PROGRAMA COOPERATIVO PARA EL DESARROLLO TECNOLÓGICO AGROPECUARIO DEL CONO SUR

PROCISUR

SUBPROGRAMA RECURSOS
NATURALES Y SOSTENIBILIDAD AGRICOLA

DIALOGO LI

VALORACION ECONOMICA en el USO de los RECURSOS NATURALES y el MEDIO AMBIENTE

IICA
Montevideo, Uruguay
1998

CONCEPT PAPER

Natural resource valuation, environmental impact assessment, and sustainability

The role of the NIARs in the Southern Cone

*by G. Stachetti *; M.T. Brown **; W. Miller ***; E. Ruz **** and H. Riquelme ******

Purpose

The purpose of this concept paper is to lay the groundwork for a proposal to develop methods for evaluating sustainability of natural resource use in the countries of the Southern Cone, carry out these evaluations, and suggest opportunities for change in methodology and operating procedures of the Agricultural Research Centers within these six countries. The proposed project will involve researchers from the Southern Cone countries and researchers from U.S. Universities as part of the GREAN Initiative.

EVALUATING SUSTAINABILITY

If sustainability is to be understood, incorporated into decision making, and planned for it must be quantitatively evaluated. The overall concept of sustainability can be disaggregated into ecological, social, and economic sustainability and appropriate methods applied within each area to evaluate. In the final proposal we will seek to evaluate sustainability within these three areas and at two scales (national and field/firm). The idea is to evaluate costs, benefits, and impacts within each area and at both scales using evaluative techniques appropriate for each area, then summarize and integrate these factors into indices of sustainable performance using techniques of systems analysis. The data exist for these analyses, so the proposed project will generate little new data, and primarily collect and synthesize existing data, develop metrics and indices of sustainability for comparing agro-ecosystems one to another, and evaluate national agricultural sustainability based on environmental and economic terms of trade for natural and agricultural resources between developed and developing economies.

We believe that it is imperative that these evaluations be conducted within each separate area of concern (ecological, social, and economic) because sustainability criteria within each discipline often result in different objective functions that are at odds with each other. For instance, changes in a farming system technology may positively affect ecological indices of sustainability which can either increase or decrease economic sustainability which in turn can either positively or negatively affect social indices. With this triad approach we will account for changes within each system, summarizing and synthesizing overall change to insure positive increases in sustainability.

ENVIRONMENTAL ACCOUNTING

Understanding the relationships between energy and the cycles of materials and information in agro-ecosystems will provide better insight into the complex inter-relationships between biosphere and society and provide methods for quantitatively evaluating environmental sustainability. Agro-ecosystems use

* *Engenheiro Agrônomo, PhD, CNPMA/EMBRAPA, Jaguariúna, SP, Brasil.*

** *PhD, Center of Wetlands, University of Florida, USA.*

*** *University of Nebraska, USA.*

**** *Ingeniero Agrónomo, PhD, INIA Quilamapu, Chillán, Chile.*

***** *Ingeniero Agrónomo, INIA Quilamapu, Chillán, Chile. (Editor de este documento)*

environmental energies directly and indirectly from both renewable energy fluxes and from storages of materials and energies that resulted from past biosphere production. Accounting for ail inputs to agro-ecosystems, renewable, slow renewable, and non renewable alike, is imperative if sustainability is to be understood in an ecological context. Farming systems and forest extraction involve both monied and non-monied flows of materials and energy. The totals of which determine sustainability. Using methods of environmental accounting, the flows of both monied and non-monied materials and energy within major cropping systems, forestry operations, and livestock production systems should be evaluated. Depletion of soils and aquifers, losses of genetic diversity, and off-site impacts from fertilizer and pesticides are presently being evaluated in common units like tons, m3, numbers, joules, etc. These varying units can be integrated into a common basis using techniques of emergy analysis where energy values are assigned to different materials and energies based on their energy costs of production within the biosphere. Much like contingency evaluation in economics, the emergy evaluation technique relies on developing "prices" for environmental goods in units of biosphere production. Thus the currency is energy instead of dollars (although the energy can be converted to money in a final step to incorporate environmental accounts with economic accounts). Using these common energy units, costs, impacts, and changes in natural capital can be summed to evaluate total environmental sustainability.

METHODS

The proposed project should be organized in two scales of evaluation. The first scale is the scale of national analysis where each country's energy and material balance will be evaluated from existing data and related to Gross Domestic Product. The second, smaller scale evaluations of agro-ecosystems within each country will be conducted as follows: (1) choose major cropping systems, forestry processes, and livestock production systems for each country, including the people within those ecosystems, (2) collect and synthesize data from existing sources on the input flows, storages, outputs and impacts for each system, (3) arrange data in tables of energy and material flows and apply appropriate multipliers to convert energy and materials to biosphere production units, and (4) relate biosphere production units to national accounts to set prices for environmental goods.

ECONOMIC EVALUATION

In order to stay economically competitive in the global economic system of exchange, farmers are continually adopting new technologies or practices. Any change in farming practices alters the profitability of the farm firm. It also alters both social and ecological sustainability of the agricultural ecosystem. These impacts occur for every change in forestry practices, crop production, and livestock production.

Some changes in production practices are profitable, but they reduce the ecological or social sustainability of the agro-socio ecosystem. Other changes in production practices improve sustainability, but may reduce profits. Still other changes increase profits and enhance sustainability. There is a constant search for the latter practices because they provide dual benefits and are often called win-win technologies. Complete measurement of the impact of a new technology requires assessment of the change in profit as well as the change in ecological and social sustainability.

Economic models have been developed to measure the macro-economic change in the whole economy that results from the change in production practices in agriculture. These macro-economic models are required because the impact of changes in the national economy caused by changes in practices are not just the sum of the changes that occur at the farm level. Interaction among firms and sectors of the economy result in impacts for the nation that can only be appropriately measured at the macro economic level. Macro-economic models are particularly useful at the level of policy analysis because they permit the Ministry of Finance to identify monetary and fiscal impacts as well as the impact on employment of changes that occur in farm firm production practices.

There are good tools of analysis to measure the impact of changes in farm practices at the micro-economic level of the farm firm. The first requirement of good economic measurement is to use accurate agronomic or forestry information about the technical consequences of the changes in the practices. Timber growth models, crop yield response functions and cattle growth rate functions are necessary to accurately assess the change in practice. Secondly, good information is required about the whole farm in order to find the interactions within the system that influences profitability. For example, if a new soybean seed that has been genetically altered to be resistant to a herbicide is adopted by a farmer, the following several aspects of the farms profitability may be affected: (1) yield and therefore revenue, (2) cost of the seed, (3) cost of the herbicide, (4) cost of the application of the herbicide, (5) cost of tillage practices, (6) crop rotation, (7) scale of operation, and (8) economic risk. Appropriate modeling of this change from a conventional soybean variety to one that is herbicide resistant requires consideration of each of these factors.

Many good methodological models are available to accurately measure these changes at the farm level. In particular, economists use mathematical programming optimization models to determine the economic impact of technological change on the profits of the farm firm. Simulation models have been another useful tool for analysis of changes in practices. Currently animal and plant growth simulation models have been particularly useful in accurately assessing changes in profits.

SOCIAL EVALUATION

Since production systems and transformations of nature are processes that imply social interactions, it is important to include the social implications of current practices in regard to the environment, as well as changes they stimulate. Sustainability is a delicate balance between ecological, economic and social requisites or criteria. It is usually easier to identify the ecological and economic criteria of sustainability than the social, in part, because social implications are often more diffuse and also because there has been less effort made to identify key processes and indicators to quantitatively evaluate social sustainability.

Social sustainability includes two aspects: (1) the need to secure or guarantee reproduction of human populations, and (2) the equitable access to full human living conditions, power, knowledge and resources in terms of class, gender, ethnicity, age, sexual orientation, religion, etc. Social evaluation of sustainability has to acknowledge that human populations are socially diverse and that distribution of power and resources is asymmetrically distributed.

One component of a social evaluation of sustainability relies on processes and features that can portray the situation of human resources and the issue of equity. For example: what are the female illiteracy rates as compared to five or 10 years ago? How has the income distribution evolved for the last 5 or 10 years? What is the male/female wage rates in the last decade? This type of secondary data is readily available from the census. A second component is the analysis of the social implications of major changes affecting economic and ecological sustainability. For example: what is the impact on female/male labor of that specific technology that increases yields and profits? What is the demand for female and/or children's unpaid labor for conservation practices (such as reforestation at community level) and what they imply for women and children in terms of income, food provision and expenditure of energy? What does a shift in type of cash crop produced imply for use of natural resources, who will make the production shift, and how will income be distributed? Answers to these questions are not readily apparent from the usual sources of secondary data but may be available at the local or regional level or in social science/farming systems research publications.

There are several techniques of qualitative analysis that can complement the quantitative analysis of social indicators to evaluate sustainability. The advantage of including some of these techniques, such as stakeholder analysis, policy analysis matrix, disaggregated cost/benefit analysis, disaggregated market welfare analysis, is to provide an opportunity to enrich the analysis of the quantitative indicators which only provide a partial account of reality. For example, resource and social network mapping and decision flow diagrams for different age groups and gender groups are a uniquely valuable way of generating information on access and control to resources (including cash) and on property rights.

The social analysis of sustainability will provide the social framework to contextualize the ecological and economic analyses, in addition to providing a set of quantitative and qualitative indicators and analyses.

ENVIRONMENTAL IMPACT ANALYSIS

It is a common practice to decide on the development of plans, projects, and even technology research programs according to economic, technical, and political criteria. Environmental quality and sustainable natural resource use seldom receive the required consideration, and when included, they are usually only considered in terms of cost-benefit analysis that offer poor basis for devising alternative, more appropriate development options.

An adequate approach for the evaluation of the environmental impacts of agricultural development plans is needed across all National Institutes of Agricultural Research (NIARs) in the Southern Cone, in order not only to ameliorate the planning of agricultural development projects and improving their implementation, but also as a means of adequately and systematically gathering and organizing data for the valuation of sustainable use natural resources. Additionally, it is proposed that the NIARs implement a system for the environmental impact assessment (EIA) of agricultural technology development in an ex-ante fashion, in order to assure that secondary deleterious effects of agricultural technology do not negatively affect the environment and the economic systems. In other words, the EIA process should incorporate social and sustainability criteria.

The introduction of sustainability criteria into EIA brings about complex conceptual and policy orientation problems, because it depends not only upon the definition of the limits for the sustainable use of natural resources and the regenerative capacity of the ecosystems, but also on the trade-offs between environmental conservation and the improvement and growth of economic activities, as well as the fair sharing of wealth among the social groups involved. In this sense, a major difficulty for the incorporation of EIA into agricultural development is the theoretical gap between the ecological and the social sides of the equation, although there are newer versions of EIAs that do include social impact assessments

Along with the proposed systems approach that tracks energy as a common unit for the evaluation of agro-socio ecosystems, and the economic assessment of the outcomes of managerial and technological changes, an integrated EIA protocol is to be developed to offer the tool for gathering and organization of existing data for the two former analytical procedures. Such an EIA protocol is now being tested at EMBRAPA (Brazil) and can be adapted to fulfill this objective.

METHODOLOGICAL APPROACH AND IMPLEMENTATION

The continued coordination of efforts by PROCI-SUR and the GREAN Initiative should be directed to the diffusion of the evaluation methodologies for sustainability and impact analysis. The proceedings of a 2 day congress at INIA headquarters in Chillán, Chile, October 7-8, 1997, provides a first opportunity to motivate researchers at the NIARs to promote environmental assessments of technology and project development, taking into account the important issue of natural resources and environment valuation. This concept paper, is an outgrowth of that conference.

The next step should be a coordinated effort to proceed toward the formulation of a proposal for integrated assessment of environmental, economic and social sustainability in agriculture and natural resource utilization. This research project would serve as both a test of the protocol and ultimately a best management practice evaluation tool. The endpoint of this initiative is to provide all NIARs with appropriate procedures to enhance their ability to evaluate and define agricultural research priorities and practices, that improve the sustainability of Southern Cone agro-ecosystems within an ecological, economic, and social context.