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Climate, energy and environmental care - experiences with international research partnerships

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1. Introduction

This paper is concerned with climate, energy and environmental care. What ties these three themes together is that they (a) all impact on natural resources, (b) are strongly interrelated, (c) are transboundary (meaning: do not respect political-administrative boundaries and may affect different political-administrative entities) and (e) are the subject of a growing global concern, not only for researchers but also for politicians and increasing numbers of citizens. What is more, these three themes all have a significant “water content”, as will be shown by this and other background documents.

During the last few years a number of authoritative publications have been written by the global scientific community that reflect a converging recognition of the seriousness of the challenges facing climate, energy and the environment, and the need for concerted global action to address them.¹ With respect to *climate* the central concern is about climate change. The debate is not whether mitigation measures should be taken but how much by which date, and the institutional and financial measures that can facilitate these, as well as what the precise impacts are for local communities and countries and the ways in which they should anticipate and adapt to the changing conditions. Adaptation for large parts of the tropics and sub-tropics means dealing with increasing temperatures, decreasing rainfall averages, increasing rainfall intensities and more frequent and longer dry spells, and for coastal areas and small island states sea level rise and increasing frequencies and intensities of cyclones. The *energy* issue is concerned with increasing scarcity of the finite fossil fuels and resulting rising prices, and the possibilities and impacts of alternative renewable energy sources, in particular hydropower and biofuels. The need for *environmental care* is by now understood by a large majority of stakeholders, but what this actually implies in terms of protecting ecosystems, changing production systems (shortening of resource cycles, the cradle-to-cradle philosophy), potential tradeoffs with economic development and changing institutions is under debate.

It is by now widely recognised that developing countries will bear a large share of the burden posed by the above challenges, whereas the majority of these countries have hardly contributed to causing the problems (Africa, having about 14% of the world population, is responsible for only 4% of global CO₂ emissions). The global community

¹ See for example: Millennium Ecosystem Assessment, 2005; the World Development Reports 2006 (UNDP, 2006) and 2007/2008 (UNDP, 2007); the 4th Assessment Report of the Intergovernmental Panel on Climate Change (Alley et al. 2007); and implications for developing countries (UNFCCC, 2007); the World Water Development Report 2006 (UNESCO, 2006); the Comprehensive Assessment of Water Management in Agriculture (Molden, 2007); and the report of the Millennium Project on the MDGs (UNDP, 2005).

has therefore recently established an Adaptation Fund, which could assist countries in adapting their societies to the changing climate conditions. What is often not recognised is that relatively few researchers from developing countries have contributed to framing the above challenges, and to the ways in which these could and should be addressed. The global change debate has been conducted foremost at the level of “high science”. Given the global knowledge divide, this implies that experts from developing countries have had fewer opportunities to make contributions (a relatively small group of 31 rich countries produce nearly all (97.5%) of the world’s most cited publications; King, 2004).

The results we can now already observe: the potential impacts of mitigation policies of developed countries on the South may be enormous (e.g. Western investments in biofuel production in developing countries have a large imprint on land and water resources, which naturally compete with existing uses that often critically support rural livelihoods). It is as if the global community has been blind for these impacts that could have been foreseen if the research community involved in climate change would have been less biased and had had a more balanced geographical representation.

There is thus dire need to bridge the knowledge divide and increase the capacity in the South to initiate research in fields that are deemed relevant, and to more effectively influence the global research agenda. Moreover, with enhanced research capacity the South could make better use of available knowledge and technologies developed elsewhere, and focus efforts on their own priorities.

In this paper we are particularly interested in (international) research partnerships that serve as bridges. This paper will first briefly reflect on the current status of research partnerships on climate, energy and environmental care, after which it will present preliminary experiences with three research partnerships that have evolved during the last 8 years in South Asia, Southern Africa and the Andes region in Latin America. Admittedly, these networks focus on integrated water resources management, as we have little inside information on how research partnerships function on climate and energy networks. On the basis of these cases some lessons are drawn.

2. Current status of research and research partnerships

We do not pretend to have a comprehensive view of on-going research partnerships in the fields of climate, energy and the environment. However, some generalizing observations may be made.

Climate

Climate stands high on the research agenda and many scientists aspire to contribute to the knowledge of the intriguing dynamics that we see unfolding. Climate is big business and climate research likewise. The research focus has been mainly on biophysical processes involved in climate dynamics, and into possible mitigation measures (measures to minimise greenhouse gases). Relatively little has been done on adaptation. This is probably because developed countries appear to prioritise mitigation, while for most developing countries (being low consumption societies) adaptation is the major policy concern. The problem is that mitigation and adaptation address different

phenomena and issues. As one climate change expert observed, “mitigation is 100% about energy, whereas adaptation is 90% about water”. Relatively little research effort is currently being carried out on adaptation in developing countries, and less so by researchers from these regions.

It is therefore welcome that the existing modest international funding facilities (Special Climate Change Fund and the Strategic Priority on Adaptation of GEF; and the Nairobi Work Programme for establishing National Adaptation Programmes of Action NAPAs), will now be complemented by a fully fledged Adaptation Fund under the Kyoto Protocol.

We have found little evidence of the impact that these international funding windows have so far had on research and research capacity in the South. It is important that the Adaptation Fund will promote research by and for developing countries, and will be responsive to the knowledge demands formulated by these countries.

Individual countries are reviewing their research priorities in light of climate change. South Africa is currently setting up an ambitious climate change related research and development programme, the required investment being justified by the social and economic costs of failing to anticipate the expected impacts (WRC, 2008).²

Energy

Nearly all developing countries are low consumption countries compared to developed countries (Africa, which is home of 14% of the world population, uses only 3% of global commercial energy consumption).³ On top of these “commercial” energy sources, the rural poor tend to survive on traditional energy sources derived from biomass such as wood fuel, which are said to be “highly labor intensive, inefficient, polluting and destructive to the environment” (AMCHSD, 2006). However destructive these traditional sources may be, they are nevertheless renewable.

Of all electricity consumption in Africa, 22% is from hydropower. Certain countries heavily depend on hydropower, making them vulnerable to shortages during periods of prolonged low rainfall. Ghana, Uganda and Tanzania were faced with serious electricity shortfalls during 2006 and parts of 2007 due to their heavy reliance on hydropower. These countries are now desperately trying to diversify their energy sources.

Despite their relatively low energy consumption, developing countries have an enormous potential for energy production. Africa harbours 7.1% of global oil, 7.5% of global gas, 10.5% of global coal and 18.7% of global uranium reserves. Especially

² Perhaps we should mention here the topic of “Index insurance” for agricultural crops: The World Bank has suggested weather index insurance that pay out farmers on the basis of objectively verifiable climatic parameters, the cover of which may be automatic for all communal farmers or is paid through a special tax on some key input (e.g. seeds) (Hess and Syroka, 2005; World Bank, 2005; Keyzer et al., 2007). More generally, the role of insurance companies in funding research on the cost of climate change/adaptation (e.g. Munich Re and Swiss Re re-insurance companies) could also be mentioned, as well as the problem of private ownership of this type of knowledge that could have a strong public utility.

³ Half of all African countries had a per capita electricity consumption of less than 100 kWh per capita per year; only 7 more than 1,000 kWh per capita per year and only 2 more than 2,000 but less than 4,500 (Libya and South Africa). By comparison, Dutch per capita energy consumption was 7,250 kWh during 2006. (N.B. These figures include industrial use.)

promising is Africa for its renewable energy potential. It holds 13% of global exploitable hydroelectricity capacity (WEC, 2003). The potential of the Congo River is particularly imaginative: the base flow of 42,000 m³/s could produce 44 GW of hydropower. Plans exist to connect all corners of the African continent to the Congo.

The solar power potential of Africa is virtually without limits: the Sahara and Kalahari deserts receive sufficient solar radiation to provide for all global energy requirements.⁴ Finally, the developing world is also seen as the place that could produce most biofuels for the world, whereby increasingly questions are posed about the low net CO₂ reduction achieved and the increased competition over land and water resources that this will cause (Uhlenbrook, 2007; Fargione, et al., 2008; Searchinger et al., 2008).

The energy sector is dominated by large multinational corporations. This paper was unable to gain insights into the research partnerships that such corporations develop and maintain.

The energy sector is also dominated by some countries. Noteworthy is the role of China in investing in hydropower; e.g. in Ghana (Bui dam), Gabon (Grand Poubara), Mozambique (Mphanda Nkuwa, Moamba Major, Búe Maria dams) and in the Mekong region (Laos, Cambodia). The role of the USA in investing in biofuel projects elsewhere should also be noted (e.g. in Peru, Tanzania and Mozambique).

Given the low current energy consumption in developing countries, their large energy generating potential, the pressures on land and water resources caused by mitigating measures by the developed world, and the impacts of climate change on the same, all pose serious challenges. Developing nations need relevant and up-to-date expertise and technological know-how in order to develop sound policies that suit their specific conditions, needs and possibilities.

Little is known about regional and other types of South-South and North-South partnerships in researching these critical issues related to energy, and what the role is and could be of multinational corporations as well as aid agencies to foster such research.

Environmental care

It is by now widely accepted that caring for the environment not only makes ecological sense, but also may make sense for social and even economical reasons. This is so because many rural families in developing nations rely on environmental goods and services for sustaining their livelihoods. A complex relationship obtains between economic development and environmental protection, whereby certain environmental protection measures may yield important economic benefits. It is important that societies recognise and identify the type of ecological services that are worthy of maintaining. This is essentially a political choice, which requires strong local expert knowledge on a range of disciplines, as well as genuine consultations with local stakeholders.

⁴ Average net solar radiation in the Sahara (250 W m⁻² over an area of 9x10¹² m²) is equivalent to 180 times the current total world energy consumption (personal communication Steven Weijs, Delft University of Technology, February 11, 2008).

An interesting example of a project that builds research capacity is the Water and Nature Initiative of the IUCN. This projects tests how stakeholder participation, improved water governance and innovative financing can improve livelihoods and maintain healthy ecosystems. IUCN works with governments, basin authorities and local communities in a number of rivers in Asia (Mekong and Huong basins), Africa (Lake Tanganyika, Okavango, Pangani, Senegal and Volta basins) and Latin America (Tacaná and Barra de Santiago-El Imposible basins). Arguably the most important output of this initiative is enhanced capacities of basin authorities, stakeholders and experts from a broad variety of disciplines to meaningfully engage in decision-making concerning water allocation for social, economic and ecological benefits (Dyson et al., 2003; PBWO/IUCN, 2007).

Several other initiatives exist that aim to strengthen the research capacity in the South on environmentally-related issues. This is further elaborated in the background paper by Van Dam, Kitaka and O’Keeffe (2008).

An interesting EU funded research partnership is SWITCH (Box 1).

Box 1: SWITCH: Sustainable Water management Improves Tomorrow’s Cities’ Health

SWITCH is an EU-funded research programme aimed at achieving more sustainable integrated urban water management in the 'City of the Future', 30-50 years from now. It involves a Consortium of 33 partner organizations working in 15 European and Southern cities, who are working together to share knowledge and research on a range of tested scientific, technological and socio-economic solutions to urban water management. Accra, Alexandria, Beijing, Birmingham and Belo Horizonte, Lodz, Tel Aviv and Zaragoza are some of the Switch cities.

Cities around the world are facing a range of dynamic global and regional pressures, including rapid urbanisation and urban sprawl due to population growth, industrialisation, and climate variability and change. They are facing difficulty in efficiently and transparently managing ever scarcer water resources, delivering water and sanitation services, and disposing of wastewater, while minimizing negative impacts on the downstream environment and on the urban populations' quality of life including environmental, health, social and economic aspects. The ecological 'footprints' of cities are ever growing through over-exploitation of available resources (land, water, energy, food, building materials, energy, finance) for their populations whilst producing massive streams of waste (solid, gaseous, liquid) in return, contaminating soil, air and water.

In order to face these challenges, SWITCH is facilitating a paradigm shift in urban water management by converting from ad-hoc actions into a coherent and consolidated approach. The overall goal is to catalyse change towards more sustainable urban water management in the "City of the Future".

The project is implemented by combinations of consortium partners, along various complementary and interactive themes.

- Action research address problems through innovation based upon involvement of users.
- Learning alliances to link up stakeholders to interact productively and to create win-win solutions along the water chain;
- Multiple-way learning European cities learn from each other and from developing countries, and vice versa.
- Multiple-level or integrated approach to consider the urban water system and its components (city level) in relation to its impacts and dependency on the natural environment (river basin level), and in relation to global change pressures (global level).
- Linking up with key experts on urban water from Europe and developing countries, and pooling scientific, technological and financial resources from partners and in the demonstration cities through an integrated, multi-disciplinary research effort.

More information: <http://www.switchurbanwater.eu/>

3. Learning from some new research partnerships linked to water management

The above has argued in favour of the need to strengthen analytical capacity in developing countries to inform their policies related to climate, energy and the environment. Business as usual will not suffice, given the large knowledge divide between low and high consuming nations, i.e. poor and rich countries. Special efforts and initiatives therefore exist to help bridge this divide and promote capacity in the South. This section reviews three regional initiatives that are all (partially) supported by the Dutch Directorate General for International Cooperation DGIS, namely *Crossing Boundaries* in South Asia, *Concertación* in Latin America, and *WaterNet* in Southern Africa.

Crossing Boundaries: Regional capacity building on Integrated Water Resources Management and Gender and Water in South Asia (Gunawardena, 2008)

In South Asia, as elsewhere, the paradigm shift in water resources management policy and practice towards 'integrated water resources management' (IWRM) is in the making and partly happening. 'Integration' refers to a broad and diverse agenda. It includes issues like inter-sector water resources allocation and use, institutional transformation/bureaucratic reform towards less segmented structures, stakeholder participation in policy, planning and implementation towards inclusive forms of governance, interdisciplinary analysis and modelling, and the incorporation of rural development, ecological sustainability and empowerment perspectives in water resources policy and practice. All South Asian governments have endorsed the principles of IWRM, and incorporated it into their general water policy statements in some form or another.

The Crossing Boundaries project aims to contribute to this process from the angle of capacity building of those professionally active in the water sector – practitioners in government, NGO and private sector service, policy makers and political decision-makers, and researchers and social auditors. While new research and innovation in the different water resources disciplines is important, the notion of 'integration' remains elusive, particularly that between natural/technical science perspectives and social science perspectives. Innovative research is – therefore – needed to enhance the IWRM knowledge base. Such knowledge is best developed in the concrete context of real water resources management problems, and efforts at intervention, transformation or reform towards IWRM.

The Crossing Boundaries has developed a partnership-based programme for capacity building of water professionals through higher education, innovation and social learning focussed research ('research with an impact'), knowledge base development and networking.

SaciWATERs, the South Asian Consortium for Interdisciplinary Water Resources Studies, based in Hyderabad, India and the Irrigation and Water Engineering group at Wageningen University, are implementing the project with six South Asian partner institutions in four countries, namely Bangladesh, India, Nepal and Sri Lanka. The activities of the project take place at two levels, the national and the South Asian. The university partner institutions implement the national level activities.

Crossing Boundaries provides support to each South Asian partner institution to carry out this innovative research programme by providing resources to enrol four research coordinators, 15 PhD and 160 Masters students during the project period.

This huge research effort requires a careful design of its research agenda. During visits to partner organizations, staff of member institutions extensively discussed the strategies to link the research programme to existing projects and also participated in many meetings with stakeholders. The research proposals that were developed are all linked to on-going projects. In so doing it is ensured that the research effort is embedded in society and addresses real-world problems. Here the cases of Bangladesh and Sri Lanka are briefly discussed.

In *Bangladesh*, the research projects are located within the “Southwest Area Integrated Water Resources Planning and Management: Bangladesh” project co-funded by the Asian Development Bank and the Government of the Netherlands. Major components of the project will be implemented by the Bangladesh Water Development Board (BWDB). Other components are implemented under the Small Scale Water Resources Development Sector Project (SSWRDSP) of the Local Government Engineering Department (LEGD).

In *Sri Lanka*, the research projects are aligned with the existing projects and networks related to water pollution in the area such as the Water and Environmental Sanitation (WES) Program of PLAN Sri Lanka, the Greater Kandy water supply and sewerage project funded by Japan International Corporation Assistance (JICA), the Water Dansih water supply project, projects operating in Walapane area for resettlement of landslide affected people, solid waste management project of the Kadugannawa Pradeshiya Sabha (a local government organization), as well as the Asian Institute of Technology and Swedish International Development Assistance Link project.

Crossing Boundaries is still a relatively young project, so it is not yet possible to judge the results of the project in terms of the research outcome. The interest of this initiative lies in the fact that it is built on regional cooperation between researchers from four different countries with common professional interests, the effective facilitation of the process by SaciWATERS in Hyderabad and the Irrigation and Water Engineering Group in Wageningen, and linking the research projects to on-going development projects.

Concertación - Interdisciplinary research and capacity building program on water policies and water management in Andean countries (Rap, 2008)

Concertación is an interdisciplinary research, capacity building and policy advocacy network and programme that aims to improve the water- and livelihood security of peasant and indigenous water management in the Andes. This will be achieved through the development and support of democratic, equitable and sustainable water management policies and practices. Concertación is a collaborative project between Dutch and Andean institutions (Peru, Ecuador and Bolivia).

The urgency of the water problem is well recognized in the Andes. New water policies try to respond to the water management challenges. These have been and continue to be

highly debated because of diverging visions, objectives and strategies of the different water use sectors and water use groups.

One of the central issues in the debate is the effect these new policies have on water access security of the Andean communities and organizations, especially those of the farmers, indigenous peoples and other groups of low economic resources that depend on water for their livelihoods. The present distribution of water and decision making power over water management is characterized by problems of justice, democracy and sustainability.

This project pretends to feed the debate over water policies through research, exchange and capacity building. This will lead to the creation of new responses and proposals of actors at local, regional and national level. These actors will participate in the public debate over the present water policies with the purpose to develop water management strategies and policies that are effective, equitable, democratic and adapted to the local context. The strategy of the project is to:

1. Educate practitioners in order to establish a shared network of water professionals in the Andean countries.
2. Develop innovative academic research and stimulate social learning processes in the development and management of water resources.
3. Develop a knowledge and knowledge exchange platform on sustainable and equitable water resource development and management.

By comparing concrete experiences in water management and stimulating exchange and learning at an Inter-Andean level, Concertación aims to have an added value, both for policy and practice.

The central themes of the project are:

1. Legal pluralism, water management and recognition policies;
2. Local water management and the strengthening of authorities and organizations;
3. Integrated management of water in river basins;
4. Regional and international policies for integrated water management .

These main themes have several sub-themes. The sub-themes are used to organise research, capacity building and policy advocacy activities. For example, “collective water rights” was one of the sub-themes addressed during 2007. For 2008 the sub-themes of ‘local irrigation systems, their productivity and agrarian dynamics’ and the ‘feminisation of water management’ have been identified.

Around these themes, special knowledge teams are formed. These knowledge teams are made up of Andean water specialists from connected institutions that know the specific regional water problematic and design a comparative knowledge project. International expertise may be called in at this point. The actual field research is carried out by giving five months fellowships to recognised or promising researchers and water professionals who often have problems getting their research financed or require training on the job. The action-research is initiated with a base-study by a regional or international expert on the research theme in question, who also ensures the quality of the final products.

A knowledge project entails three steps: (1) *action research* on the current state of affairs and problems in actual water management regarding this topic. The research

findings have to be translated into (2) the improvement of *capacity building* efforts and subsequently in (3) *advocacy* and networking activities to improve water policy and water law. In this manner, and together with national water debate and training platforms, the results of action-based studies can be translated into proposals, methodologies and actions to improve water legislation and policies.

The knowledge products emanating from the research are targeted to different audiences, from the traditional academic, to professional, policy and lay audiences. An Andean publication line is foreseen that distinguishes three levels: (1) academic, (2) policy related and professional, and (3) practical for water users, their leaders and activists. Regional researchers can thus target their publications to different target groups and acquire prestige accordingly. For international researchers, these regional experiences in relation to international water policy debates provide significant opportunities to publish.

Though fundamental research is not the primary objective of the program, the research network, its partners, the local and national study cases, and the different policy processes it is embedded in offer a wealth of data for critical analysis of water policy and intervention processes. Research time (for data analysis at meta-scientific levels), in this sense, is a far greater limitation than the production and availability of research data themselves.

Concertación is financed by the Dutch government and the network is constituted by a large number of Dutch and Andean partners that are active in the field of water management for marginalised groups. The Andean network is coordinated by one institution in every country: in Peru the Institute for the Promotion of Water Management (IPROGA), in Ecuador the Inter-institutional Consortium for Capacity Building on the Sustainable Management of Renewable Natural Resources (CAMAREN) and in Bolivia, the Andean Centre for Water Management and Use (Centro AGUA). The network coordinator in the Netherlands is the Irrigation and Water Engineering Group (IWE) of Wageningen University, which cooperates intensively with the Centre for Studies and Documentation on Latin American (CEDLA) of the University of Amsterdam.

WaterNet in Southern Africa

Several recent publications have suggested that one important way of stimulating research is to identify leading research centres, to heavily invest in these and to connect them to similar centres elsewhere. This focus on supporting “centres of excellence” has been strongly identified by the InterAcademy Council (IAC, 2004: 5), but has a potential pitfall. As it singles out the relatively stronger research groups, this focus may turn into exclusivity and exclude small research groups that on their own would not have critical mass but if connected could make meaningful contributions. An example of a more inclusive regional network of knowledge institutions is WaterNet in Southern Africa.

WaterNet was established in 2000 and currently links some 50 university departments and knowledge institutions in 14 southern and eastern African countries. What these departments have in common is an interest and expertise in topics relevant to water. Individually they have insufficient breadth to cover the broad field of water resources

management, but in pooling their knowledge resources they cover all major water aspects, from hydrology to water and sanitation technologies, from environmental engineering to economics and law. In so doing WaterNet is in a position to offer a unique and regional Master programme in IWRM, in which six universities are directly involved (University of Dar es Salaam in Tanzania, Chancellor College of Malawi, Polytechnic of Namibia, University of the Western Cape in South Africa, University of Botswana and the University of Zimbabwe), as well as many guest lecturers from other WaterNet member institutions. The WaterNet Master programme in IWRM involves 12 months course work and a 6 months thesis research. Over the period 2000-2007 over 170 students graduated. These were nationals from 15 southern and eastern African countries, of whom one third (55) were female.

Connecting institutions on a regional basis makes sense not only in that it allows to pool resources, but also because water has a transboundary dimension. Through connecting universities regionally, knowledge capacities are being spread and shared, which will contribute to equity and is more cost-effective than doing this at national level (Opschoor, 2006). Furthermore, students from different countries sitting in the same class, learning the same concepts will enhance respect and mutual understanding. Moving these students around in the region further exposes them to a regional perspective. All this is thought to facilitate future cooperation on water and provides an investment in future peace.

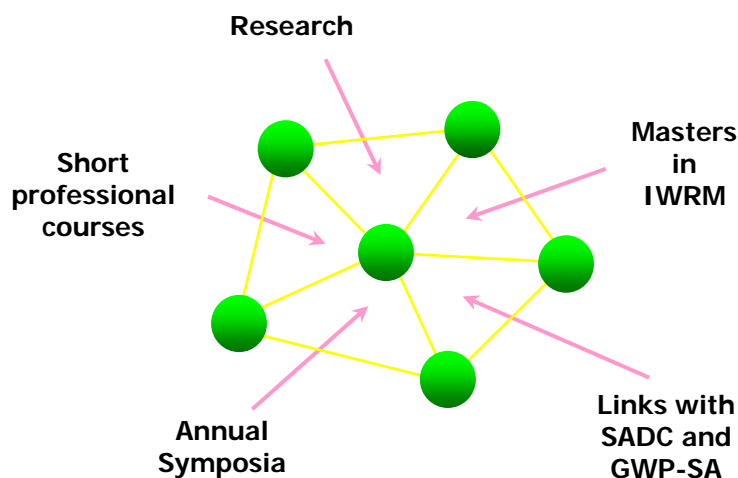


Figure 1: WaterNet and its mutually reinforcing activities

The success of WaterNet lies in the combination of activities that it develops and that reinforce each other: the modular Masters programme in IWRM allows for a comprehensive short professional courses programme; the research activities provides thesis research projects for Master students, generates new insights that are fed back in the curriculum, as well as research papers that are presented during the annual Symposia, co-organised by the Water Research Fund of Southern Africa (WARFSA) and the Southern Africa Water Partnership (GWP-SA). These symposia provide a platform where researchers, professionals and policy makers meet and exchange ideas. For the latter platform to be effective it is important that WaterNet is formally recognised by the Southern African Development Community SADC, and this again

strengthens the reputation of WaterNet as a legitimate regional academic network that offers a credible postgraduate programme.

There are synergies between the WaterNet network and the WARFSA fund (Box 2). WaterNet also implements two major research projects in which several member institutions as well as international knowledge partners collaborate: the “TWRM for Improved Rural Livelihoods in the Limpopo river basin” project of the Challenge Programme on Water for Food (see e.g. Love et al., 2006), and the Smallholder System Innovations in Integrated Watershed Management project in the Pangani (Tanzania) and Tukhela (South Africa) (Bhatt et al., 2006). The latter project is an applied and multi-disciplinary research initiative which focuses on the potential of indigenous and exogenous water system innovations in smallholder farms for improved land and water productivity, and is funded, among others, by WOTRO, Sida and DGIS. Both projects maintain strong links with local agricultural research organisations and rural development NGOs, and the research is characterised by working closely with farmers and practitioners. This is to ensure that the outcomes of the research are relevant and will indeed contribute to the improvement of the livelihoods of rural communities in sub-Saharan Africa.

Box 2: Synergies between the WaterNet network and the WARFSA research fund

Because the WaterNet Master programme in IWRM includes a 6 months thesis research project, there are some interesting synergies with the WARFSA fund. WARFSA supports several research projects in which WaterNet member institutions and their academic staff are involved. Such projects provide a good research environment for MSc thesis research. This combination of tertiary education and research proves a powerful combination. Many WaterNet graduates, through their thesis research, have contributed new insights in a variety of aspects of water engineering and management. Some of these insights have been presented at the annual WaterNet/WARFSA/GWP-SA Symposia and published in the journal *Physics and Chemistry of the Earth*, which annually publishes a special issue with the best Symposium papers. This is a growing body of scientific output that currently consists of six special issues containing more than 250 papers. This is significant: one out of six scientific articles with “water resources” and “Africa” in title, abstract or key-words published in the period 2002-2007 originated from the WaterNet/WARFSA Symposia. These articles are also frequently cited (Van der Zaag, 2007).

WaterNet represents a first step towards a knowledge community characterised by a strong connectivity between its parts, a sharing of resources and distributed access. These elements are the ingredients for a learning society that is able to frame its own societal problems and find new ways of resolving them. Sharing of knowledge between the WaterNet members is clearly a key factor in the success of the network, and requires to be explained. What also requires an explanation is the eagerness of academics to contribute conference papers during the annual symposia. Whereas in the beginning many lecturers were reluctant to write papers, justified by the fact that there were more urgent issues (i.e. increasing meagre university salaries through conducting consultancy work), this has changed rather rapidly. Now each year the symposium receives over 300 abstracts. Although university salaries may not have improved much, having an abstract in the conference proceedings, and a paper in an international journal, is now perceived to be of great value.

4. Conclusion

Efforts reviewed in this paper of fostering research partnerships all aim to bridge the global knowledge divide. This is an urgent issue because the challenges that developing nations are facing and have to address are enormous, especially when dealing with climate, energy and the environment.

Apart from the issues raised and discussed in this paper, two additional issues merit attention. The first is related to access to scientific information, the second is about the funding of research.

Access

For local knowledge institutions to be functional, they need to be connected to global developments. Hence the importance of universities having access to relevant scientific journals. If the global knowledge divide is to be bridged the North should open up, and share its knowledge resources with the South and make these accessible. An increasing number of journals are open access, such as the journals *Hydrology and Earth System Sciences* and *Ecology and Society*. However there is a down-side simply because journals do need a financial basis. In the case of these two journals it is not the reader but the *author* who pays (depending on size and some other details, an author would pay from Euro 500 upward per published article). *Water SA*, another open access journal, is free for both reader and author, and is funded by the water consumers of South Africa through the Water Research Commission (see below). Most other scientific journals are not freely accessible, but are actually prohibitively expensive for most universities in developing countries. Students and staff at many universities in developing countries are thus often practically speaking excluded from access to up to date academic knowledge. The Online Access to Research in the Environment (OARE) initiative is therefore important. OARE allows free access to key journals for institutions located in the poorest developing countries (Box 3).

Box 3: Online Access to Research in the Environment (OARE)

Set up by Yale University, UNEP, MacArthur and Hewlett Foundations, and 300 of the largest and most prestigious publishers and scientific societies and associations, Online Access to Research in the Environment (OARE) now represents the largest collection of scholarly, peer-reviewed scientific research in the environment related sciences currently available to 106 least developed nations in Africa, Asia and the Pacific, Latin America and Eastern Europe. The project provides access to approximately 70% of the world's most prestigious scientific journals, together having an annual US retail subscription value in excess of \$1.3 million.

Source: Personal communication Dr P. Walberg

Generally there is a need for new approaches to copyrights that provide more suitable ways of protecting intellectual property rights and rewarding innovators, while supporting the public interest in having broad and rapid access to knowledge and technology. Concepts such as “creative commons” are in this respect promising (see <http://www.creativecommons.org>).

Research funding

A plea to increase research funding is often heard. Experts have made several suggestions how this could be done, e.g. through fixing a percentage of GDP or through

sectoral funding (whereby a portion of a nation's tax levies on for-profit corporations are redirected into a special fund for financing research in selected science and technology areas of economic interest to the nation). Often a case is made in favour of public-private partnerships: some argue that this would ensure that research is directed to promising applications and would yield immediate results.

But the question is why research remains under-funded. It would appear that politicians and entrepreneurs see little value in research compared to other priority areas. They seem to lack faith in the capacity of researchers to address real problems and doubt whether research investment will ever payoff.

An example where funding for research has been institutionalised, with an enormous positive impact, is the Water Research Commission in South Africa (Box 4). This is an interesting example of how a country maintains and stimulates knowledge and research capacity, and how such an institution helps in shaping and strengthening the interface between research and society.

Box 4: The Water Research Commission of South Africa

The Water Research Commission (WRC) of South Africa is a statutory body which has a budget that is independent and separate from the government budget and is composed of revenue from a small tax on all bulk and commercial water uses in the country. The WRC has boosted the water research infrastructure in that country, both private (mostly engineering companies) and public institutions (mostly universities), through a system of regular solicited and unsolicited calls for research projects. The WRC also disseminates the research findings through reports and an open access scientific journal (*Water SA*; http://www.wrc.org.za/publications_watersa.htm). A recent report analysed six research projects funded by the WRC, and found that the economic benefits resulting from these projects were significant. These investments in research had a benefit-cost ratio of nearly 25 (Conningarth Economists, 2004).

The WRC concept may not be replicable everywhere, since it is premised on significant commercial water use by users that have an ability to pay. Nevertheless, the WRC has been the inspiration behind the establishment of the Water Research Fund for Southern Africa (WARFSA). This fund is open to any researcher or institution resident in a member country of the Southern African Development Community SADC, and a thorough system of peer review ensures that only the best research proposals are selected for funding. A board consisting of researchers with different professional backgrounds and from different countries in the region formulates the research policy of the fund and defines priority areas. The fundamental difference between the WRC and WARFSA is that the latter is donor-funded (mainly by the Swedish and Danish development organisations Sida and Danida), which may put a greater challenge on ensuring responsiveness to the needs of the region. WARFSA is currently searching for ways to better link societal demands to the research community, and is reviewing its potential role in promoting that connection.

The question of how research funding can be made sustainable is a difficult one. We should acknowledge here that in many countries it will not (yet) be possible for the water sector to generate sufficient funds to maintain a fully fledged research programme. Cross subsidies from other sectors or from donor countries may be necessary. The question then is how under such circumstances the right research priorities will be articulated, the right research products be generated, and how the knowledge infrastructure can be maintained while remaining sharp and responsive.

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