Scientific challenges

H. Van Keulen[1], R.P. Roetter[2] and C.T. Hoanh[2]

[1] Plant Production Systems Group, Wageningen University, P.O. Box 430, 6700 AK Wageningen, The Netherlands
E-mail: herman.vankeulen@pp.dpw.wag-ur.nl
[2] International Rice Research Institute (IRRI), P.O. Box 3127, Makati Central Post Office (MCPO), 1271 Makati City, Philippines

Introduction

This final report of the SysNet project presents proof of considerable progress in the field of land use systems analysis, as a component of participatory land use planning. It would be an illusion to think that this presents the ultimate word on this issue, first of all because the issues and their relative importance continuously change as a result of autonomous developments. Secondly, technologies are continuously developing, leading to both increased possibilities for the use of data and improved methodologies for analysis and integration. Moreover, while scientists engaged in international agricultural research hope to find novel solutions with an impact on 'rural development', they frequently realize that the answer to one question leads to the formulation of at least two new questions.

In this contribution, major challenges are identified for research in the field of partcipatory land use analysis and land use planning, based on the SysNet-experience.

Description of production activities (technologies)

Analysis of the possibilities for regional development as a tool for identification of scope for improvement and attainment of various objectives strongly hinges on accurate quantitative description of agricultural production technologies. Current technologies, as practised in a region, generally do not represent the 'potential' situation, i.e., the production possibilities as dictated by factors that cannot be or can hardly be affected by land users, such as radiation and temperature. It often appears difficult to quantify the technical coefficients of these technologies, as in traditional farm surveys such information is not routinely collected. It would be necessary to include in farm survey handbooks guidelines for collecting the technical information required for accurate quantitative description of current production technologies.

For alternative production techniques that are not currently practised in a region, technical coefficients can, in principle, be generated by applying (crop growth) simulation models. Such models have been developed for various

(major) crops, but, for many of the minor crops, for which subsistence and market-oriented systems in developing countries can be of critical importance, such tools are not available. This also holds true for most of the perennial crops that often represent an important component in agricultural production systems in tropical countries. It appears that, in agricultural research, development of such tools does not have a high priority (anymore). In many low-external-input farming systems, mixed cropping, i.e., the simultaneous growth of a mixture of crop species and/or varieties, is a common technology, to reduce risks, to profit from the spatial heterogeneity of the resource base or to make use of synergistic effects. Also, for these types of crop systems, adequate simulation models are not available. This lack of quantitative tools for generating accurate technical coefficients of alternative production technologies seriously hampers their inclusion in land use analysis.

Spatial analysis

The LUPAS methodology operates at the regional level and resource availability and quality are defined at that level, i.e., the total area of land of a certain quality, the total quantity of irrigation water, the total labour force, etc. However, the spatial distribution of these resources is of major importance for the way in which they are being, and can be used. This holds true for both the physical characteristics (i.e., the spatial distribution of the water resources determines to what extent they can be used for various purposes) and the socioeconomic characteristics (such as the distance to markets, in absolute terms, or in terms of transport possibilities, which determine whether production of a certain commodity is economically attractive). The larger the distance, the higher the transportation costs, and hence the more difficult the marketing of a commodity. For some commodities, however, such as fresh milk or vegetables, distance may be a prohibitive constraint.

First attempts to introduce the spatial dimension in models for land use analysis have been made, but these have been shown to present serious difficulties, so that no established methodology is available. Especially for effective targeting of policy measures, this lack of spatial differentiation is a serious drawback.

Integration of regional analysis and farm household analysis

The ultimate decision makers on land use are farm households, and the possibilities to affect land use therefore depend on the criteria used by the farm households in these decisions and their response to policy measures. The regional land use analysis can illustrate the (bio)physical potentials of the natural resources, but cannot identify the major socioeconomic constraints to modifying land use at the farm household level. For that purpose, the regional analysis has

to be integrated with the farm household analysis that incorporates farmers' behaviour. Again, developments in this direction have started, but a much more systematic analysis is necessary, that yields a methodology in which results of regional models can be used to identify boundary conditions and/or objectives for farm household models (FHMs). Results from FHMs, such as production and/or price elasticities, in turn, should provide the revised scenario settings for subsequent regional analysis, and so on.

Such integration is also hampered by the typical methodology applied in socioeconomic analysis, which is based on the identification of so-called farm types, distinguished by economic characteristics. Regional analysis on the basis of upscaling of farm household results typically suffers from aggregation bias, because non-linear relations play a major role in the process. Such biases could be minimized when similar to the biophysical data, which have a long tradition in being geo-referenced, socioeconomic information would also be presented, incorporating its spatial dimension.

Uncertainty analysis

The scope for agricultural development is determined not only by the long-term possibilities and constraints but also by the risks associated with uncertainty. This plays a role in both the biophysical sense (weather cannot be predicted and the more erratic the weather pattern in a region, the larger the uncertainty) and the economic sense (in most situations, producers are price-takers that have no influence on the market price of their commodities). In addition, in subsistence farming systems, which have only weak links with the market economy, food security is a major consideration, and that will lead to risk-aversive behaviour, effectively constraining the possibilities for increased production at higher risks. In explorative land use analysis, the possibility of taking into account this uncertainty should therefore be incorporated.

Interaction with stakeholders

In the development of tools for land use analysis, the biggest challenge is probably their implementation in the ‘practice’ of land use planning and policy analysis. That requires close cooperation with the various stakeholders, in which it is important that the models be designed in such a way that answers are generated to questions relevant to the stakeholders. Moreover, the stakeholders need to develop confidence in the tools being applied. It appears not evident now what the best ‘package’ of procedures is to stimulate, maintain and institutionalize that process.