Agronomy and Policy Design: Tackling the 'where, what and how' Questions

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ABSTRACT

A methodology is presented for exploring future land use options, aimed at supporting strategic land use policies. A major role of agronomists in implementing this methodology is to quantify future-oriented production activities (technologies) for the various land units within the system to be explored. These technologies are confronted with value-driven objectives and preferences of stakeholder groups within a mathematical linear programming model. The consequences of different priorities are revealed at the systems level, both in terms of trade-offs and associated land use. The SysNet project in South East Asia operationalizes such a methodology in four case studies. Major milestones of this project are highlighted.

KEYWORDS

Land use, production ecology, South East Asia, optimization, natural resource management; policy analysis.

INTRODUCTION

Future crop production and other land use systems must meet a range of societal objectives that are perceived and prioritised in different ways by different stakeholders. One of the roles of science is to make the societal and political debate more transparent in terms of setting out effective and efficient future options for such systems, and to support their development. Alternative answers must be generated to the questions of 'where, what and how to produce in the next decades?' under 'what-if?' scenarios. Trade-offs among objectives must be explicitly identified, before the policy debate on possible interventions may start effectively. Such information is valuable as part of a learning process, rather than as a linear decision support system. Agronomy, as a scientific discipline, has to operationalize its knowledge in such a way that it can contribute to the generation of such information.

Approach

An integrated approach to the analysis and design of systems takes into account the various objectives that stakeholders may have with respect to future systems. In short, our methodology for exploring land use options uses:

i. Quantified, future-oriented, options for growing crops (and animals) on different land units;

ii. information on societal objectives;

iii. well-defined exogeneous variables affecting the system under study (scenarios);

iv. a mathematical linear programming model integrating i-iii, to generate land use options.

Component i. is the domain of agronomists and represents the 'hard' side of these studies. Knowledge about basic processes (climate-soil-plant-animal interactions) and their management is obtained from the literature, experts, experiments and simulation models, and is then integrated in so-called technical coefficient generators (TCGs). TCGs enable quantification of a wide range of alternative, future-oriented technologies for the different land units in a system. These technologies are identified and quantified in a systematic way through the application of production ecological concepts (2).

Components ii. and iii. represent the 'soft' side of these studies. If the study is to have any impact, relevant stakeholder groups must be identified and involved throughout the study, in identifying objectives (ii), specifying scenarios (iii) and evaluating options (iv).

Sysnet in South East Asia

The methodology, which had its genesis in studies in Europe and Africa (3,4), has been operationalized in four case studies in the SysNet (Systems Research Network for Ecoregional Land Use Planning in Support of Natural Resource Management in Tropical Asia) project (1). This is a cooperative activity of the International Rice Research Institute (IRRI), several National Agricultural Research Systems (NARS) in South East Asia and Wageningen University and Research centre. The four case study regions were Haryana State in India, Kedah-Perlis Region in Malaysia, Ilocos Norte Province in the Philippines and Can Tho Province in Vietnam. Four aspects of the project are highlighted:

1. Land Use Scenarios for Individual Case Studies – Example Ilocos Norte

Agricultural land use in Ilocos Norte is predominantly rice-based. Rice is planted during the wet season and a wide range of crops are grown in the dry season using groundwater for irrigation. One of the 'what-if?' questions put forward by stakeholders was to determine the consequences for agricultural production and land use of sharing irrigation water among different irrigation systems. This is currently not possible. The results of the study revealed that under improved water-sharing conditions, rice production could be 50% higher, while farmers' income, given current prices, could increase by 25%. The results also indicate the consequences of water sharing for the where, what and how questions. That is, the results identify how land units are allocated to different cropping systems and production techniques.

2. Operational Methodology and Tools

Calibrated and validated crop growth simulation models (WOFOST), mathematical optimization models, GIS applications, interfaces and an interactive website (http://irriwww.irri.cgiar.org/sysnet/mglp/sysnetmglp.htm) form part of the toolkit that has been developed (1). Researchers of the R&D teams working on the four case studies have been trained in using the tools, and through the web, stakeholders have access to part of the software.

3. Comparative Analysis of the Four Case Studies

The four regions represent a variety of agro-ecological, socio-economic and political environments. This is reflected in the way the general methodology is operationalized. For instance, the degree of future-orientation differs considerably between the four case studies. This is mainly because of differences in i. the degree of future-orientation in identifying and quantifying alternative technologies, ii. the extent to which present socio-economic constraints with respect to land use are projected into the future, and iii. the degree of projecting present political aims and targets into the future. Hence, the potential of this methodology to look beyond present issues and constraints is not always fully exploited.

4. Networks of Researchers and Stakeholders

SysNet created an effective network of R&D teams in the four case study regions, as well as networks of local, regional and national stakeholders in the four regions. Many courses and workshops facilitated this. The shared research aims and methodology stimulated interdisciplinary research cooperation, and may

be instrumental for setting future research agendas. The approach raised considerable interest among stakeholders and enhanced communication between science and policy. We are currently evaluating stakeholders' perceptions of the project and its impact.

REFERENCES

1. Roetter, R.P., Van Keulen, H., Laborte, A.G., Hoanh, C.T. and Van Laar, H.H. 2000. SysNet Research Paper Series No. 2. International Rice Research Institute, Los Banos, The Philippines, p. 266.

2. Van Ittersum, M.K. and Rabbinge, R., 1997. Field Crops Res. 52, 197-208

3. Van Ittersum, M.K., Rabbinge, R. and Van Latesteijn, H.C. 1998. Agric. Systems 58, 309-330.

4. Van Latesteijn, H.C. 1995. Ecol. Engineering 4, 211-222.