



# SUSTAINABLE LAND MANAGEMENT

## GLOBAL CHANGE IN A REGIONAL CONTEXT





Conversion of rain forests into pastures, Brazil (study area of the Carbiocial research project).

- International teams of scientists are investigating changing land use in twelve regions worldwide, in a major research programme funded by the German government. The GLUES support project has the dual aims of linking up the individual sub-projects while also itself conducting scientific analyses. Its mission is ambitious: the project aims to demonstrate the need to use land sustainably.**

Many people dream of playing the politician and steering the fate of a country. Landscape ecologists at the Helmholtz Centre for Environmental Research (UFZ) in Leipzig have designed the computer game LandYOUs, which allows players to decide how much of the national budget they wish to invest in nature conservation, education, reforestation, urban development and farming subsidies. The priorities that they set influence the population's living conditions: they can bring about a drop in the price of agricultural products or degradation of the environment, or force the need to import agricultural products. Anyone who resolves these challenges

»Our project is intended to become a blueprint for other projects.«

to the satisfaction of the population can hope for reelection at the end of their five-year term of office – otherwise the end of their political career looms.



Land use decisions influence environmental quality and quality of life (LandYOUs online game).

The game is not merely a challenging pastime for schoolchildren and students – it is also grounded in reality. »The computer game vividly illustrates how changes in land use affect society, biodiversity, forestry and agriculture«, says Professor Ralf Seppelt, Head of the Department of Computational Landscape Ecology at UFZ.

#### More than 50 million Euros for twelve sub-projects

The 44-years-old landscape ecologist is one of around 500 scientists engaged in analysing the interactions between land management, climate change and ecosystem services worldwide in the context of the »Sustainable Land Management« funding programme. The German Federal Ministry of Education and Research (BMBF) is providing around 50 million Euros in funding for twelve projects in global regions running until 2017. In these projects, international research teams are investigating the effects of changes in land use for example in the Amazon Basin, the Siberian Steppe, the Okavango Delta in Africa and along the Baltic and North Sea coasts of Germany. Seppelt and his colleagues in Leipzig are leading the accompanying scientific project with the acronym GLUES (Global Assessment of Land Use Dynamics, Greenhouse Gas Emissions and Ecosystem Services). The GLUES team has several tasks. Firstly, it aims to link up the individual projects and communicate the results to the general public and to experts in the form of conferences, videos and science portraits. This role is intended to facilitate the work of the project scientists.



Ecosystem functions of the landscape such as pollination affect yields of fruits and vegetables.

The GLUES team also faces scientific challenges: »We are treading new ground with this programme in that we are putting together results from research projects with a regional focus in order to provide globally consistent scenarios and models. Thus we are able to analyse interactions, combine practical management measures from the regional projects and test these for transferability«, says Seppelt, who sees the project as a blueprint for other projects: »We ensure that these trials are also embedded in global processes.«

### Land use causes emissions

Scientists all agree that global change has been under way for a long time already. Renowned scientists have already described some of the consequences. »Between 20 and 30 percent of climatically relevant emissions worldwide are generated by land use and changes in land use«, says GLUES project leader Seppelt. Although globally around eleven percent of the Earth's land surface is protected, many animal and plant species are still dying out every year. With less and less land available for humans to utilize, management of the Earth's land surface must change – especially management of the 35 percent that is agricultural land. »Many regions are not as productive as they could be«, says Seppelt. The people lack resources and the soils are eroded; ecosystem functions are being lost, and climate change demands changes in farming practices.

Global scientific scenarios are therefore an important element of the GLUES project. In one GLUES



Landscape degraded through forest clearing provides space for rubber plantations, China (SURUMER research project).

work area, research scientists at the Potsdam Institute for Climate Impact Research (PIK) are calculating how potential land use might change by 2100. Professor Gernot Klepper, Head of Environment and Natural Resources at the Kiel Institute for the World Economy, is investigating the mid-term perspective until 2030 in conjunction with colleagues from the University of Munich and the GEOMAR Helmholtz Centre for Ocean Research in Kiel. »We have broadened the scope of economic general equilibrium models, which are often used for climate policy or trade policy analyses, so that they can be used to analyse land use and bioenergy subsidies and how these compete with food production,« explains Klepper. The model simulates yields from the eighteen most important food crops such as wheat, soya and maize. This provides a basis for investigating the effects of biofuel subsidies on the agricultural markets and other energy markets such as oil, gas and coal. Five global scenarios describe and analyse how possible developments such as bioenergy subsidies or an increase in meat consumption might appear.

**»Many regions are not as productive as they could be.«**

Klepper is hoping that this will provide important insights into global food security and the yield potential of agricultural products. The scientists are already able to reveal their initial findings:





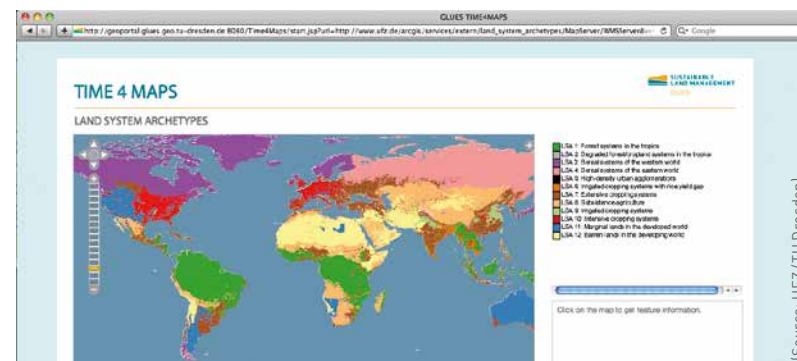
[Source: I. Kämpf]

Vast cornfields in Siberia (study area of the SASCHA research project).

»The yield potential from agriculture is higher than previously realized«, says Klepper. In previous studies only the present land use was considered, without taking account of the fact that further yield potential could be tapped by changing the crops grown. »These effects could be very great, because the cropping patterns on which previous calculations are based make no sense under other economic conditions or with higher productivity«.

**»The yield potential from agriculture is higher than previously realized.«**

Seppelt and his colleagues are also working on an analysis of land systems based on global land use data. The GLUES scientists have evaluated over 30 global datasets relating to the environment, agriculture and socioeconomics in order to identify twelve so-called archetypes. These archetypes range from extensive agricultural use and tropical forest systems to subsistence farming and irrigated agriculture. Seppelt sees the archetypes as an important first step: »They help us to understand the interactions that exist between human activities on the one side and social and environmental changes on the other side«. The analysis is innovative in that the scientists have used significantly more data and indicators than usual. »We did not know for example in which regions agriculture could be further intensified or in which regions intensive cultivation had



[Source: UFZ/TU Dresden]

Online visualisation of various scientific data and results in the GLUES geodata infrastructure.

already reached its limits«, explains Seppelt. Information that would normally be swallowed up in the complexity of the data is thus made visible. »For example: if we had analysed only environmental indicators, we would not have been able to ascertain the regions where agriculture yields high profits.«

### Databank for scenarios

To ensure the successful transfer of results between GLUES and the projects in the funding programme, the team led by Professor Lars Bernard from the Dresden University of Technology (TU Dresden) has built up a geodata infrastructure with a scientific geoinformation portal. This contains global data for the regional projects such as climate scenarios and information on land use, biodiversity and water resources. The research partners can access and exchange information through the portal. »The global information consists of basic data which serves as reference data for all the projects and enables the scientists' research«, says Bernard. However the two tools are not for the sole use of the research scientists involved in the BMBF funding programme – anyone conducting research in one of the twelve regions or investigating land use can access information or upload data onto the portal.

While this might sound simple, in reality it is a complicated task. »For the data to be used by everybody a common language is required – otherwise chaos ensues«, says Bernard. This means common rules and standards. Where the standards used in the past



Researchers discussing with local farmers near the city of Sinop (northern Mato Grosso, Brazil, Carbiocial research project).

are not sufficient, the computer geoscientists have to develop them further – this was the case with the multidimensional research data in particular. Many scientists regard the provision of such data with scepticism because it involves additional time and effort. But as Bernard explains, the work is important because it means that the data will still exist and remain available for use after the end of the project. Bernard also wishes to avoid uploading too many datasets onto the portal. »The objective is not to gather as much data as possible, but rather to provide relevant and coordinated information«.

#### Help for regional stakeholders

Sustainability is also important in another GLUES work area. Consultants Dr. Peter Moll and Ute Zander are assisting the scientists in their dealings with the local stakeholders. They offer training, individual advice, analyses and ideas for possible practical uses of the results in their regional projects. They also make contact with the authorities, agricultural associations and nature conservation organisations on an international level. »We look for local bodies which would welcome the opportunity to use the practical, implementation-oriented results from the regional projects«, says Moll. He and his colleague are in contact with food and agriculture organisations such as the European Environment Agency – EEA and the European Commission.

Their endeavours have already borne fruit. The European Environment Agency for example plans to



Stakeholder workshop in Vietnam (LUCCi research project).

post the results from the BMBF funding programme on the web pages of the environmental observation platform Eye on Earth. Here farmers, agricultural associations and nature conservation bodies worldwide would be able to document changes in land use via the internet. The consultants also wish to publish a book and videos describing the approaches and techniques for more sustainable land management practices developed by the project scientists in cooperation with local and regional stakeholders.

**»We look for stakeholders interested in using results from the regional projects in practice.«**

»In this way the practical results from the whole programme could be made accessible and documented. The land users involved in the funding programme worldwide could then continue this work«.

Dr. Cornelia Paulsch, Director of the Institute for Biodiversity in Regensburg and a member of the GLUES research team, is also ensuring that the GLUES results are widely disseminated. »We help the scientists to ensure that the results of their research are taken into account in important international political processes and environmental agreements«, she says. These include for example the UN Convention to Combat Desertification (UNCCD), the UN Framework Convention on Climate Change (UNFCCC), the Convention on Wetlands



Presentation and discussion of scientific results at international conventions.

(RAMSAR) and the Convention on Biological Diversity (CBD). This is an important aspect of the project because the resolutions and programmes within the agreements are constantly revised and new themes added. »There is a need for scientifically substantiated facts, so that the study groups in the committees can make well-founded decisions«, Paulsch emphasises. Scientists should therefore contribute their expertise to the agreements. Awareness of the international agreements is not very widespread however. Paulsch is therefore organising training for the scientists involved in the regional projects. »The aim is to help the scientists to determine how they can best put their findings across at conferences on the agreements«, she says.

**»Land is a limited resource and must be used sustainably.«**

GLUES project leader Seppelt hopes that the BMBF project will not only have lasting effects but will also be a model for other solution-oriented research projects. »Land is a limited resource and must be used sustainably, because our natural basis for life is preserved only if our environment is not harmed in the long term«, says Seppelt. This is the message that the GLUES research team wishes to communicate – whether through conferences, videos, books or even a computer game.

## ■ GLUES

[www.sustainable-landmanagement.net/glues](http://www.sustainable-landmanagement.net/glues)

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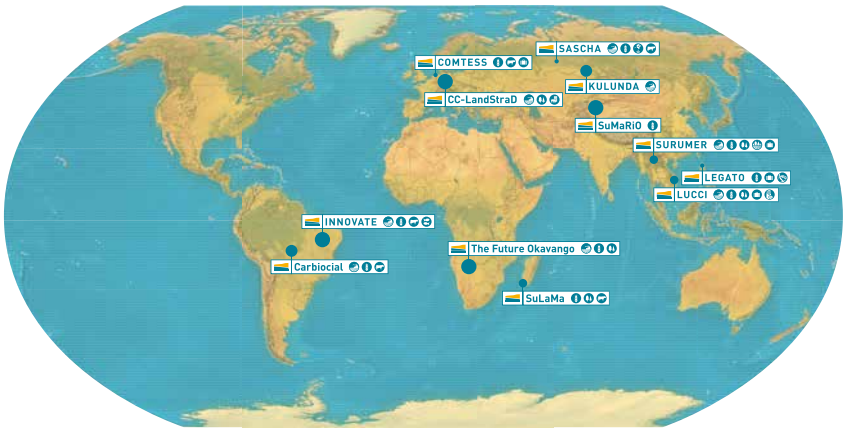
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