International environmental education – safeguarding our future through knowledge and co-operation

Education is an important aspect of many of the water management projects supported by the Federal Ministry of Education and Research (BMBF). The aim is to inform different target groups about new or established processes and technologies as well as important aspects of water management, thus raising awareness of the importance of our sustainable and environmentally sound use of the resource water. Another important aspect is the training and education of local project partners: if initiatives in countries outside Germany are to be successful in the long term, they must be continued independently upon project completion.

To simply regard international environmental education as an instrument of acute environmental protection would be short-sighted: it also represents an essential tool in the fight against poverty in developing and emerging countries. The programmes funded by the BMBF are thus in tune with the United Nations Decade of "Education for Sustainable Development" (2005 to 2014).

Projects with strong educational value also create a sustainable basis for international co-operation in regions with scarce water resources and help to strengthen the position of the German water industry by opening up new markets. Last but not least, such initiatives also build the international reputation of Germany as a centre of science and technology.

Programmes for global knowledge exchange

The disciplines of environmental protection and sustainable development are highly reliant on the continuous advancement of theoretical and practical knowledge. Germany can look back on many years of environmental and sustainability research and thus has both an opportunity and a duty to share its extensive technological and planning expertise with the rest of the world. Just one example of this is the project "Introduction of a German post-graduate course for environmental sciences in China", which was successfully completed in 2008. In 1999, the long-standing water technology co-operation between the BMBF and the Israeli Ministry of Science and Technology (MOST) also saw the creation of the "Young Scientists Exchange Program" (YSEP) with the aim of motivating young scientists to participate in this international co-operation. The YSEP is primarily geared towards graduates, PhD students and post-docs and offers research stays of up to six months at partner institutions in Germany or Israel. As part of the German-Israeli co-operation, over 100 research projects have been completed over the last few years. Developed in conjunction with numerous European universities, the study module "Integrated Flood Risk Management" (FLOODmaster) and its e-learning component are also suitable for specialists who wish to expand their knowledge in this area (project 3.2.01).

Knowledge transfer in Uzbekistan

The transfer of knowledge also plays a central role in a BMBF-funded project in the Central Asian republic of Uzbekistan entitled "Economic and ecological restructuring of land and water use in the Khorezm region". Khorezm is situated on the Aral Sea, which has all but disappeared over the last few decades as a result of the massive irrigation required for the region's intensive cotton production. Working with their Uzbek partners and local farmers, the project participants are promoting environmentally sustainable agriculture in the region and supporting the inhabitants of Khorezm with the independent implementation of necessary measures. This is done by providing regular training to farmers and water technicians and by developing appropriate organisational and communication tools. The initiative also supports the education of Uzbek students (project 3.2.02).

International scholarship programme

In 2001, the BMBF launched a scholarship programme under the title of "International Postgraduate Studies in Water Technologies" (IPSWaT). The programme offers scholarships for Masters degrees (M.Sc.) and doctorates (Ph.D) as a means of supporting young, highly qualified scientists from home and abroad with their research into integrated, sustainable water management. By awarding these scholarships, the BMBF hopes to improve the international transfer of knowledge and technology in the field of water management and support future decision-makers in developing and emerging countries. The programme is also laying the foundation for future scientific and economic co-operation (project 3.2.03).

Learning from the experience of others – progress through global knowledge transfer

The disciplines of environmental protection and sustainable development are highly reliant on the continuous advancement of theoretical and practical knowledge. Germany can look back on many years of environmental and sustainability research and thus has both an opportunity and a duty to share its extensive technological and planning expertise with the rest of the world. After all, conserving the foundations of life and protecting people from natural hazards are not just domestic concerns. Three examples from the field of water management highlight the many means of imparting knowledge to young scientists across the globe.

German environmental experts teaching in China

Co-operation between China and Germany in the fields of education and research has greatly increased in recent years China has thus become an important partner to the Federal Republic – both with regard to the number of projects and the funding volume. Two main goals are being pursued: firstly, the expertise of German specialists is being used to promote environmental protection efforts in China. Secondly, the transfer of environmental knowledge is to familiarise the Chinese people with German standards, environmental technologies and expertise, while also paving the way for the entry of German companies into the Chinese market.

As an important aspect of this knowledge transfer, the project **"Introduction of a German post-graduate course for environmental sciences in China"** was launched in January 2003. This study programme is open to decision-makers and specialists from the fields of economics, industry and administration, who hold a Bachelor's degree or are current Masters students, and provides them with an in-depth insight into German technologies and standards. Elements of the Environmental Sciences postgraduate course offered by the Institute of Environmental Engineering (ISA) of the technical university RWTH Aachen have been integrated in the Masters degree courses of two Chinese universities. German tutors are delivering series of lectures on the subjects of water management and waste disposal to students at these institutions. At the end of the lecture programme, the top 15 students of each class are invited to Germany to experience our water technologies and water management structures first-hand.

ISA employees teaching at the Tsinghua University of Beijing

Exchange programme for young German and Israeli scientists

Since its initiation in 1974, the water technology co-operation between the BMBF and the Israeli Ministry of Science and Technology (MOST) has given rise to over 125 research projects. In 1999, the co-operation was further enhanced by the addition of the "Young Scientists Exchange Program" (YSEP). The aim of this initiative is to motivate young scientists to participate in the German-Israeli co-operation in the field of water technology.

The YSEP programme his since become one of the most important aspects of the joint efforts between these two countries. It is geared primarily towards graduates, PhD students and post-docs and offers research stays of up to six months at partner institutions in Germany or Israel. Up to the end of 2011, a total of 70 budding scientists (35 Israeli, 35 German) participated in the programme – one particularly positive aspect being that female students have accounted for half of this number.

Test drilling for a well in the Judean desert near the Dead Sea as part of a research project

International study module on flood management

Extreme flood events continue to underline the importance of comprehensive risk management – both in Germany and abroad. Transdisciplinary analyses of complex flood risks and assessments of management options are proving particularly challenging both from a research and practical perspective. By providing an appropriate range of courses, university education can instil young scientists and experts with a better understanding of the issue as a whole. This includes both the connections between the hydro-meteorological causes of floods and social, economic and ecological vulnerability◄ as well as the effectiveness of preventative measures and disaster management.

This is the aim pursued by the international study module "Integrated Flood Risk Management" (FLOODmaster), which is taught at the Technical University of Dresden as part of the Masters degree course in Hydro Science and Engineering. The international, English-language study programme effectively combines basics of natural sciences and engineering with economic, social and planning expertise. The course is aimed at Masters candidates, students in higher semesters and graduates. The special e-learning component of the programme is ideal for experts who wish to expand their knowledge in this field. The teaching materials are made available on the Internet both for full-time students and distance learning purposes.

The study concept comprises the following components:

- Two series of lectures on the subjects "processes of extreme flood risks" and "integrated flood risk management".
- Three focus workshops dealing with the most important flood types; conflicts in the development of management strategies are addressed in an actor's workshop involving specialists and professional experts.
- Transnational issues are covered in the form of a multi-day excursion to a European flood risk area.
- The theoretical and methodical basics from the individual components are combined in a seminar paper on a specific subject.

The module was developed in close co-operation with multiple European universities and scientists from national and international research initiatives and is supported by a scientific advisory board. The programme arose from the BMBF initiative RIMAX (Risk Management of Extreme Flood Events) in co-operation with the European research project FLOODsite (Integrated Flood Risk Analysis and Management Methodologies). Today, this university course is taught as a dual module in Flood Risk Management as part of the international Masters course in Hydro Science and Engineering at the TU Dresden and represents a perfect example of the successful practical application of a BMBF-funded initiative.

Students assessing the flood risk along the Elbe river as part of the River Flood Workshop in Dresden

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Opening up new perspectives – sustainability in Uzbekistan

Stopping the inefficient and ecologically damaging use of the soil and waters while alleviating poverty among the people: these are the objectives of a German-Uzbek project at the Aral Sea. There is an urgent need for action in this area as decades of intensive agriculture (cotton production) have resulted in the gradual disappearance of the Aral Sea. At the same time, the initiative hopes to provide local farmers with the necessary knowledge to improve their income using ecologically sustainable farming methods.

The irrigation agriculture practised in Central Asia reduces the productivity of soil and water resources, while poverty continues to rise – issues that can be attributed to the inefficient and unsustainable use of available resources. This applies particularly to the irrigated lowlands of the Aral Sea basin in Uzbekistan, an area that is home to some 27 million inhabitants: intensive cotton production has had a serious environmental impact on the region's soil and waters.

To halt this downward spiral, the Uzbek population should be able to work in a more market-oriented manner. After all, farmers account for over 70% of the population, and they are most likely to protect their resources if this will help them to raise their income. However, they have insufficient experience of private agriculture, having only recently become independent operators. In addition, their economic freedom is still quite limited: the farmers are still under the strict control of the central government and are bound by its plans. Merely demonstrating to these people how sustainable agriculture works would therefore be wholly inadequate. It is equally essential that they understand the local decision-making structures and consider the interests of the different policy-makers.

Concepts for irrigation agriculture

To make sustainable improvements to the utilisation of resources at the Aral Sea, the Centre for Development Research (ZEF), an interdisciplinary research institute at the University of Bonn, joined forces with UNESCO and the Uzbek government to launch the research project **"Economic and ecological restructuring of land and water use in the Khorezm region"** (period of study: 2002 to 2012). Institutes from Germany, Uzbekistan and other countries are also involved in the project.

A ship graveyard on the dried up ground of the Aral Sea

Experts from a range of disciplines (land use, agricultural sciences, water management, economics and social sciences) are developing concepts for the ecologically sustainable and economically efficient use of resources in the Aral Sea basin. The model region of the BMBF-funded project is the Uzbek province of Khorezm, situated south of the Aral Sea along the lower Amu Darya. The most important local partner is the Urgench State University, where a modern laboratory building was constructed and equipped for the project.

One of the fundamental objectives of the initiative is to support the persons responsible in the region in their independent implementation of the necessary measures. The scientists are therefore looking closely at local decision-making structures in order to make recommendations for improving the organisation of land cultivation and water management – in conjunction with the local decision-makers. Studies relating to agricultural business and macroeconomics and covering the entire product chain are to uncover potential for a more efficient management of resources and improved value creation. New land use technologies are also being tested. The project also supports the academic training of Uzbek students: many are given the opportunity to attend a Masters degree course in Tashkent, while 22 postgraduate students have gained their doctorate at the ZEF in Bonn (many of whom have found positions in Central Asia or are now supporting the transfer of knowledge as post-doctoral fellows in this initiative).

Forestation of a degraded area

An irrigation channel with distribution structure

Participatory approach

The success of technological innovations is also greatly dictated by the level of participation: the needs and expectations of the partners must be addressed, while technical and institutional changes must be adapted to local circumstances. Close co-operation with the Uzbek partners has a significant impact on local acceptance. Regular training of farmers and water technicians is equally essential, as is the development of appropriate organisation and communication tools. With regard to technical co-operation, the project team is working closely with German, Uzbek and international organisations.

Part of the initiative included the creation of interdisciplinary models for water and land use, which incorporate ecological, social and economic aspects. These have proved particularly helpful in examining the interplay between the various factors and participants, thus allowing the team to predict the long-term effect of specific measures. At the same time, cost/benefit calculations are employed to highlight the financial benefits if individual technologies, thus enabling the local decision-makers to implement suitable measures.

Four project phases

The ten-year project has been broken down into four phases. The first phase involved the creation of the local infrastructure and required database (e.g. digital maps), both from existing materials and the team's own research.

Based on intensive field studies and model developments, the second phase saw the generation of options for the future management of resources. These included new, soil-friendly cultivation methods, optimised irrigation strategies and technologies as well as the introduction of alternative crops and tree species, which not only offer environmental benefits but also increase the earnings of local farmers.

These concepts were then tested by the project participants during the third phase, in close co-operation with farmers, representatives from the water authorities and the partner institutions in the Khorezm region. Phase 4 (2012) is the implementation stage, in which the scientists and their Uzbek partners intend to spread their restructuring concept across the province. The ultimate aim is to implement a long-term solution that will allow the region to enjoy an ecologically, economically and socially sustainable future.

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International scholarship programme – imparting knowledge and cultivating contacts

The BMBF scholarship programme "International Postgraduate Studies in Water Technologies" (IPSWaT) represents the direct implementation of a recommendation made in the "Action Concept: Sustainable and Competitive German Water Industry" from 2000. The aim of the programme is to support highly qualified young scientists, promote the international transfer of knowledge and cultivate long-term contacts in the fields of science, water management and development co-operation.

The Federal Ministry of Education and Research (BMBF) launched the IPSWaT programme in 2001 as a means of providing highly qualified students and budding scientists from Germany and abroad with scholarships for international, English-language Masters courses and Ph.D degrees at German universities. In the context of capacity building◄, the granting of these scholarships is to promote the international transfer of knowledge and technology in the field of water management and support future decision-makers in developing and emerging countries in particular. The programme is also to lay the foundations for future co-operation.

Scholarships are available for Masters courses (M.Sc.) and Ph.D degrees. Around 35 M.Sc. and Ph.D. scholarships are awarded in two annual selection rounds. Candidate applications should ideally refer to a specific problem in their home country or region and include a methodical solution approach. The relevant issue should be studied in the context of a bi- or multi-lateral research project. The selection panel is particularly interested in applicants intending to research areas of integrated, sustainable water management including aspects of economic value creation. Depending on the desired scholarship, applicants must have acquired a Bachelors or Masters degree. The scholarship will allow Masters students to participate in one of 20 accredited German degree programmes for a period of two years. Ph.D degrees are funded for a period of three years and can be completed at any German university.

Numerous universities and technical colleges have been accredited for the IPSWaT programme (source: IPSWaT brochure)

Applications assessed by experts

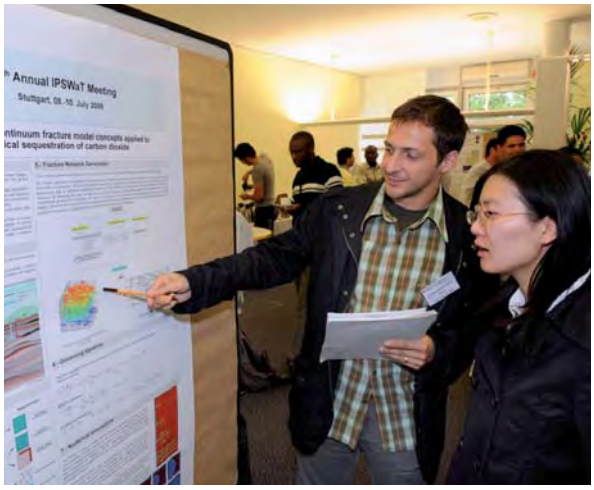
An expert panel meets twice a year (April and November) to assess received applications. Once the successful applicants have been selected by this external, independent committee, the relevant universities are notified of the results by the International Bureau of the BMBF. Candidates are selected first and foremost on the basis of their outstanding academic qualification. Other selection criteria include:

- Potential to be included in bilateral or multilateral co-operation in science, industry or development policy
- Practical relevance and transferability of the planned research work
- Institutional links to countries of origin and/or partner countries
- Relevance of the research project to integrated water resource management

Scope of scholarship

In addition to the monthly stipend (and family allowance, where applicable), the following will be paid to IPSWaT scholarship holders: travel allowance for one return journey to the place of study, a German language course at the start of the scholarship, health, accident and liability insurance for the duration of study, tuition fees for the first semester, maintenance grants for research visits abroad, a one-off start-up payment and a monthly bonus in the form of a research grant. During the study pro-

A group of students at the IPSWaT scholarship meeting in Leipzig, July 2010



A poster session at the IPSWaT scholarship meeting in Stuttgart, July 2009

gramme, the scholarship will also cover attendance of any relevant international conferences, training courses and trade fairs, field studies abroad as well as placements of up to three months at a German water technology company or water supplier. The following are not covered: Insurance and travel costs for family members as well as multiple journeys to and from the place of study.

Creation of networks

Since the programme was launched, the BMBF has funded over 350 students from 60 different countries. A central aspect of the IPSWaT is the creation of networks both among current and former students as well as with German partner organisations from the fields of water management, research and development co-operation (e.g. with the BMBF programmes IWRM and IWAS or the institutions DAAD, DED, GIZ, InWEnt, KfW). The annual scholarship meetings have proved to be a successful platform for internal and external networking. At these events, students can discuss their research work with one another and also have the opportunity to meet relevant stakeholders from German water institutions representing the worlds of business, science and development co-operation.

The programme is currently scheduled to run until the end of 2014.

Project website ▶ **www.ipswat.de**

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