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Development of a Conceptual Model for the DINARIO Project, Rio de Janeiro, Brazil

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Abstract

The complexity of interactions between numerous environmental and socioeconomic systems in the globalised world requires a deeper understanding of the related systems. Global problems, such as climate change, land degradation, energy crisis or poverty cannot be solved without an understanding of system behaviour and structure. For various broadscale systems, models have been developed. Well known are climate models which are used to generate projections of future climate. For use on regional scales, climate models are downscaled. In addition to climate models, numerous other models have been developed, related to specific topics, such as regional economic models, hydrology models, erosion models, or traffic models. Common aim to all models is the optimisation of systems or the solution of certain problems, respectively. In the hinterland of Rio de Janeiro, many problems, such as biodiversity loss, water pollution, and soil degradation are related to land use intensification processes which are in turn linked to population and economic growth. Against the background of biodiversity conservation in the Atlantic forest, the BMBF project BLUMEN (2002–2005) focused on system stability in the agricultural landscape in the mountain region of the Serra dos Órgãos, which still contains a high proportion of small forest fragments. Based on BLUMEN, the current BMBF project DINARIO - Climate Change, Landscape Dynamics, Land Use and Natural Resources in the Atlantic Forest of Rio de Janeiro - integrates lowland landscapes into the research. Furthermore, the development of sustainable land use strategies will be supported by a deeper analysis of water and soil systems.

The poster presented at Tropentag 2009 shows the conceptual model for the DINARIO project developed by ITT M.Sc. students and their supervisors. It is based on a problem analysis via literature research in the fields of biodiversity, water availability, water quality, soils and geomorphology, climate change, agricultural structure analysis, agronomy and socioeconomics. Methods of information exchange, definition of system boundaries, identification of key parameters, analysis of relations between the parameters, as well as means of evaluation are briefly described. The conceptual model can be used as a basis for numeric models and decision support systems.

Methods

As the project team was constituted by persons from different scientific backgrounds it was necessary to establish effectively working communication and information exchange. From the outset, each member of the team was in charge of one specific research area. The objective was to identify how all the areas interact with each other and to generate a model of relationships.

In the beginning the team acquired a general overview over the different research areas. During and after this phase the project team met pairwise to exchange relevant information between the disciplines respectively in a procedure we called “speed dating” (see figure 1). In this way new input has been created by other disciplines in order to direct and focus the initial specific knowledge acquisition. To continue the work as a group, team meetings took place regularly to decide over further steps and procedures.

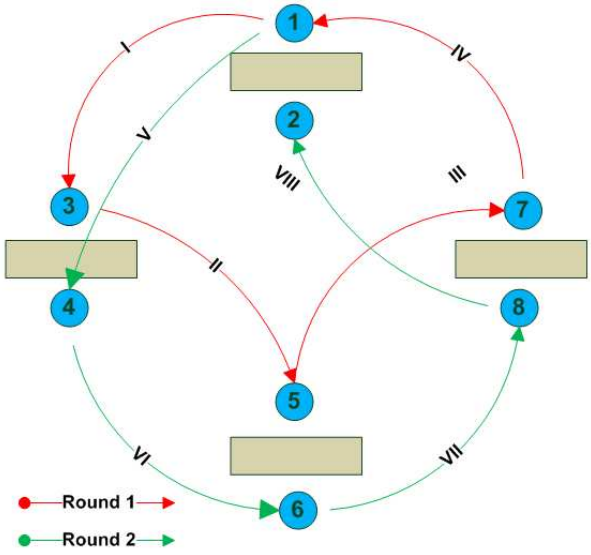

***Figure 1. Speed Dating procedure**: Consists of sessions of one-to-one meetings, every person rotates to the next team member after a certain fixed time period. We chose a time frame of 15 minutes, which we extended to a maximum of 20 minutes if further communication to the same partner was still productive.*

After designing a general overview about the specific research areas in the Federal State of Rio de Janeiro, the problem definition phase started. For each discipline, the main problems and their corresponding interrelations to other fields of research were identified. This process was supported by the exchange of information via email, telephone and intensive discussions in group meetings.

The next step was to select a specific region which is of interest to all the different disciplines. This was realized by using satellite images from „Google Earth“ and relating them to the knowledge acquired by the team members. The area has been selected according to the team’s perception of an area where most of the identified problems occur. It was agreed that the Municipality of Cachoeiras de Macacu fits best for further research.

Within the selected area the core problems were pointed out by each discipline and indicators required for further research of the identified problems were identified.

An overview of the methodological concept used in the project is presented in the figure 2.

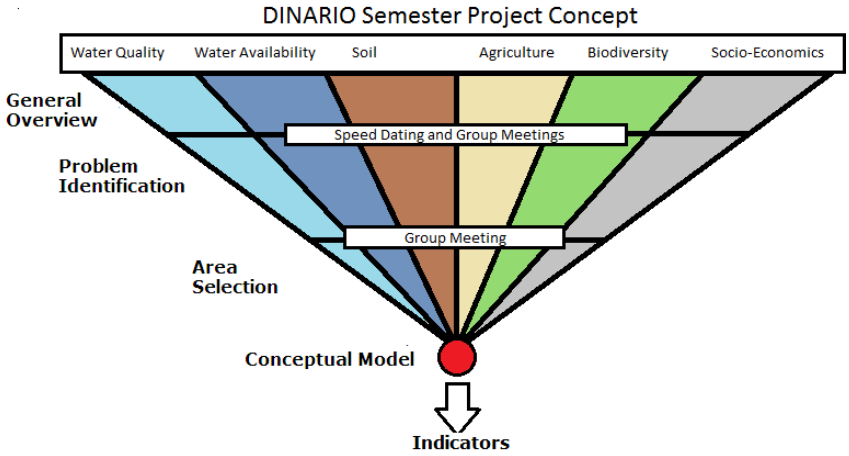

Figure 2. Methodological Concept used in the project

Results: Description of the conceptual Model

The main focus of our model is biodiversity which is facing a major threat in our study area. Our interdisciplinary conceptual model is divided into three major parts, agriculture (light yellow), natural (light green) and non-agricultural biodiversity (grey). The big black arrows on our Model represent main interactions between disciplines, the red dotted arrows represent identified specific influences between disciplines and the small black dotted arrows represent influences within the disciplines. Soil, water and climate are conditions that allow the appearance of what we call “natural biodiversity” such as native forests undisturbed by human influence. Agricultural practices represent another type of biodiversity composition which is called “agricultural biodiversity”. Other human activities such as urban settlements and non-agricultural activities will produce the third kind of impacts on the natural system, generating the so-called “non-agricultural biodiversity”. In addition, our interdisciplinary conceptual model is divided into six different fields, namely biodiversity, agriculture, soil, water quality, water availability and socioeconomics. These disciplines are in one way or another interrelated to each other.

The two big red arrows at the bottom represent the anthropogenic influences on the system namely: agriculture and non agricultural human activities. Agricultural biodiversity is affected both by the production systems and by the production patterns, which influence biodiversity directly or through changes in the soil and water conditions. On the other side non-agricultural socioeconomic activities cause changes in biodiversity because of two main driven forces: urban population and economic stimulation, these forces origin processes of migration, construction, tourism and suburbanization that have an effect as well in water availability and quality, soil and destruction of habitats through deforestation.

All processes taking place in the area are framed by the local, regional and global climatic conditions which are also a determinant factor in the composition of the ecosystems founded. Anthropogenic influences cause green house gas emission to the atmosphere which leads to global climate change. Many human beings are affected due to climate change, for example in case of drought and flood, the expected temperature increases will also determine changes in the conditions for the growth and development of certain species. The complete version of the final model can be seen in the next page (figure 3).

Interdisciplinary Conceptual Model for DINARIO