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Agroecological Approaches and Appropriate Technologies for Tropical Ecosystems – A Concerted Effort among NARS, IARCs, NGOs and Farmers

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AGROECOLOGICAL APPROACHES AND APPROPRIATE TECHNOLOGIES FOR TROPICAL ECOSYSTEMS

A Concerted Effort among NARS, IARCs, NGOs and Farmers in the context of GFAR

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AGROECOLOGICAL APPROACHES AND APPROPRIATE TECHNOLOGIES FOR TROPICAL ECOSYSTEMS

1. BACKGROUND AND RATIONALE

Crop and livestock production systems are the basis of the rural economies of humid and sub-humid tropical regions. However, tropical ecosystems are suffering the consequences of an accelerated deterioration in its ecological capital and most agriculture production systems of the region show high degree of environmental degradation, as indicated by declines in soil fertility, vegetation cover, biodiversity loss and increases in soil erosion. The underlying causes of environmental degradation in tropical ecosystems include the poor understanding of agroecosystems dynamics and carrying capacities which lead to developing of unsustainable production systems. It is also recognized that in recent years the region is facing stagnant yields, and that the growth taking place in some of the major agricultural products of the region is being done at the expense of the natural resource base.

The prevailing agricultural research model in tropical countries focuses on traditional food crops (cereals and grains) that nowadays offer few competitive advantages in national and international trade. Less attention is given to crops such as fruits, vegetables, perennial species and forest, or integrated production systems which offer the potential of added value in national and international markets.

Despite being the most common systems in the tropics, integrated cropping (rotation or intercropping) or mixed production systems (crop-livestock) or multi-strata production systems (agrosilvopastoral), have received less attention for technological development. A similar scenario prevails in the livestock sector where dual purpose cattle production, clearly the most important livestock production system in tropical countries, has received very little attention by the scientific community.

Tropical countries are therefore facing the critical need to develop sustainable and competitive production systems based on the strategic use of their natural resources, while protecting these particularly fragile ecosystems. The complexity of the interactions among the different components of tropical agriculture systems requires a holistic approach for research and development activities. Development of sustainable and competitive tropical agriculture production systems also implies the revision of the contributions of different sciences and disciplines to the analysis and understanding the bio-physical, socio-economic and environmental components of agricultural systems and their interactions in specific regions and niches. Additionally, there is an urgent need to integrate smallholders in the development of research and technology strategies to improve the social impact of these processes.

Strategic research areas to improve management of natural resources and to develop sound technologies for tropical ecosystems include the evaluation of energy and nutrient cycling in integrated crops, crop-livestock systems and agrosilvopastoral systems; development of ecophysiological and adaptation models; ecological studies of tropical ecosystems; development of sustainable tillage practices; evaluation of environmental services and development of sustainability indexes for tropical agroecosystems. Nevertheless, these various topics are being structured around the **three main challenges** mentioned above: (a) improving our understanding of tropical agroecosystems' structure, function and dynamics in order to understand better their carrying capacity; (b) the development of integrated cropping systems, mixed production systems and multi-strata production systems that are sustainable in these circumstances; and (c) to restore the production capacity of degraded pastures in tropical savannas on the basis of the new knowledge that is being generated. In order to address these challenges, research institutions of the tropical regions need to increase the critical mass of researchers, on the one hand, and to integrate both scientific knowledge and traditional knowledge (local innovations), on the other.

Given the above characteristics a **holistic approach** is required. This holistic approach has three dimensions to it. The first one is the need to link *research*, *education* and *training* to build-up the capacities of tropical countries to develop scientific knowledge and appropriate technologies for the development of really sustainable production systems. A second dimension of this required *holistic approach* is the need to develop closer interaction between agronomists and veterinerians, on the one hand, and ecologists and other scientists that look more at the dynamics of ecosystems. A third dimension of the *holistic approach* that is required is the need to develop a much more closer interaction between researchers, farmers and the indigenous population that lives in these tropical ecosystems. Here a strong stakeholder involvement and very close collaborative efforts between the various stakeholders involved (in which the researcher is only one of them), is required. One of the important issues that are involved here is the need to bring together local/traditional knowledge, that is extremely important in the management of tropical ecosystems, and the scientific knowledge that is generated by the research process. These three dimensions of the new *holistic approach* can play an important role in strengthening the capacity of tropical countries to effectively reach the objectives of eradicating rural poverty, assuring a sustainable management of the environment and attaining food security.

2. NATURE OF PROGRAM BEING PROPOSED AND OBJECTIVES

In order to respond to these challenges, it is deemed very important to be able to promote and strengthen cooperation between the various NARS and stakeholders that are interested on these topics. Given the nature and magnitude of the challenge, there is a strong conviction that no single country nor stakeholder can successfully tackle this challenge alone. Collaboration through research partnerships is here a prerequisite, seeking to bring together the efforts of NARS, NGOs, IARCs, farmers' organizations, indigenous

communities, ARIs, and the private sector, hopefully with the support of donors and other funding agencies. Given the magnitude of the effort required, and the importance of addressing this issue for sustainable agricultural production and equitable development at the global level, the Latin American and Caribbean Agricultural Research Regional Forum (FORAGRO) is presently discussing with their colleagues in other Regional Fora, as well as with all the stakeholders mentioned above, the possibility of developing a *"Global Partnership Program on Agroecological Approaches and Appropriate Technologies for Tropical Ecosystems"*. This is being done in the context of the Global Forum on Agricultural Research (GFAR), as part of the effort that stakeholders are carrying out of developing research partnerships in strategic areas of research and development that are of common interest to them. Given the characteristics of this research area as analyzed above, and the need to bring together both local/traditional knowledge as well as scientific knowledge to develop innovative approaches to the challenges being confronted, *it is of great importance to assure a very strong stakeholder involvement*, both at the grass-roots (community) level, as well as in the design, conception and management of this program. This program has to be essentially a *stakeholder-driven program*, if it is to have success.

Until now this initiative has been under discussion and development in the FORAGRO region. Since the GFAR meeting of Durban in South Africa, a dialogue has been initiated with NARS, NGOs and IARCs in other regions, to explore their interest in participating in this initiative. The reflections that are presented in this section reflect the ideas that are emerging from this inter-stakeholder dialogue that is presently taking place. ***The main idea is to build on activities and programmes that are already being carried out by the interested NARS, NGOs and other stakeholders.*** But instead of continuing to work parallel to each other, this Global Program will seek to facilitate the exchange of information, of experiences and of research results among interested stakeholders, and eventually, once we can develop a *more structured shared research agenda*, the possibility of collaborative research efforts could be explored. At the beginning, these collaborative research efforts will most likely be carried out at the *sub-regional and/or regional levels*, where stakeholders find it easier to carry out joint research activities. Thus the Global Program that is being envisaged would have very strong regional or sub-regional chapters, where most of the operational activities would take place. On the basis of dialogue among stakeholders, we hope to identify those activities in which there can be an *added-value* to doing them in a *collaborative mode at the global level*. This can refer to: exchange of information and experiences, exchange of research results, exchange of methodologies and approaches (with the knowledge of what works and what doesn't), and maybe carrying out of training activities on key strategic topics/techniques. In some specific topics, the possibility of developing inter-regional research networks that facilitate the interaction of researchers that are working on the same topic in different regions (i.e. following the IPM or the PROMUSA networking models), could be feasible. But most activities would continue to be carried out at the regional and sub-regional level, following the principle of subsidiarity.

After the initial discussions held at Durban, the second inter-regional interaction is taking place this week in the GFAR-IFAD Workshop held in Rome on Global Partnership

Programs (October 9 and 10, 2001). This dialogue will be continued in the coming months (i.e. GFAR-SC and NARS-SC meetings of Washington at the end of October), and we will explore with RF/SRF how best to interact with the research groups that are presently working on these topics in the various regions.

From these preliminary discussions among stakeholders, **three general objectives** are gradually emerging:

- To improve the sustainability of agricultural production systems in tropical regions by improving our understanding of the *tropical agroecosystems structure, function and dynamics*, and by developing appropriate technologies for them

- To develop agropastoral (crops and livestock) and agrosilvopastoral systems (tree species, crops and livestock) to restore the production capacity of degraded pastures in tropical savannas of South América, Sub-Sahara Africa and Asia/Pacific

- To develop collaborative research, education and training programs to build-up the critical mass of research institutions in tropical countries and to empower community stakeholders

It should be pointed out that these three objectives are still under discussion, and most likely from this ongoing inter-stakeholder interaction that is taking place in the context of GFAR more focused objectives will soon be emerging. Given the "decentralized structure" that is being envisaged for this Global Partnership Program, with strong regional/sub-regional chapters, most likely we will soon start to distinguish between two levels of objectives. At the global level one can have very general objectives, that can provide a "shared framework for action" that will facilitate interaction and complementarity between the research efforts that are being done in the different regions. Secondly, at the regional/sub-regional level we may have much more specific objectives, on the basis of which a much more structured research agenda is carried out for that particular region/sub-region by the stakeholders in that region.

3. MAIN OPERATIONAL COMPONENTS OF THE GLOBAL PROGRAM

In this very initial phase, this program is being envisaged as being organized around three main components: (1) An *Electronic Communication Platform* that will seek to facilitate communication among research groups that work in this area, both within each region/sub-region and between regions. This electronic platform will also be used for other purposes: allow access to the research results being generated by the participating research groups, hold electronic conferences on topics of common interest, and other research-support functions that are being discussed with the interested stakeholders. (2) A *Virtual Education and Training Centre on Agroecological Research for Tropical Ecosystems* aimed at graduate education for researchers and for the training of extension persons and other human resources that may be considered necessary. This virtual centre will use the

electronic communication platform as an important basis to operate from. (3) A *collaborative research agenda* that will be implemented through concrete projects. As pointed out above, this component will mainly be developed at the regional/sub-regional level (subsidiarity principle), with a clear effort of seeking to promote exchange of information, of experiences and of research results between regions. This exchange among regions may lead to the identification of themes/topics where it is possible to develop and consolidate inter-regional networks. But this has to emerge from the direct interaction among stakeholders that are working on those topics/themes. A brief description of each component follows.

a) The Electronic Communication Platform

An initial Electronic Communication Platform is presently being designed at CORPOICA in the LAC region, as a first pilot phase of this proposed program, and it is expected to be operating by May of 2002. Consolidating of this platform will facilitate communication among the stakeholders that participate in this GPP around the world, as well as facilitating the access to knowledge and the pooling of knowledge among interested stakeholders. A close interaction will be developed between this electronic communication platform and both FORAGRO/INFOTEC as well as EGFAR. One of thew areas in which INFOTEC (the FORAGRO-RAIS) is working is to see how to strengthen communication platforms of regional research networks.

In addition to this, close interaction will also be developed with the Livestock Environment and Development Initiative (LEAD) that is looking at the environmental dimension of tropical livestock. Initial contacts were recently established with this group at the GFAR/IFAD Workshop in Global Partnership Programs that took place in Rome.

The consolidation of the electronic platform will allow the implementation of networking groups by region as an essential part of the program. In the very first phase, this platform is being developed primarily for the FORAGRO (LAC) region. The possibility of extending it to other regions is presently being discussed with the Regional/Sub-regional Fora of each region (i.e. CORAF/WECARD, APAARI, etc.). If this platform is extended, coordinating or lead institutions would have to be identified in each region. Exchange of information on critical areas of tropical agriculture through electronic conferences and workshops will also be an important role of the electronic platform of this GPP.

The regional networks will participate in research priority setting activities, facilitate the formulation and implementation of collaborative research projects and will be a key factor to strengthening the development of integrated approaches to tropical agriculture. They will play an important role in connecting local and regional different stakeholders to share experiences and to avoid duplication of efforts.

b) Virtual Education and Training Centre on Agroecological Research for Tropical Ecosystems

The implementation of a Virtual Center of Excellence for education and training in tropical ecosystems using new computer-base learning resources and communication platforms of different institutions is being led by CORPOICA in the LAC region as an alternative to develop capacity-building programs on key areas of knowledge and technology for tropical countries under a global partnership program and to empower community and participating stakeholders.

The Virtual Centre is conceived as a centre of excellence that can be constructed by linking through internet groups of researchers located in different institutions (NARS, IARCs, ARIs, Universities, NGOs) for purposes of collaborative research, for development of graduate program of studies, through the collective effort of participating institutions, and for developing of training programs to technical assistants or producers.

This initiative will have an integrated approach to solving problems in tropical agriculture covering new strategic research activities and innovative training programs based on the existing capacities and agendas of the participating institutions, and taking advantage of the different tropical ecosystems as natural laboratories. Strengthening the critical mass of researchers in the region is fundamental to improve the impact of R&D on agricultural systems of the tropics.

Education and training modules as well as computer based learning material and other tools for distance education will be developed based on strengths of partner institutions (NARS, IARC, National and International Universities, NGOs) joining the project.

Sharing of research results and exchange of information on critical areas of tropical agriculture through electronic conferences and workshops will also be an important role of the Virtual Centre. Databases on established research and education capacities as well as in thematic areas, and decision making tools for different stakeholders involved in the project will be developed.

c) Collaborative Research Agenda

In the case of the FORAGRO component that is presently emerging, a concerted research agenda including three initial collaborative research projects on development of appropriate technologies to restore the production capacity of degraded pastures in tropical savanna ecosystems of South America and to improve sustainability of crops and beef and milk (dual purpose) cattle production systems in the region has been developed with the participation of NARS, IARC, NGOs and Farmers. The first three research projects have been presented to the Regional Technology Fund (FONTAGRO) to be financed. Other collaborative research projects are being discussed with

interested stakeholders in the LAC region. In the ongoing dialogue with stakeholders in other regions, the present research efforts being carried out in each region are being discussed, as well as how to proceed with the identification of the regional research priorities in this particular research area. One interesting side-product that can come out of this dialogue is an identification of the main research projects presently underway that may be deemed of interest for the approach that is being proposed for this program.

The collaborative research projects are instrumental for the implementation of the new approaches to develop appropriate technologies for tropical ecosystems. They include ecological studies of native savannas, evaluation and modeling of primary and secondary productivity savanna ecosystems, integrated soil and water management practices, and evaluation as well as utilization of native cattle breeds, crops and tree-legume species in multi-strata production systems. Important methodological tools will be developed aimed to improve decision making processes for technological intervention in these fragile ecosystems.

A close link between the research projects and education and training programs through the Virtual Centre is a key component of this collaborative agenda.

Since a clear interest was expressed by stakeholders from Africa and Asia to join this initiative during the recent GFAR-IFAD Workshop held in Rome, in the next months the dialogue with Regional/Sub-regional Fora and other stakeholders will continue, to see if the idea of a Global Partnership Program on this topic can materialize. This dialogue involves very much a close interaction with NGOs, farmers' organizations IARCs and ARIs that are interested on these topics.

4. MAIN ACTIVITIES BEING CARRIED OUT IN EACH COMPONENT

a) Consolidation of the Electronic Communication Platform: In close cooperation with FORAGRO/INFOTEC, the Electronic Communication Platform for this program is being established at CORPOICA in an initial pilot phase. Once it is operational, the question of its definitive institutional location and its "inter-institutional management" at a regional and global levels will be discussed with interested stakeholders. CORPOICA will be funding the first initial pilot phase for the establishment of this platform as a contribution to the initial pilot phase of this program. Improving of computer hardware, software and protocols of the electronic communication platform and the implementation of different electronic communication capacities to reach researchers, development workers, farmers and other interested stakeholders is a key step for the GPP to be successful in fostering networking and sharing of information. During this pilot phase cooperation with other stakeholders will be explored through the following channels: (a) At the regional level, the construction and development of this platform is being discussed with other NARS of the LAC region (i.e. EMBRAPA, CATIE and the INIAs of

Venezuela, Ecuador and Peru). Collaboration with CIAT and with the CGIAR centres will be sought. (b) At the inter-regional level, contacts are being established with research groups working on these topics in Sub-Sahara Africa and in Asia/Pacific to explore possibilities of exchange of information and of collaboration with them. (c) At the global level, the possibility of collaboration with EGFAR (as part of the RAIS activities), with WAICENT and with the LEAD initiative coordinated by FAO, have been initiated. Through this cooperation, technical support will be sought to upgrade the presently existing platform and to facilitate the connecting processes with other compatible existing platforms of participating institutions in different regions. Internet access (www, e-mail, file transfer protocol, List), systems infrastructure to electronic conference and forum events, databases of experts and institutions, and other tools will also be implemented. This initial pilot phase was initiated in August of 2001 and will be carried out during the second semester of this year and the first semester of 2002.

b) Implementation of the Virtual Centre for Education and Training: Education and training programs on AE/NRM, databases on research results, electronic libraries, and management tools will be developed by join efforts of different stakeholders involved in the GPP. Computer-base learning materials on agroecological approaches and technologies to improve sustainability of crop-livestock production systems in tropical environments will be developed by Cornell University and CORPOICA, learning materials on DMC and agro-pastoral systems will be supported by Embrapa, tropical feeds composition library will be supported by CORPOICA, modeling and tools for optimizing grazing feeding systems will be developed by U. California, CORPOICA, and EMBRAPA; agroforestry modular training programs will be supported by CATIE. It is expected that new partnerships for developing other learning materials will emerge with the participation of stakeholders from Africa and Asia in this GPP. Graduate programs for researchers and training courses for different stakeholders will be implemented, based on regional priorities, research collaborative agenda, and established capacities of participant institutions.

c) Collaborative research projects: In the case of the FORAGRO region, a set of three projects have been prepared in the last six months, based on regional priorities identified through both the PROCITROPICS and PROCIANDINO subregional collaborative programmes. These three projects are being envisaged as the starting point of a concerted research agenda oriented to developing sustainable technologies to improve production of crop-livestock systems in the region, with a strong environmental component. These projects have a clear component of capacity-building and training of human resources.

The three initial projects are:

1) Development of agropastoral systems to improve efficiency and sustainability of lowland tropical savannas of South América. The main objective of this project is

to design and validate integrated agricultural production technologies and strategies to restore the production capacities of the intervened savanna ecosystem and to improve social and economical conditions of farmers in the region. Crops and legumes will be used as a means to improve physical and chemical soil conditions and biofertilizers based on native strains of mycorriza will be used to improve biological soil conditions and nutrient availability for crops and forages. DMC best practices will be implemented and feeding systems will be formulated to improve nutrition status and productive and reproductive performance of grazing cattle. CORPOICA, EMBRAPA, INIA (Venezuela) and the University of California (Davis) will be involved in this project. Local farmers' associations and technical assistants are key participating stakeholders in this project. A major departure from the traditional research approaches is being developed, on the basis of very strong stakeholder involvement.

2) Development of feeding systems for beef and milk production in the tropics. The objective is to develop decision making tools that can be used to optimize management of tropical pastures and nutrition of grazing animals under tropical conditions. The project will allow the development of tables to estimate nutrient requirements of different types and classes of cattle in tropical ecosystems. Models for prediction of intake of tropical forages and energy and protein supplements, milk production and body weight gains in response to intake and diet quality will also be develop. The technological innovations resulting from the project will contribute to stop the expansion of the crop and livestock frontiers to fragile ecosystems, by increasing the efficiency of the present production systems. Improved feeding and management systems will allow better and rational use of renewable resources, soil and water conservation and livestock products of better quality. The project will generate feed information databases available for farmers and extension workers in tropical countries. Technical guides of feeds and forage management strategies for different tropical ecosystems will be published. Participating stakeholders are: CORPOICA, EMBRAPA, INIAs (Venezuela, Ecuador and Peru), CIAT, U. California (Davis), Cornell University, CIPAV, Farmers' Organizations, and technical assistants.

3) Alternative feeding strategies to improve efficiency and sustainability of small-holder dual purpose cattle production systems in the Andean region of South America. The main objective is to evaluate the potential production of new forage alternatives (grasses, legume, forage-tree) as well as local agricultural byproducts to develop sustainable and efficient milk and beef production systems. Local technologies will also be validated, and resulting innovation alternatives will be socialize among the different stakeholders and local and regional production chains. Biophysical, technological and socio-economical characterization of representative production systems within each country will be conducted to develop indicators for planning and land uses policies. An electronic network will be implemented to share experiences and results, strengthening interactions among different stakeholders working on dual purpose cattle production systems in this region.

Participating stakeholders are: CORPOICA, INIAs of Venezuela, Ecuador, Peru, local and international universities, CIAT, livestock small-holder, and technical assistants.

5. Interaction with other GPPs

At the GFAR/IFAD Workshop on Global Partnership Programmes that took place in Rome the interaction and complementarity between this initiative and other GPPs became evident. There is close interaction that can take place with both the DMC initiative (conservation tillage), and the PROLINNOVA initiative aimed at promoting local innovations. The difference and the specificity of this GPP is the vantage point it takes, since it is specifically aimed at addressing the three main challenges mentioned above in section 1: (a) improving our understanding of tropical agroecosystems' structure, function and dynamics in order to understand better their carrying capacity; (b) the development of integrated cropping systems, mixed production systems and multi-strata production systems that are sustainable in these circumstances; and (c) to restore the production capacity of degraded pastures in tropical savannas on the basis of this new knowledge that is being generated. In this context, conservation tillage and the management of local innovations can be powerful tools in addressing the problems faced by tropical agroecosystems. But this programme builds on such inputs to concretely address the three challenges mentioned above.