

Climate, energy and environmental care
Research practices: embedding research in society

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1. Introduction

The conference 'Knowledge on the move: research for development in a globalising world', organised by The Netherlands Organisation of Scientific Research NWO/WOTRO, will explore new ways of promoting science for development and reflect on the relations between the changing fields of development cooperation and international research cooperation. The conference will try to inspire innovative policies and practices in the fields of research, knowledge and innovation for development. The cross-cutting issues of the conference are (1) Research arenas: international research partnership; (2) Research practices: embedding research in society; and (3) Research capacities: capacity building for relevant research. This paper addresses the second issue within the theme 'Climate, energy and environmental care', which is one of the eight themes that have been identified for the conference. Main objective of this paper is to provide answers to the following questions:

- How is research on climate, energy and environmental care organized?
- What lessons/best practices can be distilled from global experiences?
- What innovative ways of articulating demand for knowledge, for enhancing research capacity and for creating international partnerships can be identified?

These questions are addressed by formulating a conceptual framework for the research-policy-practice continuum and its actors. Then, three cases from our own experience are presented from which we extract some lessons on the links between research and society. Finally, we integrate the case discussions and come up with some conclusions and recommendations. Because of the authors' backgrounds and interests, emphasis in this paper is on environmental management and the case studies are about rivers, wetlands and water, mainly in Africa. We hope that the lessons that can be drawn are more widely applicable.

2. Research, policy and practice for environmental management

Environmental policy making starts with the awareness and identification of a problem (problem identification phase; see Figure 1). The problem is investigated, different options for solving the problem are formulated, and a preferred policy option is selected (policy formulation phase). Then, the policy is implemented by applying policy instruments, such as laws, subsidies, fees, licences, etc. (policy implementation phase). Finally, the effect of the policy needs to be evaluated and the policy can be adjusted (policy evaluation phase).

In all stages of the policy cycle, involvement of stakeholders is important. The main groups of stakeholder that can be distinguished are:

- Resource users – These include both corporate enterprises and private individuals or communities who modify the quantity or quality of resources (e.g., air, water, soil, minerals, crops, fish etc.). Their motivation for exploiting environmental resources is generally based on economic considerations, ranging from small-scale, household-level livelihoods support and subsistence resource exploitation to large-scale commercial interests.
- Policy makers – Policy makers exist at various levels, ranging from local to district/provincial, national and international policy makers. Policy makers include government employees at various levels who collect and analyse information, develop policy scenarios, develop and implement policy instruments and monitor and evaluate the impact of policies. Politicians also belong to the policy makers. In the environment and climate field, there are some important international conventions (such as the Ramsar Convention on Wetlands and the Convention on Biological Diversity) that play an important role in formulating policies and supporting countries that are party to these conventions in setting their national policies.
- Implementing agencies – These are organisations charged with implementing policies. Such organisations may specialize in disseminating certain technologies among resource users (e.g., agricultural extension services), or in implementing specific elements of policy (e.g., national environmental management authorities). They can be government but also non-governmental organisations. In the environmental field, there are many large non-governmental organisations (e.g., WWF, IUCN, TNC, Wetlands International) who have assumed important roles in the implementation of environmental policies.
- Researchers – these are usually located in universities or in government research institutions. Some are linked to international research organizations like the CGIAR or UN institutions. Researchers often need to compete for funds, and decisions on who is allowed to spend the money are made by independent scientific and sometimes societal review panels. The success of researchers is generally defined in terms of their contributions to scientific conferences and their publication records, and not necessarily in terms of the impact of the research on societal goals or on their networks with research clients. In the policy cycle, researchers can be involved in formulating different policy options (policy analysis) and also in monitoring and evaluation.

- Funding agencies – These range from private to public and from local to international. Funding for research generally comes from international, government or private funding agencies who all have their own procedures for determining priorities and allocating funds. For funding agencies, the impact of their funding programmes depends strongly on the terms in which their programme objectives are formulated. There is a negative relationship between the "degree of appliedness" of objectives and the generality of research results.

Knowledge and information are the main products of research. In the traditional way of looking at knowledge management, some groups in society are mainly concerned with supplying knowledge, and others are the main consumers. Nowadays there is more appreciation for different forms of knowledge (both explicit and tacit) and for the notion that knowledge is present with all stakeholder groups and needs to cycle around rather than flow in one single direction.

Traditionally, environmental research focused on the ecology and hydrology of environmental systems and on the protection of natural systems from the impacts of human activities. Research on natural resources emphasized the rational exploitation of resources for maximum economic benefits. Numerous examples of this approach can be found in agriculture, fisheries, forestry and other fields. With a growing world population and the realization that resources are finite, more interest was generated in the interaction between humans and nature (e.g., Club of Rome report in the early 70s). Both conservationists and resource managers realized that they could not be successful without considering nature and humans together. This led to more integration of the natural with the social sciences and to an increase in the scale level of research (from the study of individual biotopes to ecosystem approaches to catchment and river basin studies). Agricultural research experiences a similar transition from commodity-oriented research in the 1960s (on certain crops like rice or potatoes) to farming systems research in the 1970s and 1980s to participatory action research and integrated catchment studies in the 1990s (Sayer & Campbell, 2004). Similar examples can be given for research on wetlands and fisheries. A wide array of 'new' approaches was introduced (Integrated Natural Resource Management, Sustainable Rural Livelihoods Framework, etc.). Research on natural resources involves multi-disciplinary teams of natural and social scientists and engineers who consider not only the natural system but also the drivers of change that affect the system, including the political-economical context, institutional factors and global change.

One generally accepted notion in environmental research is that communication with stakeholders and their participation in the research are of critical importance. Funding agencies urge researchers to involve stakeholders in research programmes right from the formulation stage, through data collection, analysis and modelling to scenario formulation, policy formulation and dissemination of results. The main objectives of participation are to ensure the relevance of the research, to promote ownership of the results among stakeholders, and to maximize the acceptance of the ensuing policy among resource users.

3. Case studies

3.1. Environmental flows for rivers

Rivers provide the majority of water supplies for people world-wide. They are also major repositories of domestic, industrial and agricultural waste. Rivers, lakes and freshwater wetlands together account for as much as one third of global vertebrate biodiversity (Gleick, 1996; Stiassny, 1999). They also provide fish, reeds, building sand, and a host of recreational, cultural and spiritual services. Because of the increasing importance of water resources for human development, freshwater biodiversity is more severely endangered than its terrestrial or marine counterparts (e.g. Dudgeon *et al.*, 2006) and global populations of freshwater vertebrates declined by 55% between 1970 and 2000 (Loh *et al.*, 2005).

Rivers can't provide all their goods and services at the same time and in the same place – people have to choose which ones they want. Some rivers can be kept largely natural; some, in urban settings, may be highly modified but are important as cultural icons (e.g., the Thames in London); and some may become “workhorse” rivers, harnessed to supply irrigation water or hydro-power. The natural flow regime of the Mekong River provides annual floods which sustain the livelihoods of many millions of people through flood irrigation of rice, and floodplain fisheries. The research question that arises is: “What are the sustainable limits to the use of rivers, and how can people balance the use of their water resources with protection for long-term sustainability?”. The science of environmental flow allocations (EFA) has emerged to provide some of the answers to this question. In essence EFA provides an estimate of the amount of water that should be retained in the river, and its distribution through time as base flows, higher flows and floods, in order to maintain the river in a pre-determined condition, so that it can continue to meet people's needs.

Methods for EFA were first developed in the 1970's (e.g., Tennant, 1976) and there are now over 200 different methods described (Tharme, 2000). Most of the methods rely on the assumption that managing a modified flow regime to maintain a variety of hydraulic habitats

(in terms of current speed, depth, wetted perimeter and substrate type) will result in the maintenance of some proportion of the natural biodiversity, and therefore the goods and services on which people depend. Research has focussed on integrating hydrological, geomorphological and hydraulic modelling with the investigation of habitat preferences of indicator species – usually fish, benthic invertebrates, riparian and floodplain vegetation.

Without the understanding and support of the people who use the river, even the best flow assessments will not be implemented. Participatory stakeholder approaches and socio-economic analysis are gradually developing to complement the biophysical data on flows and indicators. Central to this development has been the realisation that environmental flows have to be embedded in a comprehensive catchment management plan, using the principles of IWRM, so that people can see how the environmental flows are a necessary part of equitable distribution of resources from the headwaters to the sea.

EFA has been very successful in providing a coherent framework for integrating different scientific disciplines. The need for societal choices has encouraged the participation of stakeholders in the process of setting environmental objectives, and this has resulted in spectacular policy initiatives and revolutionary water legislation such as the South African Water Act of 1998, and the EU's Water Framework Directive (EC, 2003), both of which have environmental objectives as a focal point. Many other countries (e.g., USA, Australia, Tanzania, Kenya, Zimbabwe, Mexico) have also embedded, or are in the process of embedding environmental flow requirements in their legislative requirements. However, there is a major gap between the good intentions of the policy, the excellent advances in scientific knowledge, and the implementation of environmental flows. To date, despite the 200 or more assessment methods, there are still only a hand-full of rivers¹ in which environmental flows have been allocated and provided. Good intentions and flow assessments in several basins in Tanzania, the Indus in Pakistan, the Rio Conchos in Brazil, and almost all the rivers in South Africa have yet to be implemented. This lack of final success is due to a number of reasons, but primarily:

- EFA is a relatively recent concept, and many water management agencies are ill-equipped to apply it;
- The persistence, especially among water managers, of the belief that water left in rivers is “a waste” and could be better used for irrigation etc.;

¹ E.g., several rivers in the USA, the Snowy River in Australia, the Senqu (upper reaches of the Orange River) in Lesotho, and one or two small rivers in South Africa.

- Inadequate water release mechanisms on dams which were built before environmental flows were required;
- The lack of effective valuation methods for environmental issues, compared with the more obvious market-related values of water use;
- The emphasis in legislation of the need to *assess* environmental flows before water is allocated for use – once the assessment is done, the licenses are issued and the motivation for implementing the flows disappears;
- The general perception that, while the long-term environmental protection of water resources is important, this is over-ridden by the imperative of short-term water supply priorities.

3.2. Papyrus wetlands in East Africa

Just like rivers, wetlands need to be conserved because they perform vital functions and provide important services. The enormous value that wetlands represent is often not expressed in economic terms and therefore not taken into account by decision makers (de Groot et al., 2006). Wetlands are particularly important in developing countries because they are frequently hotspots of livelihoods services that attract people who flee environmental degradation and poverty elsewhere.

Despite their enormous importance, wetlands are steadily disappearing. Their global area has declined by 50 percent since 1900 and wetland biodiversity is declining more rapidly than its terrestrial equivalent (Moser et al. 1996; WWF 2002; MEA 2005). A recent assessment of changes in papyrus cover in the Kenyan sector of Lake Victoria showed that 34-50% of papyrus wetlands were lost between 1969 and 2000 (Owino and Ryan, 2007). This reduction has a direct impact on the water quality of Lake Victoria which depends strongly on sediment and nutrient buffering by the surrounding wetlands (Loiselle et al., 2006). Wetlands degrade or disappear because of direct local-level drivers like upstream dam construction, water abstractions, pollution, etc.; and direct use for agriculture or harvesting of wetland products. More indirect, large-scale degradation drivers are: lack of appreciation of the value of wetlands, global economic integration, international policies, and climate change (Lemly et al., 2000; Sarch & Birkett, 2000; Zwarts et al., 2005).

Government policies for African wetland conservation and their enforcement are often non-existent or poor. Most countries have signed the Ramsar Convention (Ramsar, 2005) and

wetlands feature prominently in initiatives like NEPAD, LVEMP, LVBC, NBI and WPRP². Despite this recognition, several constraints to formulation and implementation of wetland policies exist. One major problem is that wetland research is not well embedded in the policy process. Wetland research still has a strong ecological orientation, focusing on the impact of exploitation, pollution and physical modification on key species and biodiversity. Integrated research that includes other drivers of change in wetlands is scarce. The challenge is to understand how people's livelihoods impact but also depend on wetlands, how people make decisions about exploitation, how actors and policies at different scales interact with decision-making at the wetland and river basin level, and how policy makers can use this knowledge to design more effective policies.

Another problem is wetland policy coordination and implementation. Wetlands are zones of overlapping interests between different government sectors (e.g., agriculture, industry, water, and environment) which leads to fragmented policies. Agriculture and development ministries often see wetlands as "wastelands" that need to be "reclaimed" and converted to agricultural or other production purposes, ignoring the loss of important wetland functions after conversion. African floodplain wetlands provided livelihoods benefits worth over five times the value of formal irrigated agriculture (Barbier & Thompson, 1998). Implementing agencies are often caught between central-level policy targets and local communities confronting them with practical constraints (Dixon & Wood, 2003).

Approaches like Integrated Water Resources Management, Sustainable Use (Zaccagnini et al., 2001) and the Ecosystem Approach (CBD, 2002) recognise human dependence on ecosystems and the need for stakeholder participation in adaptive management. The Ramsar Convention promotes "Wise Use", but there is little scientific knowledge that helps operationalize this concept for policy making and management. Research on sustainable use often does not transcend the level of localized case studies and lacks a more integrated analysis of development options and risks of upscaling.

There is increasing attention for a dialogue between research and policy-making to achieve better-informed policies (Winkler et al., 2007; see also section on EAWA below). However, a gap exists between the perceptions and discourses, values and goals of these two realms. Approaches are needed that recognize this diversity and accommodate qualitative and quantitative, local and external, scientific and non-scientific languages. Such approaches should support a more common understanding about wetland processes and outcomes of

² New Partnership for Africa's Development, Lake Victoria Environmental Management Project, Lake Victoria Basin Commission, Nile Basin Initiative, and Wetlands and Poverty Reduction Project, respectively.

policies among resource users, policy makers and policy implementers. Despite the strong links between the livelihoods of small-scale wetland resource users and wetland ecology, the many small-scale users in African wetlands are often ignored by policy makers because of a lack of knowledge about their situation, their role in resource management and their economic importance. Research should play a crucial role in supporting the search for innovative, integrated approaches to wetland governance that allow more poor people to build sustainable livelihoods without losing valuable wetland ecosystems.

3.3. Eastern Africa Water Association (EAWA)

Eastern Africa as a region shares common problems that affect people's livelihoods and act as a hindrance to achievement of the Millennium Development Goals (MDGs), such as water stress, climate change and population growth. Population growth affects water resource management through an increase in the cost of production and delivery, coupled with an increase in water requirements for various uses (Khroda, 1996). Together, these problems influence investment opportunities for other sectors of development in the region. In addition, locally adapted strategies targeting people's demands for societal benefits are limited or lacking. The persistence and sometimes worsening of these problems gives rise to questions like: are African education and research institutions strong enough to contribute effectively to public development efforts?

African research institutions face immense challenges in policy and funding at national, regional and international levels. These challenges influence the management structures, scientific output and therefore the linkages between research and society. In most cases, policy decisions do not have a good scientific basis. This is not so much due to a lack of research initiatives, but caused by poor information dissemination among scientists themselves and between scientists and the implementing agencies. There is limited knowledge among African scientists of how to investigate and address impediments to policy development. There has also been a lack of expertise in effective experimental design, lack of information required for technology implementation and policy development, and to a lesser extent a lack of ability to write effectively.

To improve the links between research and society, African scientists need to communicate more effectively to other stakeholders in society. To begin with, they need to start communicating effectively with each other. One impediment to effective communication is the limited availability of fora or platforms for informal communication. There is a need for networking at local, regional and international level between scientists, technology

innovators, policy makers and the private sector. To this end, the Eastern Africa Water Association (EAWA) was founded in December 2003. Main objective of EAWA is to bring together water scientists and other stakeholders from across eastern Africa. Initially, EAWA targeted East African water experts who had undertaken higher education through sponsorship of the Austrian Development Cooperation (ADA). In the process of establishing an alumni association (EAWA, the East African Austrian Water Association), demand arose for a broader association designed to link water-related educational programmes and research institutes within the East African region. For regional ownership and wider coverage, the association changed its name to Eastern Africa Water Association (EAWA) in 2006.

EAWA currently links institutes in Eastern Africa with established chapters in Kenya, Tanzania, Uganda and Ethiopia. Other countries have shown interest in establishing EAWA chapters. EAWA offers an Eastern African platform for regional networking coupled with international cooperation. Synergetic effects are expected as a result of establishing direct links between experts in Eastern Africa, higher education and research institutes and programmes in the region and elsewhere, and policy makers and implementing agencies.

In December 2006, EAWA organized a workshop in Mombasa, Kenya with more than 130 participants from the region (including researchers, policy makers, donors and other relevant stakeholders) to discuss ways of more effectively orienting research efforts towards regional demands and to support regional policy planning processes (Winkler *et al.*, 2007). Workshop results included: strategies to enhance the impact of research, ways to impart knowledge for strengthening the capacity of stakeholders to develop and implement collaborative action plans and extension projects; and approaches for supporting policy development and implementation. The workshop recommended:

- Promotion of participatory approaches through community action plans and trans-disciplinary research to ensure ownership and sustainability of development initiatives;
- Repackaging of research information to enhance information flow and exchange for development, hence fostering communication between researchers and other stakeholders;
- Active marketing of research findings and sensitization of end users by researchers to create awareness and understanding of research for adoption into policy and technology development;

- Giving priority to demand-driven research that is responsive to the needs of the end users: researchers should work with the end users rather than for them, since the latter perpetuates dependency.

Given its interdisciplinary and international membership, EAWA has the potential to play a leading role as a platform for addressing all issues pertaining to water and environmental services in the region. Sustainability of EAWA is a challenge. It is currently supported by donors. More members are being recruited and an affordable membership fee will be set. Partnerships with other fora (e.g., VicRes, WaterNet) are being explored.

4. Discussion and conclusions

The three cases show that improving the impact of environmental and water research on policy and practice are necessary and that regional initiatives are underway. There is a broadly-felt need for spending budgets on relevant research projects, for research that supports the policy making process and its actors/stakeholders, and for incorporating more scientific findings into policies and practice. However, the mechanisms for embedding research into society have not been developed sufficiently. In this discussion section we list some reasons for this, and identify some options for improving the situation (including some of the challenges that come with them). Some reasons for the problematic link between research and society are (see Figure 2):

1. Little and ineffective interaction between stakeholders in the environmental policy making process. There is insufficient knowledge management, i.e., a conscious strategy of getting the right knowledge (both formal, explicit and informal, tacit knowledge) to the right people at the right time and helping people to share and apply information. Stakeholders should be involved in a process of joint learning and exchanging each other's knowledge and building a common vision on which joint objectives can be based. Stakeholder partnerships should be formed to achieve this (Smits et al., 2005). This means networking and cooperation among the stakeholders, capacity building and resource mobilization, empowerment and gender mainstreaming, and integrated research management. Stakeholder's involvement in formulation and implementation of research projects enables them to realize and conceptualize the problems facing them and to take an active part in seeking solutions (Winkler *et al.*, 2007). Knowledge management should be supported by modern information and communication technology (including internet-based tools for collaborative work). The formation of active stakeholder partnerships

should lead to a more supportive role of research in the policy process (see Box 1).

Research should assist all stakeholders to gain an improved understanding of the complex ecological, economic and social systems in which natural resource management and environmental conservation operate (Sayer and Campbell, 2004). The formation of multi-stakeholder partnerships calls for the involvement of specialized science-practice facilitators who know how to effectively link researchers with other stakeholders in all stages of the research process (from formulation through implementation to application of results).

2. There should be more effective communication of research results from researchers to the other stakeholders. Again, research should work much more in support of stakeholders than it does at the moment. This can be as part of the policy process but also in direct cooperation with stakeholders (see Box 2). Besides their scientific publications, researchers should engage in a dialogue with other stakeholders and market or repackage their research through publications that are targeted more directly at specific stakeholder groups (e.g., policy briefs and extension leaflets, websites, etc.). Stakeholders can participate in various stages of the research process, e.g., in formulating research objectives, identification of field sites, data collection, evaluation of research results, and even in modelling (see e.g. Henriksen et al. 2007). The provision of timely and accurate information by the researchers enhances reception and internalization of the results by the policy makers and resource users.
3. Researchers should look beyond the boundaries of their own disciplines and institutes. Environmental problems are typically multidisciplinary and should involve scientists from both natural and social sciences (Meinzen-Dick et al., 2004). There should be a balance between inter/trans-disciplinary applied research aimed at understanding and managing complex environmental systems at a suitable scale (for adaptive management and governance this will often be the catchment or river basin scale), and the more traditional, mono-disciplinary and fundamental research aimed at clarifying specific issues, solving specific problems or developing specific technologies that support the needs of the partnership and its objectives. It is important to prioritize research needs and review resource allocation. Monitoring and evaluation need to be incorporated in research programmes and indicators for tracking research impacts should be identified.

Evaluations should include feedback follow-ups with clearly defined targets, milestones and deliverables.

EAWA is an example of how researchers and practitioners actively seek to improve communication and get more out of limited resources for research. However, whether such initiatives will lead to effective policies and management in the future depends to a large extent on the presence of strong institutions, strong economies and transparent, democratic decision making procedures. In reality, many countries suffer from weak and ineffective government institutions that can lead to clientelism and corruption. Researchers cannot overcome such hurdles, however efficient and dedicated their work. Capacity building should be an integral part of joint efforts. As stakeholders work and learn together, a new generation of scientists and policy makers who are familiar with an integrated approach should emerge. They will be aware of the importance of participation of resource users, policy makers and researchers in integrated research programmes that support the development of environmental policies and practices.

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Box 1. Example of multi-stakeholder partnership: the GLOWS programme "Transboundary Water for Biodiversity in the Mara River Basin" (TWB-MRB)

The Global Water for Sustainability (GLOWS) Program is supporting the efforts of the East African Community (EAC), Kenyan and Tanzanian Water Ministries, and other national and local institutions to improve water resource management to reduce and mitigate threats to biodiversity in the Mara River Basin and Mara-Serengeti Ecoregion. The programme "Transboundary Water for Biodiversity in the Mara River Basin" (TWB-MRB) supports development of more integrated management of water in the Mara River basin, working with local partners to meet the water needs of the basin's peoples without harming aquatic ecosystems. TWB-MRB is working with the EAC to forge an agreement between the countries of Kenya and Tanzania on the joint management of water resources in the Mara River Basin. Simultaneously TWB-MRB has been supporting the formation and operation of grassroots water users associations in the Kenyan and Tanzanian portions of the basin. Another activity has been the quantification of the flow characteristics of the Mara River required to sustain biodiversity and ecosystem processes in the Mara-Serengeti Ecoregion. Water management planning must be informed by a scientifically sound and credible quantification of the reserve flow acknowledged in the new water laws of both Kenya and Tanzania. The reserve flow is defined as the quantity of water that must be preserved in rivers to satisfy the needs of both rural domestic water users and ecosystems. TWB-MRB mounted a team of local scientists and international experts to conduct an environmental flow assessment for the Mara River along the reach that passes through Masai-Mara and Serengeti conservation areas and also conducted a campaign to increase awareness of environmental flows among other users through outreach activities with the water user associations on both sides of the border (see also: <http://glows.fiu.org>).

Box 2. Example of direct cooperation between scientists and resource users: the Gazi Women Mangrove Boardwalk, Kenya.

An example of a direct collaboration between researchers and a community of resource users is the Gazi Women Mangrove Boardwalk project in Gazi, Kenya. Gazi Bay is located about 50 km south of Mombasa on the Indian Ocean. The bay is bordered by some 700 ha of mangrove forest and several villages of which Gazi is one. With fishing, the harvesting of wood for construction and fuel, and the production of medicinal products the mangroves are vital for the livelihoods of these communities. Like elsewhere in the world, mangroves in Gazi were degrading because of increasing pressure from agriculture, aquaculture, human settlement and economic development. Reforestation attempts in Gazi were started in the early 1990's and continued with participation from the Gazi community (see e.g., Kairo, 1995 and Bosire et al., 2003). Apart from the scientists of the Kenya Marine and Fisheries Research Institute (KMFRI), several academic institutions and other organizations from abroad were active in Gazi. With support from these researchers, a group of women organized themselves for an ecotourism project with as the main attraction a 300 m boardwalk through the mangroves. The women were trained by the researchers in identification of mangrove species and ecology of the mangrove ecosystem. The women work as guides for visiting tourists and generate extra income by catering local Swahili food and drinks. There is still a strong link between the women's group and the scientists at KMFRI, which has a satellite station in Gazi. This guarantees not only a continued flow of technical information but also regular encouragement and moral support.
(see also: http://www.vub.ac.be/APNA/staff/FDG/Gazi_Women_Mangrove_Boardwalk_brochure_low.pdf).

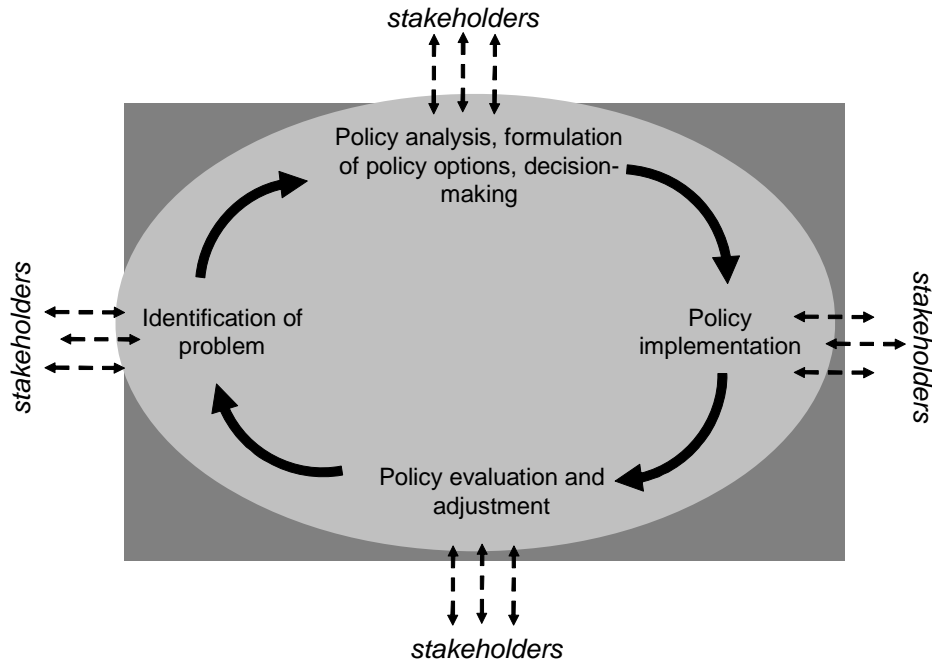


Figure 1. Policy process in environmental policy making

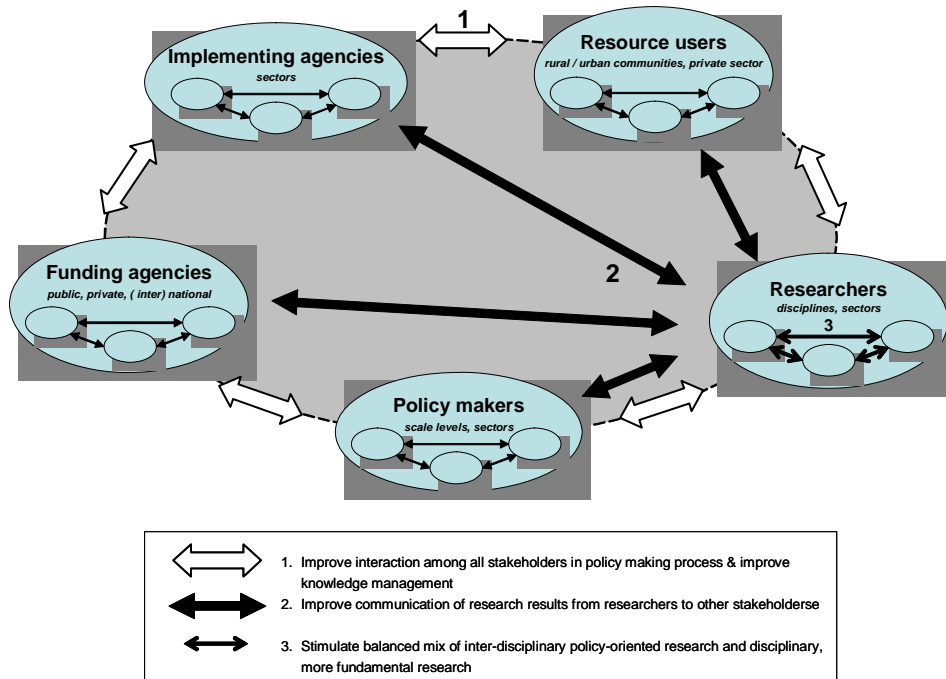


Figure 2. Options for better embedding of environmental research in society