



GM crops. Evidence on impacts and constraints

While global adoption rates of genetically modified (GM) crops have been increasing rapidly over the last few years, their socio-economic and ecological impacts are still the matter of controversy. ZEF is carrying out a project funded by Deutsche Forschungsgemeinschaft (DFG) that analyses the broader implications of this new technology for developing countries. One of the first GM applications was so-called Bt cotton. These are new cotton varieties which are resistant to certain insect pests. A recent empirical study in Argentina rendered some interesting results.

Pesticide use and crop yields

In collaboration with local research partners, a representative survey of Argentine cotton farmers was carried out for two consecutive growing seasons. The data show that Bt technology leads to a considerable decline in pesticide application rates. On average, farmers adopting it use 50% less insecticides than their colleagues who only

grow conventional cotton. Almost all of these reductions occur in highly toxic chemicals, with concomitant positive effects for the environment. Moreover, technology adopters benefit from higher yields. This is due to insufficient pest control in conventional cotton.

Since there is concern that GM technologies might be biased towards large-scale agricultural producers, the impact was also examined for different farm sizes. In Argentina, large farms tend to use more chemical inputs than smaller ones, so it is not surprising that they also realize bigger pesticide savings through Bt varieties. For cotton yields, however, the opposite is true. Many smallholders do not use insecticides at all, so they suffer significant pest-related crop losses in conventional cotton. Econometric models show that the net Bt yield gain is 17% for average large-scale growers, whereas it is around 42% for small farms. Also, total gross benefit per hectare of Bt cotton is higher for smaller than for larger farms. Similar results have been observed



Argentine farmers participating in a survey.

Editorial

Tendencies on the global agricultural market

The volume of international trade in agricultural and food products is growing slightly, whereas its structure is changing enormously. The share of agricultural raw materials in the total amount of export trade in agricultural products is rising rapidly, whereas the share of processed agricultural products has been increasing 5% annually between 1975 and 1985 and has been doubling in the subsequent years.

Especially developing countries contribute to the increase of processed agricultural products: they raised their share in the total volume of export trade in agricultural products by one third. As such, this is a positive effect, since by exporting processed agricultural goods, the net product remains for domestic use, which triggers growth, employment and positive income effects.

Despite these positive tendencies, most developing countries are concerned about their deteriorating chances of access to the rich world's markets. This is due to the fact that its consumers require higher standards of quality and security of food products and in production processes.

Developing countries are often not capable of fulfilling high technical and social standards like those set by the WTO.

They need technical and financial support in order to adapt to these new tendencies. ■


Klaus Froberg
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in other countries – notably Mexico, South Africa, India, and China. Obviously, GM crops can be very suitable for small farms. A wider diffusion at affordable prices could bring about desirable economic, social, and environmental effects in developing countries.

Risk of resistance development

Like for any pest control technology, there is the risk that insect populations could develop resistance to Bt crops over time. This is a serious concern with respect to the technology's economic and ecological sustainability. If resistance were to build up in a short period of time, the productivity gains and environmental benefits would only be of short duration. Instead, Bt technology would perpetuate the pesticide treadmill that GM crops actually promise to ease. So far, resistance to Bt has not been observed in Argentina or anywhere else, but, since GM crops have only been grown for a few years, observation periods are still rather short. Biological models have been used to simulate developments over a 15-year time horizon. Scenario results show that rapid resistance build-up is unlikely under Argentine conditions if a certain minimum of the farm area is grown with conventional cotton varieties. Farmers in Argentina usually

follow this requirement, and they also grow other conventional crops that are host plants for Bt target pests. Thus, there are sufficient non-Bt refuge areas to weaken selection pressure on insect populations. Nonetheless, more research into the complex interactions with environmental systems and longer-term observations are needed before conclusive statements can be made about the technology's sustainability.

Multinationals and monopolies

GM crops are often believed to be inappropriate for developing countries, because most of the applications available to date were developed by multinationals that are interested in commercial profits rather than farmers' welfare. There are many examples where small farmers in developing countries do benefit tremendously from GM crops developed by multinationals. Benefits are particularly high where intellectual property rights are not existent or weakly enforced. In such situations, seeds can be reproduced by farmers or acquired at low cost. In Argentina, however, the US company Monsanto has a monopoly on Bt cotton, and the price charged for GM seeds is more than four times the price of conventional varieties. Although farmers in high pest-pressure areas can still benefit financially, the hefty seed price is an important adoption constraint. Unsurprisingly, a willingness-to-

pay analysis reveals that diffusion would be much more widespread if prices were lower. What is more striking, however, is that Monsanto's revenues and profits would increase, too, if GM seeds were sold at a lower price. The reasons for this sub-optimal pricing strategy are unclear. But they might have something to do with the US farm lobby, which fears competitive disadvantages when US technologies are marketed more cheaply abroad than at home.

Many are concerned that small farmers in developing countries would be exploited by foreign monopolists charging excessive prices for GM seeds. But farmers are quite clever. As the Argentine case shows, they will rather decide not to adopt the technology at all if it is too expensive. Yet the study also demonstrates that resource-poor farmers are definitely not the main target group of multinationals. While foreign companies can supply innovations for certain commercial market segments in developing countries, it is unlikely that they will develop specific technologies for niche markets in semi-subsistence settings. Developing GM technologies for such situations is feasible from a technical angle. But this is not going to happen on a larger scale unless public research investments targeted at such areas are increased significantly. ■ Matin Qaim

The author was a senior researcher at ZEF until March 2004.

SERIES ON INSTITUTIONAL ANALYSIS

New role, new models. Reforming constitutional control in Latin America

Iraq and Afghanistan are now facing the challenge of having to construct a new constitutional order. The latest developments highlight how complex, time-consuming and difficult such a process can be. Considering the importance currently being attached to the process of democratisation, surprisingly little research has been done on the legal mechanisms involved. Few in-depth studies on experiences in other countries and other regions exist and are only selectively taken into account by the actors involved in the process. Unlike the nations of the Near and Middle East, the countries of Latin America have a long history of attempts to democratise and liberalise, from the first constitutions after gaining independence in the early nineteenth century to the wave of democratisation at the

end of the Cold War. Causes for successes and failures provide an insight into the pros and cons of specific solutions which could prove of interest for other regions.

Experiences in Latin America have shown that an important factor in long-term success of constitutional reform is the system established for constitutional control. The juridical branch of government – and specifically the courts entrusted with constitutional interpretation and control – have a pivotal role to play in the construction of a functioning constitutional state. Long recognised by social sciences, the importance of constitutional courts is increasingly being brought to the attention of international donor institutions such as the World Bank. The Supreme Court of the United States and the German Constitu-

tional Court are two examples of how courts and court rulings have had a decisive influence in building a societal order. Decisions by constitutional courts have proved essential in clarifying the competences of the branches of government and their organs, in protecting human and civil rights against infringements by the state and in establishing precedents for the functioning of the new constitutional order. Furthermore, composition and quality of a constitutional court can foster trust in society in state organs established by a constitution. The role of constitutional courts is being studied at ZEF as a part of historical and comparative legal research on democratisation and institutional change in Latin America. One of the observations made in the current research is that, in the past two decades, the



Presidential palace in Bolivian capital La Paz.

organisational form of the Supreme Court of the United States – not its meaning and relevance – has lost in influence as a role model in Latin America. A comparison of the reforms in public law in Latin America has shown that continental European models are increasingly being followed. Since 1980 six countries of Latin America have created new specialised constitutional courts (tribunales constitucionales) according to Spanish or French models, for example in Chile, Peru and Bolivia. During the same time, six more countries introduced court senates specialised in cases regarding constitutionality (salas constitucionales) within existing Supreme Courts. Only in six countries – among them Argentine and Uruguay – were traditional Supreme Courts of the type found in the United States kept as the sole organs for constitutional control.

However, an in-depth study of the individual courts suggests that not all constitutional courts or senates created actually have the competences needed to function according to the models of continental Europe. In Paraguay, for example, rulings on unconstitutionality – even if laws are regarded as unconstitutional – only apply to the specific case (inter partes as opposed to erga omnes). While being regarded unconstitutional, the laws remain valid. During the Constitutional Convention, this inconsistency was explained by previous experiences with a juridical branch that acted according to the will of the authoritarian regime, is therefore lacking public trust and shall

not have the competence to override parliamentary legislation. In many other countries, the power to rule laws unconstitutional is not limited to a single court. Lower courts may also rule on cases of constitutionality, even though the judges are not trained accordingly.

The difference between the designation of a court and the competences assigned to it is also apparent in countries in which traditional Supreme Courts have retained their name but assumed new competences. In fact, some so-called “Supreme Courts” – like that of Brazil – now closely resemble models of Continental Europe. Only history will tell whether the new organs established in Latin America for constitutional control will be a success. However, an in-depth analysis of their composition, competences and procedures already shows the problems of confronting traditional institutions with new concepts, and the importance of consistency – or at least compatibility – of solutions for the success of reforms. In the end, individual decisions by the courts and their impact will show to what degree the instituted organs for constitutional reform will be able to fulfil their new role. Keeping cultural differences in mind, the experiences made in Latin America may prove helpful for other regions. ■ Anja Schoeller-Schletter

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★ NEW: ZEF- Policy Brief

- ZEF-Policy Brief No. 1: “Why a further Afghanistan Conference?” By C. Schetter and B. Kuzmits, March 2004.



Testing the effects of pesticides should take place under tropical conditions.

Effects of pesticides on soil fauna. Development of ecotoxicological test methods for the tropics

Soils make up a central component of terrestrial ecosystems in which important ecological processes such as the decomposition and nutrient cycling of organic matter and humus formation occur. Soil organisms play an important role in these processes. Pesticides have been widely used in agriculture to control pests and pathogens and have contributed to the "Green Revolution", but many of these substances have toxic side effects on the environment. Therefore, and to avoid effects on the structure and function of soil organism communities, in Europe and the USA pesticides must be tested before they can be applied in the field. A catalogue of standardised ecotoxicological test methods now exists for this purpose. In the tropics however, side effects of pesticides have not been sufficiently studied. In tropical countries, governmental organisations usually only have the option of testing pesticides using procedures optimised for temperate regions before allowing them onto the market. This is in spite of the fact that in the tropics, with typically higher average temperatures and differently structured and more diverse soil organism communities, one can expect that the behaviour of these chemicals as well as their effects on both organisms and ecosystem processes will be significantly different to those in temperate regions. Therefore, in an initial study, ZEF has attempted to lay the foundations for a tropical soil

toxicology program. The study was carried out within the framework of the SHIFT program of the German Federal Ministry for Education and Research (BMBF), and in close cooperation with the Brazilian agricultural development organisation Embrapa as well as with ECT Ecotoxicology GmbH, a private research institute in Flörsheim near Frankfurt. In this study, the effects of three pesticides on the structure (earthworm and arthropod communities in the soil) and function (decomposition of the litter) of the soil fauna communities in the Amazon region was investigated and compared to the situation in central Europe. The goal of the study was to answer two main questions: Do behaviour and effects of these pesticides differ under tropical and temperate conditions? Can data on these effects originating from temperate regions be used for risk assessment in the tropics?

All tests in the laboratory, in microcosms and in the field followed international standard guidelines of the OECD and ISO and were modified with regard to the tropical conditions. The mean test temperature in the lab was 28°C (instead of 20°C), and the test organisms were two varieties of the compost worm *Eisenia fetida* stemming from Brazil and Germany, as well as the isopod species *Porcellionides pruinosus*. Further tests - in smaller numbers - were made with the earthworm species *Pontoscolex corethrurus*, com-

mon in the tropics, and with isopod and diplopod species that are native to Amazonia. The model chemicals used in the experiments were the fungicides Benomyl and Carbendazim and the insecticide Lambda-cyhalothrin, which are used in agriculture in Brazil (Benomyl has recently been removed from the market in Brazil by the supplier). The tests were also modified in a way that allowed them to be carried out at low cost with materials available in tropical regions. For example, the peat used in Europe for the production of a so-called artificial soil was successfully substituted with a local product from a tropical tree fern and with coconut coir dust.

The "tropical" version of the standardised acute and chronic laboratory tests with the earthworm *Eisenia fetida* and the isopod *P. pruinosus* was carried out without problems. The only exception concerns the unsatisfactory assessment of the pesticide effects on the reproduction rate of isopods, due to the complicated biology of these animals. These results show which difficulties arise due to our still insufficient biological knowledge of tropical organisms. Further studies will be necessary. This also applies to the worm *P. corethrurus*, which was difficult to breed.

The laboratory tests further showed that the model chemicals had clearly different effects under tropical conditions, for instance due to the increased temperature. Carbendazim, for

example, was less toxic to earthworms under tropical than under temperate conditions, whereas with Lambda-cyhalothrin the effect was the opposite, albeit less pronounced. The sensitivity of the studied tropical species was generally similar to that of the standard test species. In the acute tests with earthworms, however, the effects of Carbendazim were about 20 times greater in *P. corethrurus* compared to the tropical variant of *E. fetida*.

Experiments with terrestrial model ecosystems (microcosms) were carried out in the tropics for the first time. Here, both Carbendazim and Lambda-cyhalothrin had significant effects on the tested animals. Litter decomposition, used to test the ecological functionality of the system, was also negatively influenced. The toxicity of the model chemicals in these experiments was in the same range as

in Europe. In the field, the decomposition of leaf litter was slowed by both Carbendazim and Lambda-cyhalothrin, and the abundance of the native earthworm species *Andiorrhinus amazonius* was reduced one year after the application of Carbendazim.

Based on these results a first assessment can be made of the environmental risks of pesticides under test conditions specifically developed for tropical conditions. For both Benomyl and Carbendazim the environmental risk recognised for temperate regions can be confirmed for tropical conditions, whereas the use of Lambda-cyhalothrin in the tropics must be considered more critical than in higher latitudes.

To answer the two questions posed above, it can be said that the behaviour and the effects of the pesticides under tropical and temper-

ate conditions sometimes differ strongly according to the characteristics of the tested chemical, and that for a risk assessment in the tropics data from temperate regions can only be used with caution. For pesticides to be used in the tropics, the responsible authorities should develop and carry out ecotoxicological tests specific to the tropics, and these should also be integrated into the risk assessment. Now it is imperative to receive support from decision-makers for political implementation of this approach. ■ Marcos Garcia, Bernhard Förster, Jörg Römbke, Gerd Welp, Christopher Martius

Marcos Garcia is a scientist at the Embrapa Amazonia Ocidental, Manaus, Brazil, and a PhD student at ZEF. B. Förster and J. Römbke work at ECT Ecotoxicology GmbH, Flörsheim, C. Martius at ZEF, and G. Welp at the University of Bonn.

True peace or routinisation of collective violence? Local-level politics in KwaZulu/Natal in the post-apartheid era

Is the South African province of Kwa Zulu/Natal finally at peace? At first sight this question seems to be rhetorical: the number of casualties has declined from an all-time high of more than 600 killings in March and April 1994 to 54 people murdered in collective violence in the first half of 2000. Furthermore, the provincial leadership of the two major political organisations, Inkatha Freedom Party (IFP) and African National Congress (ANC), started peace talks in 1996 and at present form a coalition in the Provincial Government. Apparently, the most populous South African province is following the path to peace after more than a decade of collective violence with approximately 20,000 people murdered and more than 500,000 refugees.

However, a forthcoming PhD thesis at ZEF questions this widespread assumption. The main objectives of this study are to analyse and understand collective violence in the local arena in KwaZulu/Natal after 1994. So far, only very few research projects have investigated violent action at local level, so that there is still a need for in-depth studies on the microcosms of collective violence. In the course of one year of fieldwork in KwaZulu/Natal it became evident that despite a decrease in media coverage and public attention, a substantial number of people had been killed in the post-apartheid era. Recent figures put the number of casualties at about 2,000



A suburb in Kwa Zulu/Natal.

from 1994 to 2000. This of course casts a shadow on the peace process between the provincial leadership of ANC and IFP that is generally portrayed as being successful and bringing "true peace" to the province.

It is not disputed in this thesis that collective violence has indeed declined in terms of casualties: this is obviously (and fortunately) so. What the study questions is whether peace has prevailed in the local arena in KwaZulu/Natal or, rather, a shift in the patterns and character of violence occurred in recent years. Therefore, one argument is that violent action became routinised in the local arena and either continues in these days or is at least an omnipresent option of acting in local-level politics. Processes of revenge are discerned as a key motive in the reproduction and routini-

sation of collective violence. Revenge is a driving force behind most acts of violence following the initial one and became a norm in the local arena in the 1990s. Under conditions of ineffective state institutions revenge serves as an act of retribution for perceived injustices and thus produces justice from the perspective of the perpetrators. Therefore, processes of revenge result from insecurity and lack of trust in the criminal justice system but are not culturally determined. Although transforming collective violence remains a highly complex issue, one major task for the future is hence to improve the effectiveness as well as an impartiality of the police and judiciary in order to realise the vision of a province at peace. ■

Mario Krämer

The author is a junior researcher at ZEF.

Viewpoint

Interview with Prof. Janos Bogardi, Director of the United Nations University Institute for "Human Security and Environment" (UNU/EHS)



The United Nations University (UNU) is an independent UN institution set up by the United Nations General Assembly in 1973. The 13 UNUs across the world have dedicated themselves to the goal and mission of research and training. They act as a UN think tank, serving as an interface between science and the UN member states and UN committees. The UNU in Bonn is the UN University's first institution in Germany and commenced its activities towards the end of 2003. It is a research and training center focusing on human security and environment. Prof. Janos Bogardi, who used to work for UNESCO in Paris, heads this institution.

What is the profile of the UNU/EHS programme?

The two most important research fields for the United Nations University are "Governance and Peace" and "Environment and Sustainable Development". The UNU Institute for Environment and Human Security can be assigned to the second research priority area. The UNU/EHS programme in

Bonn above all deals with the threats human habitats face due to natural disasters and with chronic changes to the environment such as desertification and climate change. The problem of overlapping of short-term incidents (such as flooding) and long-term processes and their impact on the vulnerability of stakeholders to these threats is another focal aspect of this research. However, the aim is not only to do cross-subject, interdisciplinary research on these fields of topics but to also provide training and upgrading for high-ranking decision-makers and players with an optimum of practical relevance.

What are Bonn's locational advantages?

I think it was right to opt for Bonn as the seat of Germany's only UNU so far, for synergy effects are certainly going to develop with already existing research institutes and UN secretariats. Above all, close co-operation with ZEF suggests itself thanks to its close thematic proximity. Here, I would consider possible joint research projects as well as close co-operation among, and ex-

change of, academics and post-graduates in particular.

What specific options for co-operation with ZEF would you emphasise?

There is a considerable amount of common ground as far as the UNU/EHS programme and ZEF are concerned in which I would look forward to a fruitful exchange. In addition, there are overlaps in the area of Capacity Building, since it is not only the task of UNU/EHS to train and upgrade Germans but also, in accordance with our mission, to train and upgrade international staff. So Capacity Building for executive staff from the developing countries themselves assumes an important role. Here, there are good options for co-operation with ZEF's International Doctoral Studies Program.

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At a glance

■■■ On 1 April 2004, Matin Qaim was appointed Professor of International Agricultural Trade and World Food Security at the University of Hohenheim in Stuttgart. Mr. Qaim was among the first ZEF doctoral students, finishing his PhD in 2000. After a post-doc phase in Berkeley (California) he has been a research team leader at ZEF since early 2003.

■■■ The SHIFT Project "Smallholders in the Amazon: Interactions between Ecosystem and Social System in the Use and Protection of Tropical Forests" has been extended by six months to July 2004. Project results will be presented at a stakeholder workshop to be held in Belém, Brazil, in June 2004.

■■■ ZEF will be conducting a needs assessment study on education in four Arab countries (Morocco, Egypt, Jordan and Yemen) for the BMZ. Noha El-Mikawy (n.el-mikawy@uni-bonn.de) is to co-ordinate the study, which

will entail an analysis of the policy process, policy discourse, stakeholders and the appropriate role of international development in this area of cultural co-operation.

Facts & news

■■■ The second phase (2004-2006) of ZEF's Uzbekistan project was approved by the BMBF towards the end of December 2003.

This phase, "Economic and Ecological Restructuring of Land and Water Use in the Khorezm Region (Uzbekistan): Field Research and Development of a Pilot Farm Concept" is devoted to more intensive field research aimed at providing sufficient data to understand and simulate the most important processes with a model (KEOM = Khorezm Ecological and Economic Optimization Model) that will lead to the development of an integrated concept for restructuring of land and water use. The concept is to be tested in a pilot farm scheme during a subsequent

phase starting in 2007.

■■■ The Robert Bosch Foundation has approved funding for the second phase (4/2004-3/2006) of the Research Group "Alternative Institutions for the Management of Natural Resources in Developing Countries", directed by Stefanie Engel. In addition to continuing and comparing the country studies initiated in the first phase, this second phase will conduct more detailed research into the policy option of paying communities directly for the ecological services they provide.

■■■ ZEF organised an international workshop on "water, development and co-operation in the Euphrates, Tigris and Southern Africa regions" in co-operation with Bonn International Conversion Center BICC on 1-2 March in Bonn, which was attended by 60 international experts and practitioners. A workshop summary is available on www.water-workshop-bonn.de.

Development in practice. Dammed-up problems

Burkina Faso has the highest density of development NGOs world-wide. Development and aid organisations have above all been active in this country, which is among the poorest of the world, over the last ten years. In particular, numerous micro-dams have been built in Burkina Faso, which features traditional crop farming and livestock breeding methods.

Building these dams was aimed at enabling conversion to irrigated agriculture, which is independent of the rainy season, and hence the growing of new agricultural products, chiefly rice. Crops of traditional grain varieties such as maize, sorghum and millet were no longer covering food requirements, so that additional food had to be imported.

ZEF news talked to Konrad Vielhauer, who is currently head of a project to improve irrigated agriculture initiated by the Dreyer Foundation and co-ordinator of the GLOWA-Volta Sub-Project headed by ZEF in Burkina Faso. Mr. Vielhauer explained some of the characteristic factors of agriculture in the region.

What exactly are the problems that arise when switching to new agricultural methods and products?

Conversion from traditional low-input farming to highly-organised irrigated agriculture is very difficult for the farmers. Compared to other agricultural innovations, such as the introduction of mineral fertiliser, machines, new varieties or even alternative varieties of cultivated plants, literature refers to several times the amount of time being required for a successful process of conversion to irrigated agriculture enabled by dams. What causes particular difficulties is working to schedule during the process in the field. This is prescribed by water distribution and forces the farmers to suddenly start co-ordinating their activities right down to an hour's time, which is entirely different from what they are used to. Owing to tilling of other fields, other economic activities as well as illnesses, deaths and family problems, the farmers are often unable to deal with the tasks involved. But their absence may result in fatal consequences for the harvest yield.

In what way do the farmers benefit from the opportunities created by the dam, such as crop-growing in the off-season or fishing?



A micro-dam project in Burkina Faso.

The possibility to grow crops in the off-season thanks to the dam tends to create difficulties for the traditional co-ordination of livestock breeding and crop-growing. Normally, the animals are set free again after the harvest, especially since fodder in their immediate proximity will have grown scarce. In fact, grazing of arable land is usually desired traditionally. It means that the straw can also be made use of and that it rots more quickly, not to mention the soil-enhancing effect of animal dung. In irrigated agriculture, demand is reversed. Now, animals roaming wild will harm the off-season crops and have to be kept away from the arable land. Since this is impossible or at least very hard to achieve, many farmers do not opt for a second crop season, forfeiting the benefits gained by the dam. This can result in the loss of area caused by the reservoir not even being compensated for. But even the use of the reservoirs themselves can only be promoted very slowly and to the degree to which the farmers demonstrate a readiness to provide an input for fishing.

Are there other factors that play a role in the problematic implementation of the development or dam projects?

Yes, for the farmers of the region are exposed to additional external pressures that can hardly be overcome. What strikes the eye is that the consequences of globalisation can nowadays be seen and felt everywhere. Even at the very remote local market in Dano, in the southwest of Burkina Faso, people prefer imported rice, for example from Thailand, which is cheaper because it is influenced by

the world market prices, to domestically produced, more expensive rice.

Further factors contributing to some of the numerous dam projects in Burkina Faso only having scored limited success so far are the paucity of labour, possibly caused by the AIDS epidemic, which claims several victims in every family and every village, and the civil war in the neighbouring country of Cote d'Ivoire, which also has an impact on the situation in Burkina Faso. Importing fertiliser has

become more difficult, and therefore more expensive. Moreover, thousands of immigrant workers from Burkina Faso, who maintained a major money transfer from Cote d'Ivoire for several years, are now returning to their home country, which means not only less money, but also more people to feed.

What do you think the future is for the development projects in Burkina Faso?

The great opportunity is for development-oriented organisations and research activities to co-ordinate their approaches and experience more strongly, which would enable a better steering of development strategies. In order to attain this goal, the Dreyer Foundation is setting up a research and training centre in Dano, right in the heart of the affected region. From there, ZEF research projects will be started from mid-2004 on, initially in the context of the GLOWA-Volta Project. Later on, they are going to be joined by other projects. For example, close working relations have already been established with the BIOTA West Africa Research Network (the BMBF's BI-OLOG Research Programme). The Helm-holtz Association's virtual institute on the topic of "Sustainable Use of Quasi-Natural Landscapes", which is currently still being reviewed, plans to set up its project centre in Dano as well, in collaboration with ZEF. The political decision-making structures of these projects and their services to academic and non-academic education including the training of farmers are going to benefit the local population, in whose interest we are ultimately here.

Simulation models. A tool for irrigation practitioners

Worldwide, irrigation/drainage practitioners, like project designers, scheme managers and farmers, lack information on the potential outcomes of their decisions in terms of project design, management, and cropping strategies. Comprehensive models that integrate information on water and soil characteristics as well as agronomic and economic aspects do exist, but they are not easily accessible and manageable by irrigation practitioners. A PhD student from the Federal University of Viçosa, Brazil, who is currently spending his sandwich program "sabbatical" at ZEF set off to produce a tool that is both scientifically comprehensive and convenient for irrigation practitioners.

The model comprises two components and an interface. The first component considers soil and crop characteristics, salinity, and water fluxes through rainfall, evapotranspiration, irrigation and drainage. From this set of data it generates a root zone water and salt balance that simulates the variation of the water table depth and drainage discharges. Based on this information, a relative crop yield can be derived that serves as an input into the model's second component, a linear programming model. This component considers a farmer's or

scheme's bio-physical and economic environment as well as risks in terms of water availability, product and input prices, yield and discount rate variations. The model's objective is to sketch a cropping pattern that optimises the overall net present value.

The first component of the model has been calibrated using the models HYDRUS and DRAINMOD. The complete model has so far been used for small-scale farmers in two irrigation schemes in Brazil. The results allow irrigation practitioners to compare potential returns under different conditions involving a risk and to make decisions on future cropping patterns.

The model can be applied to situations all over the world as long as input data are avail-



Testing of an irrigation model in Brazil.

able. But, in general, the data base required is very flexible. Good results can still be generated e.g. with monthly versus daily rainfall data or shorter rather than longer data periods. This allows an application of the model to irrigation/drainage projects in developing countries, where data availability is often constrained. Moreover, the model will have a user-friendly interface facilitating its use by irrigation practitioners.

The potential to further extend the model, especially the socio-economic component, is huge. Methodologically, this could include the consideration of non-linear algorithms or recursive modelling of multiple periods. Besides, more policy-relevant aspects could be included, like credit programs or alternative management and marketing structures. But, already now, the model provides a useful tool for irrigation practitioners. Its diffusion is planned through short-term training courses, first in Brazil, and through making the software, user's manual and technical documentation available on the internet. ■

João Carlos F. Borges Jr. and Bettina Hedden-Dunkhorst

João Carlos F. Borges Jr. is a PhD student and Bettina Hedden-Dunkhorst is a senior researcher at ZEF.

Farewell to ZEF

Steven Duadze was working for the "Centre for Remote Sensing and Geographic Information Services" at the University of Accra in Ghana when he started to be involved in the ZEF-led "GLOWA" - Volta project of the Federal Research Ministry (BMBF) in 1999. He was offered the opportunity to write his doctoral thesis in the framework of the project. He took

an unpaid absence of leave with the possibility to return to his former employer after finalising his PhD. Duadze has gained considerable academic and professional experience in which he significantly improved his technical and academic skills considerably by working for the "GLOWA" project. He says: "Especially in the field of land use mapping, I really

learned a lot. Moreover, the opportunity to collaborate with colleagues from so many different countries and academic disciplines was very stimulating and unique. Also, the relationship between teachers, tutors and students is very co-operative and positive".

Now that he has upgraded his skills, Duadze sees himself in a position to elaborate his professional prospects as well: "I would either like to continue doing applied research, which entails a lot of field research, or I even would like to go beyond that and get involved as an expert for an environmental organisation. To me, it's most important that research results and findings are really used and implemented to find sustainable solutions for urgent environmental issues. I would like to contribute to finding these solutions, and I'm sure I'm able to do that after this excellent training at ZEF." ■

The interview was conducted by Alma van der Veen

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