Chinesisch-Deutsches Zentrum für Wissenschaftsförderung
中德科学中心

Project No.	GZ588

Methods in Land Use and Landscape Analysis

Summer School - Summary Report

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1. Extended Summary

The objective of this training module was to provide high-level research training to young scientists from the field of natural resource research and to strengthen the research co-operation between China and Germany. For this purpose, the training module of "Methods in Land Use and Landscape Analysis" was initiated within a Summer-School with financial support from the Sino-German Science Center for Research Promotion. The Summer-School was held at the Leibniz-Centre for Agricultural Landscape Research (ZALF) e.V., from March 8th to 18th 2010 in Müncheberg, Germany. In this international Summer-School, 19 young scientists from landscape research participated, among them, 13 from Germany and 6 from China. The young German students were selected from Humboldt University Berlin (HU), Technical University (TU) of Dresden, the University of Gottingen, Brandenburg Technical University (BTU) Cottbus, the Leibniz-Centre for Agricultural Landscape Research (ZALF), the University of Potsdam, the Development Research Center in Ministry of Water Resources of P.R.C. (China), and the Institute of Geographic Sciences and Natural Resources Research (IGSNRR), Chinese Academy of Sciences.

The lectures were provided by 14 well-known German and Chinese experts and scholars of related fields in this module, who came from ZALF, Freiburg University, Humboldt University Berlin, the University Potsdam, the Chinese Academy of Sciences and IGSNRR.

The main goal of the training module was to teach interdisciplinary research methods and tools. The organizers provided sound conditions to get one-to-one instruction and practical exercises for participants in the lab, PC-pools and at stage in the field, depending on lecture and theory. The participants were requested to know well at least one of tools or methods taught in the classes to apply for research issues. In order to achieving the goal, the teaching method adopted by organizers includes classes, exercises, group discussions and field work. The training content focused on land use and landscape analysis, including 15 topics and themes such as multifunctional land use, surface water and groundwater modeling, landscape analysis as well as micro-economic models. After the training, the closed final exam was organized. During the training courses, the exchange of cultural activities was organized to promote the friendship among participants, which led to mutual familiarity including both research background and culture.

The participants were deeply impressed by the well-organized training courses and responsible lecturers. Both, lecturers and participants got knowledge about each other's research field and findings in landscape related field via exchanging the concepts and methods of land resources planning and management in China, Germany and Europe.

In conclusion, this module was very helpful for the participants to identify the objectives and direction for the future research including cooperation between German and Chinese researchers. Therefore, the module of “Methods in land use and landscape analysis” has reached the expected goals.

1) Content of the training module

The main objectives of this module were: enhancing knowledge on important methods of model-based landscape analysis, model verification and assessment tool and improving the analysis ability of sustainable land use and impact assessment. Therefore, the training courses were designed according to above objectives as follow:

i) Theory: Multifunctional landscape and its assessment, productivity of forest ecosystem, principles of model-based landscape analysis, measurement of surface water flow and erosion in landscapes;

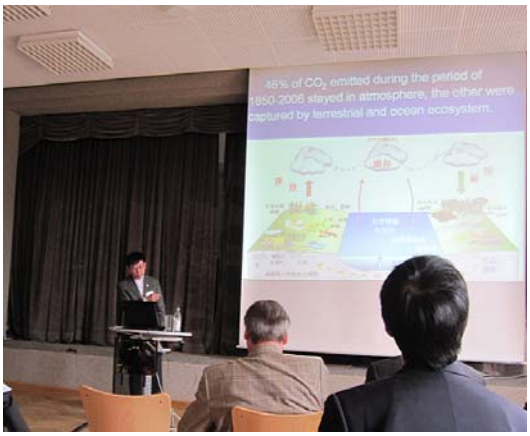
ii) Analysis principles and tools: Innovative methods of land use analysis, environmental and geo-statistical models, remote sensing techniques for landscape analysis, decision making support system for sustainable land use and non-linear analysis of system behavior;

iii) Models: Modeling of water, carbon and nitrogen cycles in watershed and agro-ecosystems, modeling of landscape processes analysis, microeconomic models of land use and artificial intelligence models;

iv) Frontier scientific issues: Complex processes and its influencing factors in biogeochemical change, hot spots in the transmutations of matter and energy, measurement of greenhouse gas, pre-processing and analysis method of experimental data, and the conflict of arable use and biodiversity.

2) Training methods

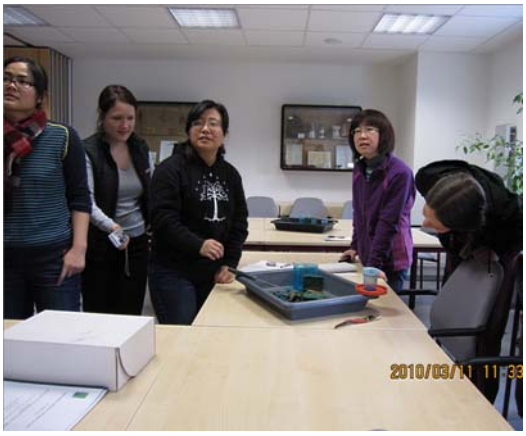
i) Lectures: 15 themes and 27 classes in total, of which 24 classes in Leibniz-Centre for Agricultural Landscape Research (ZALF), 3 classes in University Potsdam.



ii) Scientific discussion by groups: Lecturers organized 4 group discussions and reports, including impact assessment of multifunctional land use under different scenarios, methods of innovation and technology analysis for future land use development, participatory impact assessment, and farmer household survey simulation.

iii) Model simulation practices: Combined with the lectures and the profound theory, the lecturers helped the participants to be familiar with models' structure, and got command on how to apply models for case study excercises. The five exercises operated by computer included: ecological process modeling and spatial analysis tool-SAMT, HERMES model for simulating crop growth and C/N cycle in arable land, farm level multi-objective decision making support tool in agro ecosystem-MODAM (linear programming and policy scenario analysis), Multi-agent based artificial surface for land use change and high accuracy as well as speed model for surface modeling (HPSM).

iv) Experiments: Participants did the group experiments, took exercises guided by measuring methods, analyzed and discussed research results in lab or classroom. There were four experiments: measurement of water flow and velocity in large flume experiment, observing and calculating seepage velocity and flow paths of different soil profiles by dye tracing experiment, CO_2 flux measurement using chamber, and simulating wind erosion in the lab.



v) Field excursion: The corresponding lecturers arranged three field excursions, and gave lectures and demonstrated experiments in the field. The field excursions included: field visit and on-field observations of regional catchments areas, soil types and rock formations, land use systems and other typical landscape characteristics in the surroundings of ZALF field including discussions on how to reveal landscape and how to achieve multifunctional land use in landscape planning; visiting monitoring system for soil-plant-weather information and agricultural field trials at ZALF field sites; approaches for integrating nature conservation measures in arable landscapes, ecological census techniques of amphibians (aquatic and terrestrial trapping, recognizing individuals, tracking movements), set aside buffer planning for amphibian protection and field investigations of amphibian animals, pond typology and water quality.

2. Expectations and training achievements from the participants’ point of view

The main expectations of the participants for the training module were to learn new methods in the field of landscape research, to widen the individual scope by knowledge exchange and to stimulate different perspective through intense discussions and exchange among participants – and lecturers. Through comprehensive two-week training, all participants enhanced their capacity of analytical skills and methods to address specific research issues, and to develop scientific thinking abilities though interactive and participatory teaching methods. The individual achievements were summarized as following:

i) Arrangements and support

The organizers created a strong and positive learning atmosphere, and provided very good training conditions for participants through clear structures. The courses were elaborately prepared by lecturers and the lecture was enjoyable. The material for preparation, lectures, and homework were useful in helping to understand the subject, and the material was appropriate in quantity and difficulty. The module was systematic and well-organized not only to improve participants’ general methodological knowledge but also to broaden perspective of specific areas of study. The module was composed by various types such as lecture, discussion, group work, computer operation and laboratory experiment as well as field excursion. The excursion was a valuable part of the module. Especially, the module provided laptop with wireless network for each student. Participants could run models and access to information during classes. In conclusion, organizers had tried their best to create most convenient conditions to make sure the module successful.

ii) Individual and multiple skill training

The module was characterized by individual and multiple skill training. Interactive and participatory teaching stirred up the research potential of individual participants. An open teaching atmosphere allowed participants to bring up questions at any time and to share and exchange knowledge among each other. The lively and vivid teaching method led to very good group-work results.

Field investigation and observation, computer operation, and laboratory experiment accounted for a large proportion of teaching, which were a very valuable part to the module. This helped participants to increase their specific knowledge, and to understand the research tasks during the training course very well. According to the statistics of the feedback forms, more than 80% students believed that they at least mastered one methodology which can be used in their own field (post-evaluation of the training course).

iii) From theories to applied science

The training module comprised various theories, methods and tools, and applications of landscape analysis at different scales. The module covered several disciplines (social, economic, ecological) and through this helped to broaden the individual scope of research towards more interdisciplinary thinking. Although the contents of the lectures were very intensive and focus on land use and landscape multifunction students kept motivated by a balanced mix of theory and applied methods. The methods and models in this module were considered to be advanced, diversified as well as practical. They included, for example, spatial analysis models, ecological models, decision-support system, and spatial expression methods and some of the tools and exemplatory results were available for further use by participants’ own research work. Most of the participants mentioned to gained new insights, inspirations and ideas from this course. Therefore, it was concluded that the module was helpful for participants. The participants could improve their analytical thinking and applied research skills and thereby broaden their individual research profile.

iv) Complementary teaching by Chinese and German lecturers

The participants were taught by the rigorous and conscientious attitude of lecturers. The lecturers devoted much to the courses. On the one hand, the lecturers organized the material well. Some one of them arranged research assistants to assist in organizing class discussion, exercises, and field study. On the other hand, the contents of lectures were related to the achievements of long-term research work in different domains by lecturers. For example, in

order to command the migrating rules of amphibians in farmland buffer zone, the research team observed and recorded amphibians for many years, gained a lot of image information, and built database for different kinds of amphibians. The data and materials offered a valuable reference for amphibians’ taxonomy. Especially, lecturers were very patient when participants asked questions. They explained every question seriously, this issues inflected their profound knowledge and modest attitude.

Furthermore, Chinese and German lecturers have their own characters which made the module more colorful. German lecturers were more concentrate on the application of landscape analysis methods. They were very good at trigger the enthusiasm of participants. Chinese lecturers focused on theoretical principle, they paid more attention to macro management of land use and combine the methods with the actual situations of China.

v) Intercultural communication and change in research

The module also provided a strong platform for exchange and communication opportunities among participants. Not only the communications between the participants and lecturers but also the exchange ideas among participants, there was enough time for participants to asking questions and express their own opinions. Participants obtained many abilities such as capacities of solving problems at interdisciplinary level, improving the language, and intercultural communication abilities for Chinese and German students, and broadening their perspectives via scientific exchange. For example, the participants were required to demonstrate their research results after group discussions in individual presentations. Each of the participants had the chance to present results and through this to improve their own professional ability and presentation skills. Team members were asked to communicate and present individual research framework according to the research topics, show individuals’ viewpoints, and summarize the key points of discussions together. The process of the whole discussion was enjoyable and participants quite enjoyed this interactive learning process that had a sense of improved achievements and motivation.

To some students it occurs that comparatively, German students were more active in class, they expressed their opinions actively. Chinese students were introverted, but they considered things more keenly and deeply. However, there is one thing in common no matter for German students or Chinese students, that is, the strong thirst for knowledge.

3. Joint research interests in the field of natural resource management

The successful implementation of this module has established a strong basis to continue the joint cooperation between Germany and China in the field of land resources research and land management. The training module provided, both, for the lecturers and the participants an ideal platform to enhance their communication skills, as well as to discover new research areas and common concern, which is a solid foundation for future cooperation. Although training time was short, the friendship has deepened and both sides have shown a strong desire for cooperation.

As a common interest of joint research activities we identified the following research topics:

i) Sustainability impact assessment of multifunctional land use

Impact assessment is an emerging scientific field covered a variety of tools and multidisciplinary field. Sustainability impact assessment of land use is essential to natural resources use and regional development researches. Bothe, the Chinese and German counterparts will focus on developing new strategies and effective land management tools, with particular emphasis on impact assessment tools able to support policy decision making and to addressing future land management decisions. The consequences of land system change and drivers of the change, including climate change will be assessed at various spatial and temporal scales.

ii) Impacts of land use changes on key ecosystem services

Human activities have direct or indirect effects on terrestrial and freshwater ecosystems. Land use pattern change is one of the major human activities which can affect ecosystem dynamics across time and space. The Sino-German sides will look at this interactive relation by developing evaluation methods for interrelations and tradeoffs between land use and ecosystem services.

iii) Human consumption of ecosystem services and its driving role at different scales

Human rely on ecosystem products and services to meet their basic material needs for survival. By studying the consumption degree of human activities on land resource, researchers can clear the intrinsic link between land resource use, management and the socio-economic development. The Sino-German sides will explore the measurement methods of ecosystem services consumption and analyze the balance between land resources use and supply, as well as to measure the land use functions cognizance, willingness and consumption

preference of different stakeholders. It will be the scientific basis for land management decision makers.

iv) Payment for ecosystem services and ecological compensation

Payment for ecosystem services and ecological compensation is a current hot issue of ecology and economics. It relates to land use and landscape analysis closely, and involves in regional land use policy. Chinese and German scientists are dedicated to the research of ecosystem services payment, and try to discuss ecological compensation mechanism and compensation effect evaluation in the two countries. Both sides will improve the theoretical basis and modeling methods for ecosystem services payment constantly, and develop comparative study of ecosystem services payment policy between Germany and China.

v) Environmental effects of bio-fuels

Both China and Germany think highly of bio-fuels development. Germany has already accumulated rich experiences with rapeseed as raw material for bio-diesel; China has advantage on bio-ethanol production. The environmental effects of bio-fuels, especially large-scale cultivation of energy crops, have been the subject of mutual concern. In recent years, the strengths of bio-fuels - "green, clean, renewable" have been challenged, and many controversies have risen, including the energy balance of bio-fuels, carbon effect and other environmental problems. The Sino-German sides have common attention and research base in this area, which will make further cooperation possible.

vi) Natural disasters and land use change

In recent years, frequent natural disasters have caused damages to human life and property. However, the researches of natural disasters impacts on natural resources (etc., water, soil resources) and resources risk vulnerability assessment have just started. So, scientists of both sides will focus on the interaction between disasters and land resource use, and achieve quantitative assessment of natural disasters’ impacts on land ecosystems.

4. Follow up and possible cooperation

In order to continue the joint Chinese-German research activities, we intend to establish a periodic series of research workshops that should focus on land use and landscape analysis to be held in Germany and China. It was suggested to continue joint research activities in order to sustain, strengthen and exchange theories and methods in common research fields. The cooperation puts forward the application and verification of research findings and to continue methodological developments. Previous workshops and the training module showed that is it highly relevant to discuss and exchange ideas and details not only via email but also during ‘vis a vi’ workshops, exchange and training of young scientists. Therefore we propose a follow up and next joint research workshop that is supposed to be held in China.

As both the German and Chinese sides have data platform in certain scale, it would be preferable to strengthen cooperation on dynamic data sharing of field data and research findings covering different disciplines such as landscape, geography and natural resources sciences. The database could provide various data and materials, and it is helpful for German and Chinese scientists to search materials when such field data is put on in list. Some part of the data could be direct access to search and download so that it can be provided to support in landscape and land use research.

It is suggested to build up Sino-German expert tank to invite well-known experts and scholars of related research fields. Experts from Leibniz-Centre for Agricultural Landscape Research, Humboldt University, University of Potsdam, Institute of Geographic Science and Natural Resources will act as trigger. Expert address book will be updated periodically so that an effective contact platform can be established.

A series of academic exchange activities will be organized to analyze key scientific issues such as impact assessment and land use and ecosystem services as well as related fields. We will enlarge financial supporting of joint research project and a new co-operation project is supposed to be put forward every four years.

Joint training for young scientists is the common idea from both Germany and China sides, especially in the area of sustainability management of land use and ecosystem. It will create opportunities for young researchers to exchange by project cooperation. It is envisaged to seek for mutual accreditation of teaching classes at both, Chinese and Germany Universities.

In order to keep the long term relationship of cooperation from Sino-German sides, we plan to establish joint-research center on multifunctional land use, ecosystem services and related fields. Research progress and cooperation dynamics will be released on website. It is

suggested to construct data-sharing platform and collect data and information about land use from both Germany and China. Periodically special issue will be released as well.

Attachment

Attachment A: Thematic report titles and outline of "land use and landscape analysis" module.

<table>
<tr><th>Time schedule</th><th>Title</th><th>Training course</th><th>Instructor</th></tr>
<tr><td rowspan="3">08/03/2010 Monday</td><td rowspan="3">Research on multi-functionality of land use</td><td>Productivity of forest ecosystems</td><td rowspan="2">Katharina Helming</td></tr>
<tr><td>Method of analysis and assessment on multifunctional landscape, Exercises</td></tr>
<tr><td>Multifunctional landscapes: how to apply to landscape? Excursion</td><td>Hubert Wiggering</td></tr>
<tr><td colspan="4">Outline
Helming: Discussion about forest ecosystem: contribution of environmental plasticity to sustainable land use and potential risk; analytical framework of multifunctional land use in Europe; how to apply multi-functional assessment tools; DPSIR model; scenarios analysis and ecosystem function indictors selection by groups discussion.

Wiggering: Introduction of multifunctional land use; observing of various types of landscape, including waters, soil and rock etc; how to apply land use multifunctional analysis to landscape.</td></tr>
<tr><td rowspan="3">09/03/2010 Tuesday</td><td rowspan="3">Land use models and exercises</td><td>Principles of model-based landscape analysis, exercises</td><td rowspan="3">Boris Schröder</td></tr>
<tr><td>Carbon and nitrogen cycles in agro-ecosystems models, exercises</td></tr>
<tr><td>Methods of innovation and technology analysis for future land use development, exercises</td></tr>
<tr><td colspan="4">Outline
Modeling procedure, parameter design, modeling verification
Application of ecological modeling such as genetic algorithm, fuzzy analysis and neural network.
SMAT model practice on computer

Global Carbon cycle and soil organic carbon sink; organic carbon of soil procedure and its driving force; estimation of global historical organic Carbon; nitrogen dynamics of soil in cropland; impact of land use management on organic carbon in soil; HERMES model practice on computer.

Methods of Innovation and technology analysis: group discussion and main methods practice including brain storm, risk assessment and SWOT and assessing the above methods.</td></tr>
<tr><td rowspan="3">10/03/2010 Wednesday</td><td rowspan="3">Surface and groundwater model and soil erosion</td><td>Principles of surface water and experiment</td><td rowspan="3">Arthur Gessler</td></tr>
<tr><td>Solute transport and transformation in seepage and groundwater, exercises</td></tr>
<tr><td>Soil erosion(wind erosion and water erosion), experiment</td></tr>
<tr><td colspan="4">Outline
Principles of surface water and hydraulics; experiments of measuring velocity and volume in water tank in laboratory.

Structure of landscape; geo-chemical process and features of groundwater; seepage solute source and transport as well as transformation; introduction of underground water observational experiments; computing main solute in underground water by experiments.

Reasons, procedure and impact on environment by wind erosion: wind erosion risk assessment model, impact of water erosion on water quality, procedure and forms of water erosion, influencing factors of soil erosion, assessment model of water and land erosion, 3D model, conservation and management measures; simulation of wind erosion in laboratory.</td></tr>
<tr><td rowspan="3">11/03/2010 Thursday</td><td rowspan="3">Hotspot issues in landscape research</td><td>Biological, geo-chemical hotspot issues in landscape science, exercises</td><td rowspan="3">Michael Sommer</td></tr>
<tr><td>Solute transport and water movements in structured soil, exercises</td></tr>
<tr><td>Non-linear analysis of landscape system′s behavior</td></tr>
</table>

Outline
Brief introduction of geo-chemistry procedure, sources of green house gas, complexity of gas flux variables, ecosystem productivity of computation, measuring method of CO_2 flux, usage of CO_2 flux measuring equipments, and calculation of CO_2 flux.

Soil structure, 2D-DPERM model about water movements in structured soil; applying 2D-DPERM for field experiment; experiment of dyed water movements in different structured soil; soil profile oberservation.

Definition of system and system behavior and degree of freedom; non-linear analysis of landscape system's behavior including principal components analysis, spectral analysis, complexity analysis, correlation analysis, and regression analysis, (artificial neural network, support vector machine)

12/03/2010 Friday	Landscape analysis and microeconomic model	Soil Geographical procedure of landscape, exercises	Klaus Müller
		Remote sensing technology in landscape analysis, exercises	
		Farm level decision making and ecological impact assessment, group discussion, exercises	

Outline
Basic principals of remote sensing: sensor and preprocessing of remote sensing image as well as interpretation; advantage of applying remote sensing to landscape analysis; application in vegetation and soil survey; disadvantage and future trend of remote sensing.

Introduction of MODAM model and linear programming; impact assessment on environment using MODAM; Farm level ecological impact assessment and decision-making support; MODAM model on computer.

13/03/2010 Saturday	Landscape system analysis	Interactive decision support system of agriculture response to climate change	Claas Nendel
		On-the-spot observation	

Outline
Interactive tools LandCaRe2020 Decision Support System(DSS) which Stakeholders use to make decision on how to make agricultural management adapted to climate change and simulating future vulnerability change of fields; n-the-spot observation on experimental plot and equipments; observation of long-term trial plot dated from 1963 and large-scale irrigation equipments as well as meteorological monitoring apparatus and computer processing center.

14/03/2010 Sunday	Data management of landscape system	Database management	Uwe Heinrich
		Summary of the previous courses, question and answer session, Computer operation	Lecturers group

Outline
Construction and management of large-scale geographic database.
Geographic information data sharing and introduction of effectively dynamic data support platform.

15/03/2010 Monday	Ecosystem models	Digital model in comprehensive evaluation of ecosystem, exercises	Tianxiang Yue
		Artificial intelligence application to landscape system research, exercises	Heqing Huang

Outline
Tianxiang Yue: HPSM which is theoretically based on surface theory and grid-generating algorithm and gird-computing technology. Land surface system is a complex functional entirety which composes of correlative features. HPSM regards land surface system as a curved surface and defines mathematically its spatial location. HPSM can make transformations between dimensions and scales. It runs faster and creates less error. It can be applied to area like spatial change of land surface, ecological threshold model, food supply capacity of land ecosystem and landscape change monitoring.

Heqing Huang: establishment of spatial intelligent decision-making support system coupled with land resources utility and human's behavior which uses computer simulation and GIS based on Multi-agent model.

16/03/2010 Tuesday	Biodiversity conservation	Measure methods of arable land, exercises	Gunnar Lischeid
		Biodiversity conservation, taking the amphibian as instance, exercises	
		Field trip	

Outline
Designing and planning buffer zone in arable land utilization
Pond types and water quality investigation, protection of amphibian (lizard and frog) when exploring land.

17/03/2010	Social-economical	Analytical framework of resources flow, exercises	Shengkui Cheng

<table>
<tr><td rowspan="3">Wednesday</td><td rowspan="3">impact assessment on land use and spatial data mining</td><td>Social-economical impact assessment on land use, exercises</td><td rowspan="2">Lin Zhen</td></tr>
<tr><td>Participatory impact assessment and its application, exercises</td></tr>
<tr><td>Spatial data mining and land ecosystem modeling</td><td>Chenghu Zhou</td></tr>
<tr><td colspan="4">Outline
Shengkui Cheng: theory framework of resources flow in China; horizontal and vertical resources flows which are closely related with economic development in China; assessment on sustainable development in three dimensions including environmental, economical and societal at both national and regional scale.

Chenghu Zhou: theory of discrete geography system simulation; establishment of geographic cellular automata for spatially complex simulation; estimating and analyzing soil organic carbon spatial distribution in China.

Lin Zhen: impact assessment of land use in the past 20 years on China social-economical; utilization of Dynamic of Land Systems (DLS) to simulate land use change and its impact on society and economy in future 20 years; methods in participatory impact assessment; advantages and disadvantages of the above methods; group discussion on constructing coordinating framework and how to designing questionnaire.</td></tr>
<tr><td>18/03/2010 Tuesday</td><td>Examination and students communication</td><td>Examination, advices on how to improve future courses</td><td>Arthur Gessler, Hubert Wiggering</td></tr>
</table>

Attachment B: List of participants

	German participants	Organization
1	Hagemann Ulrike	Technische Universität Dresden
2	Petersen Ute	Georg-August-University of Goettingen
3	Tichter Arne	Georg-August-University of Goettingen
4	Uthes Sandra	Humboldt-Universität zu Berlin
5	Ibrahim Waad	Technische Universität Cottbus
6	Kasper-Haarhuis Laura	Humboldt-Universität zu Berlin
7	Specka Xenia	Leibniz Center for Agricultural Landscape Research
8	Kienappel Anne	Humboldt-Universität zu Berlin
9	Lotsch Heike	Leibniz Center for Agricultural Landscape Research
10	Baran Marcin	University of Potsdam
11	Nyckowiak Jedrzej	University of Potsdam
12	Hannes Koenig	University of Potsdam
13	Katharina Diehl	Leibniz Center for Agricultural Landscape Research

	Chinese participants	Organization
14	Yao Lv	Institute of Geographic Science and Natural Resources Research, Chinese Academy of Sciences
15	Fen Li	Institute of Geographic Science and Natural Resources Research, Chinese Academy of Sciences
16	Xin Long	Institute of Geographic Science and Natural Resources Research, Chinese Academy of Sciences
17	Peng Xia	Development Research Center of the Ministry of Water Resources, P. R. China
18	Dan Yan	Institute of Geographic Science and Natural Resources Research, Chinese Academy of Sciences (She went to Germany in January 2010 and is continuing her joint research in Germany after the training module.)
19	Yunjie Wei	Institute of Geographic Science and Natural Resources Research, Chinese Academy of Sciences