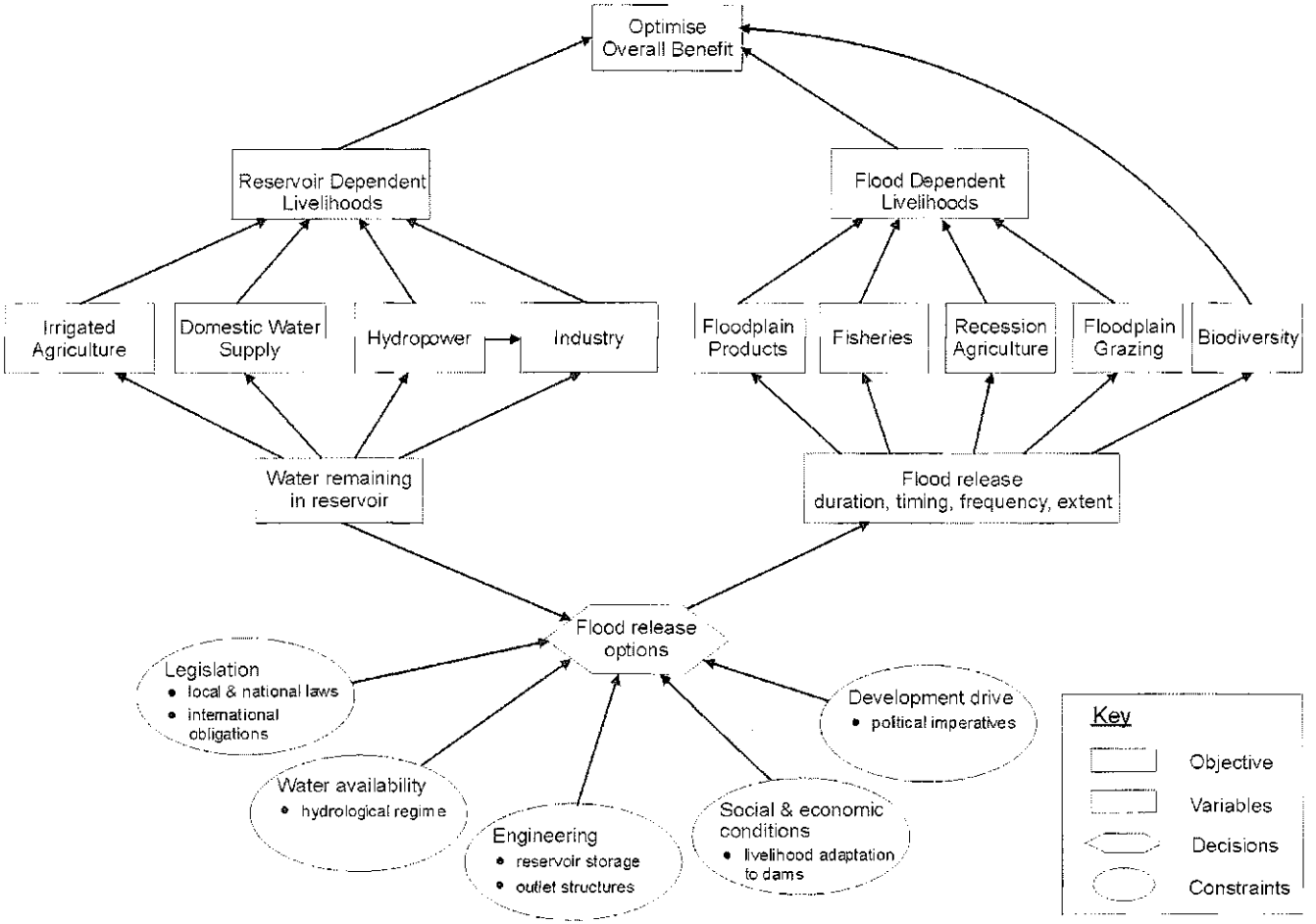


Fig. 3 Flow chart showing the trade-off between using water for managed flood releases and for reservoir based activities (Acreman, 2002).

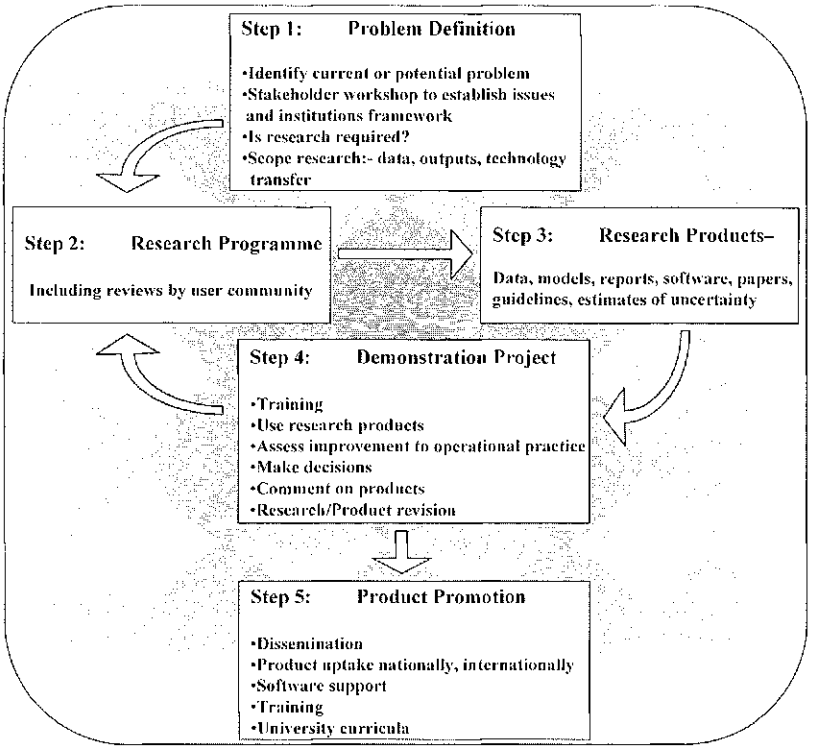


Fig. 4 From research to practice.

enhancing the livelihoods of people influenced by the operational management of flood releases from reservoirs. Acreman (2002) has highlighted how consideration has rarely been given to reservoir releases of high flows for short periods which inundate flood-plain and deltaic ecosystems. When flooded periodically, these wetland ecosystems supply important products (e.g. arable land, fisheries, livestock grazing), functions (e.g. groundwater recharge, nutrient cycling) and attributes (e.g. biodiversity), which have provided the economic, social and environmental security of rural communities worldwide for many centuries. This approach identifies uncertainties and knowledge gaps, e.g. estimating the impact of environmental change and reservoir operation on river regimes, understanding the relationships between flow regimes and wetland functions and evaluating response of ecosystems to changing quantity and water quality of river flows.

Figure 4 illustrates five steps which are essential to ensure that research is successfully transferred to the user community. Most research groups, including the FRIEND programme, focus on Steps 2 and 3. However, there is a need to give a higher priority to actively plan the process of technology transfer to ensure that adequate resources are provided for Steps 4 and 5. Indeed, there is a need for the "whole life support" of research products which may include additional research together with software support and training. With its unique base of both users and researchers FRIEND is well positioned to deliver this strategy and so ensure both relevance and take-up of its research.

CONCLUSIONS

The world faces a water crisis. Countries in the Middle East and in parts of Africa and Asia currently experience considerable stress, because demand for water is outstripping the available resource. As the twenty-first century unfolds this situation will worsen, particularly but not exclusively in the developing world. Fuelled by population increase, coupled with mounting pollution and exacerbated by climate-change-altered hydrological regimes, the stresses will intensify and resources will become more strained over wider areas of the globe. These problems provide a daunting challenge to the international hydrological community and FRIEND can play a significant role in addressing many of these issues. However, for FRIEND "to bridge the gap" and contribute to ameliorating these problems, we must place greater priority and resources on transferring our results to meet the operational needs of the practitioner.

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