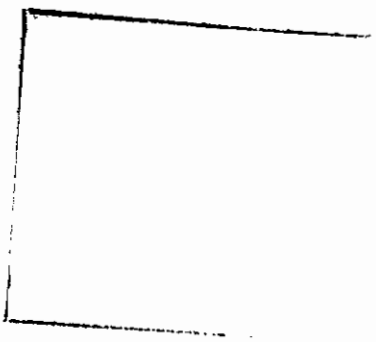
AN APPROXIMATION TO CIAT'S SOCIO-ECONOMIC RESEARCH AGENDA FOR NATURAL RESOURCES ISSUES IN TROPICAL AMERICA



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Paper Presented to CGIAR Social Science Meeting,
ISNAR, The Hague
August 1992

Valuable comments to this paper were made by Jacqueline Ashby, Gustavo Nores, and Daniel Robison. While firmly based in the CIAT Strategic and Operational Plans, nonetheless the authors are responsible for the paper's content as well as for any errors or misconceptions.

As part of its strategic plan 1991-2001, CIAT has formed a new Resource Management Division "to improve the management of resources available for agriculture in tropical America such that gains in food outputs and other commodities are compatible with long-term preservation of the resource base" (CIAT Strategic Plan, p. 47). CIAT has chosen to organize its natural resource activities principally around spatially definable agroecosystems: the hillsides, the savannas, and the forest margins. The boundaries of these agroecosystems have been drawn by overlaying land use patterns with an environmental classification based on mean and range of temperature, rainfall, and soil acidity. The three priority agroecosystems were then chosen based on economic and production potential, resource problems, relevance to overcoming poverty, technological opportunities and institutional considerations. The chosen agroecosystems all constitute fragile environments with land, labor, and market access constraints, as well as new and traditional inequalities caused by land tenure disparities and conflicts. As such, research and development challenges must be formulated in an explicitly equity oriented context.

Acid infertile soils are a common denominator across the three priority agroecosystems which points to one principle thrust of CIAT's research: on the management of these soils for agriculture and animal husbandry. This focus on integrated nutrient management in multi-species systems provides synergy with CIAT's germplasm programs (beans, cassava, tropical forages, and rice) which are not only important in the priority ecosystems, but also have already been conducting research on genetic adaptation to acid soils. Across all these agroecosystems multi-species integrated crop/livestock systems are seen as crucial to natural resource sustainability.

However, the development of management and genetic technologies is not the sole instrument through which gains in production can be made compatible with the preservation of the resource base. Policies, institutions, and the incentive structures within which resource managers frame their decisions, are critical determinants of production and resource outcomes. Understanding decision making from the individual farm to the regional

and policy levels thus becomes the second common denominator across the three agroecosystems.

Within the three agroecosystems programs, emphasis is being placed on understanding farmer decisions and their implications for technology design. Due, however, to the importance of factors such as off-farm externalities and the importance of policy in natural resource management, CIAT has decided to also initiate a Land Use Program (LUP) within the Resource Management Division. The Land Use Program's perspective will be at a regional or sectoral level, rather than on individual farm decision of technical choice. The LUP is studying land use patterns across agroecosystems, and will focus on measuring social costs of resource degradation, appraising policy alternatives for improved land use, and analyzing the spatial distribution of land use. As such, it will assist, with a more regional or "macro" perspective, the ecosystems programs in defining constraints and research niches.

The importance of socio-economic studies of decision making is emphasized by CIAT's commitment of 42% of the total core resources of the Resources Management Division to socio-economics. This reflects the premise that the research agenda for socio-economics is vital for the success of CIAT's resource management initiative. Obviously, there will be considerable complementarities between socio-economic research in the agroecosystems programs and the Land Use Program, and their respective research activities will be closely coordinated. This paper will now turn to a brief consideration of some of the issues that may emerge as central to the socio-economics research agenda for natural resources in Latin America and the Caribbean.

Land Use Program: Land use in tropical America is highly dynamic, characterized by frontier settlement, migration and the disturbance of natural ecosystems; increasing population densities and more intensive land use in areas of traditional settlement; chronic equity conflicts; the introduction of new crops and technologies in the context of rapid economic change; and the emergence of a variety of natural resource management concerns.

These resource issues include deforestation; soil fertility maintenance; soil and water conservation; loss of biodiversity; and abuse of agrochemicals in intensive production systems.

The LUP will emphasize geographic information systems (GIS) as a basis for identifying land use systems and understanding trends in land use and the underlying factors driving these changes. GIS will be vital in selecting priority areas and issues for study by the Agroecosystems Program since by definition these fragile areas have a high degree of location specificity. GIS will assist in projecting the domain of extrapobility of research results of the agroecosystems programs, which will lead to higher research and development effectiveness.

Economic analysis will also be a key tool for appraising land use and policy options. Research priorities for the agroecosystems programs need to be based on a comparison of the relative costs of different resource degradation processes under alternative management systems. Estimation of the private returns to different resource management systems will be of direct concern to the agroecosystems' programs in their technology development efforts. However, external costs and returns also need to be appraised at a regional or sectoral level in order to identify systems that approach socially optimal resource use. Conventional economic valuation of resources may need to be complemented with innovative measurements of environmental impact.

Understanding the private and social costs and returns of alternative systems of resource management is key in setting the technology development priorities of the agroecosystem programs. Technology development is more complex and of a longer term nature than in traditional commodity research. Sustainability outcomes by their nature require time to be fully observable, and by definition are expressed in a complex hierarchy of systems. As a result, initial analysis of priorities will be crucial to the overall success of CIAT's resource management initiative. The information base for making these decisions

is likely to be incomplete as well as costly and time consuming to obtain. Thus it may well prove necessary to move forward by successive iterations.

Policy may be of even more fundamental importance in many cases than technology in as much as it determines access to natural resources and influences the level of returns to private exploitation of resources. Much of the policy affecting resource use may be framed to attain other objectives, and consequently have unintended and undesirable indirect impacts on resource use. Hence it is imperative to obtain a detailed understanding of the policy environment and its impact at the earliest stage. Comparative and historical studies of the influence of policy on land use will be conducted, even though this will lead CIAT beyond its traditional bounds of focusing on technology generation. CIAT will concentrate on methodologies to assist national policy analysts in presenting policy makers with a range of options and an assessment of their probable impact. Close collaboration with IFPRI and national policy researchers will be vital. Outputs of policy analysis may on occasion run counter to conventional wisdom and prevailing interests either in tropical America or among donor countries.

The bulk of LUP attention will initially be dedicated to issues of particular relevance to CIAT's selected priority ecosystems. Nonetheless, LUP will have an additional responsibility to monitor resource degradation and land use strategies and policies in other agroecosystems in tropical America (eg., seasonally dry). This may be an important element as "ecosystem selections will be revisited in the latter half of the 1990's" (CIAT Strategic Plan, p. 24).

Agroecosystems Programs: The agroecosystems programs will concentrate on studies of farmer decision making, emphasizing analysis of farmer strategies with respect to resource management and choice of technology. The specific research agenda differs, of course, for each program.

In the forest margins, for example, immigration is likely to be an important issue. Deforestation is being driven by diverse sources including small holder migration from other regions; internal migration by small holders within the forest margins propelled by declining productivity; entry of large well capitalized enterprises (eg. ranches, plantations, loggers); land speculation; official policy including infrastructure development and colonization schemes. Understanding the relative weight of these processes and the causes underlying them, is necessarily important to the socio-economics research agenda in the Forest Margin Program.

A central research thrust of the Forest Margin Program will be to intensify and stabilize shifting cultivation systems on already cleared land by developing agroforestry/ley-farming systems for small to medium sized farm units. This will require intensive socio-economic study of the returns to existing shifting cultivation systems, as well as the evaluation of components and systems constituting new technical options. To some degree, prototype technologies for more sustainable settled systems may have already been developed by formal research entities and by innovative farmers. Participatory testing of these options should be a major initial priority, both in order to take advantage of the existing stock of heretofore largely unexploited innovations, and also as feedback to the technology design process. The roles and needs of women as resource managers should be examined in this context. In addition, market channels and opportunities will have a significant influence on the adoptability of new technologies and will need to be assessed with care. Some attention should be given to the economic viability of extracting products from the remaining forested areas within the forest margins. Complementarities among and economic returns to different land use options will be evaluated in situations with contrasting access to infrastructure and natural endowments.

Forest margin resources are variable, both with respect to the opportunities offered for settlement, and with respect to the social value of the forests themselves. Assessment of the genetic resources, including estimation of genetic variability and vulnerability, could be useful to prioritize regions for protection. Rates of biological impoverishment under-

alternative forest uses could also be worth studying. From a wider perspective, forest margins could also be assessed for their potential of "eco-tourism" and national parks as specific opportunity niches.

The Hillside Agroecosystem constitutes a contrasting situation that implies a distinct research agenda. In the hillsides, small farmers control a greater proportion of the land resources, and in most of the agroecosystem settlement is older than in the forest margins. Thus production systems are generally more intensive often associated with reduced fallowing, and sometimes by increasing crop specialization. Due to continued population growth and the poverty of many of the hillside farmers, there is a strong trend towards ever more intensive land use. This can lead to degradation of the resource base, which compels an even more intensive exploitation in order to maintain incomes, in turn leading to further degradation in a vicious cycle. In addition, degradation both in quality and quantity of soil and water resources in the hillsides can have major negative externalities on prime agricultural lands and urban centers downstream.

One working hypothesis of the Hillside Program is that this entire process can be reversed if farmers are able to invest in resource regeneration by increasing productivity and incomes. Much of the agroecosystem has reasonable access to markets, and commercialization has already largely displaced subsistence agriculture. Analysis of backward linkages from agroindustry and markets will be important to identify opportunities for introduction of technologies that permit increased incomes and capital accumulation, thereby providing both the wherewithal and incentive to investment in sustainable resource management.

In this context, studies of farmer decision making on technical choice and resource management are again paramount. Formal economic modeling of farm systems may be of modest utility due to the diversity and complexity of these systems. A major thrust will be on strategic research on institutional innovation that more effectively links indigenous expertise with a more decentralized formal research system. The knowledge and capacities

of female farm managers deserve particular attention. Crop/livestock interactions may be important in this regard.

However, where the prospects for successful intensification and accumulation are poor, and where negative externalities outside the agroecosystem are great, economic analysis will be useful in delineating how policies and transfer of financial resources could be crucial complements to improved technology in order to reach more desirable natural resource outcomes.

In general, it is erroneous to analyze Latin American hillside farming systems as closed systems. There are considerable flows of labor, cash, and food, off and onto these farms. It is almost certain that cycling on farm organic nutrients as well as the in-flow of inorganic nutrients onto the farms, will be major elements in achieving sustainability. On the other hand, pesticide abuse is already emerging as a problem in many areas, making integrated pest and weed management a likely concern to the program.

Among CIAT priority agroecosystems, the savannas provide unique opportunities for intensification and increased productivity. The underlying hypothesis is that accelerated savanna development could be sustainable and could contribute to relieving economic, social and political pressure to over exploit more vulnerable agroecosystems like the forest margins or the hillsides. However, successful and sustainable savanna development entails the generation of largely new farming and soil management systems. The highly acid soils of the savannas require special management, and stable, profitable, sustainable production systems have yet to be devised. Ley farming with acid tolerant germplasm is seen as the key technology option.

The major research issue for socio-economics will be on the profitability and sustainability of these new farming systems. Formal economic modeling of these systems will be a very useful tool, but technologies also need to be tested on farm. The impact of land prices and infrastructure development on land use and farmer choice of technology will

be issues. Employment creation, including off farm, from successful savanna development should be estimated. Settlement and utilization of the savannas depend to a large extent on accessibility, making it sensitive to public policies on infrastructure investment. Property rights are sometimes an issue with clear equity consequences.

Summary and Conclusions

The relative priority to the socio-economic research agenda of the resource management programs of different classes of research is portrayed in Table 1. The Land Use Program will give the highest proportion of its efforts to geographic information systems; policy studies; regional and sectoral costs of resource degradation; and ex-ante analysis of returns to research. Economic evaluation of technology and monitoring the environmental and welfare impacts of new technology will be major priorities in all the agroecosystems. Gender analysis and participatory testing are likely to be particularly important in the forest margins and hillsides, while whole farm models may be of greater utility in the Savanna Program. On many issues, like the ex-ante analysis of returns to research, the Land Use and Agroecosystem Programs should work so closely, that the relative priorities here may be somewhat arbitrary.

The organizational structure, level of integration and research issues emphasis in time are still topics that need further reflection and discussion. CIAT plans to continue placing socio-economists in multi-disciplinary goal-oriented programs rather than in a separate disciplinary program. This strategy has proven very successful in CIAT's experience with commodity programs. This approach has been highly effective in fostering an environment where socio-economic research is highly relevant to the activities of the biological scientists, who in turn, have come to place considerable value on the input of the socio-economic perspective.

This tends to force CIAT socio-economists to be generalists within their own discipline. Putting socio-economists into a separate program would almost certainly provide CIAT opportunities for improved disciplinary research from a balanced team of specialists

in production economics, farming systems, policy, resource economics, sociology, anthropology and geography. The creation of the LUP and some manner of formal disciplinary coordination of socio-economic research across programs will go some way to enable CIAT to improve the disciplinary quality of socio-economic research. However, CIAT continues to place priority on deploying socio-economists to optimize the output of technical innovations from multi-disciplinary programs.

Hopefully, this paper served to highlight several issues in a novel research approach in order to benefit from discussions in this meeting. Several difficult issues will confront all the programs. First, the setting of research priorities is of tremendous importance. Many issues of resource sustainability involve systems that are both highly complex and must be studied over time. This implies substantial investment in research with a long investment horizon. Incorrect identification of constraints and opportunities at the outset could entail costly waste of research resources.

Second, there are unavoidable valuation problems that may not all be easily settled. Valuation of natural resources such as genetic diversity or carbon sinks may be largely empirical problems that are in principle tractable though in practice may be difficult to measure. Issues on the sustainability of natural resource use inevitably involve questions of future values. These are extraordinarily difficult to forecast. Moreover, in conventional economic analysis, costs and returns sufficiently far into the future are essentially discounted to zero. Will it suffice for economists to merely assert that ecological critics of these methods are misinformed?

Finally, monitoring of research progress will be critical to maintaining financial support to research and as a feedback mechanism to researchers and decision-makers. This will be complicated by the fact that the outcomes of natural resource research may often be less easily identifiable than, for example, genetic technologies. Moreover, lags in observing results are likely to be substantial. The research process itself is likely to be time consuming, and additional lags should be expected before observing results on farm in terms

of sustainability outcomes which by their very nature may not be measurable in the short run. Technology transfer is also likely to often be more difficult with natural resource technologies since benefits may be distant in time or accrue principally to others than the immediate user of technology. All this points to the need for considerable creativity in the generation of intermediate indicators and constant attention to issues related to the distribution of benefits of improved resource management technologies.

TABLE 1. Intensity of Involvement of CIAT Natural Resource Programs on Priority Research Topics.
(*** = High Priority in Program; ** = Significant Priority; * = Modest Priority; - = Not priority).

	LAND USE	FOREST MARGINS	HILLSIDES	SAVANNA
Geographic Information Systems	***	*	*	*
Private Costs/Returns of Technology/Resource Degradation	*	***	***	**
Social Costs/Returns of Resource Technology/ Degradation	***	**	**	*
Ex-Ante Returns to Research/Priority Setting	***	**	**	**
Policy Economics	***	**	**	**
Immigration/ Demography	**	***	*	**
Participatory Testing of Technology	-	***	***	**
Whole Farm Models to Analyze Technology Choice	-	**	**	***
Gender Analysis	*	***	***	*
Market Linkages	*	**	**	*
Monitoring/Impact	*	***	***	***