


CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH  
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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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To: Directors of National Agricultural Research Programmes  
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(CGIAR)  
Members of the Technical Advisory Committee (TAC)  
Board Chairpersons  
Centre Directors

From:   
John Monyo  
Executive Secretary, TAC

Date: 19 April 1993

Subject: An Ecoregional Approach to Research in the CGIAR

Reference is made to the letter of 26 February 1993 from Dr. Alex McCalla, Chair of the Technical Advisory Committee, and Dr. Hubert Zandstra, Chair of the Centre Directors Committee for Sustainability and Environment (CSE/CDC) which provided a progress report on the TAC/Centre Directors initiative for the implementation of ecoregional approaches. In that letter, they informed you about the activities of the Joint TAC/Centre Directors Working Group which had been commissioned to prepare a document on the ecoregional approach to research in the CGIAR.

On behalf of TAC and the Centre Directors, I am pleased to forward to you a copy of the report of this Working Group entitled "The Ecoregional Approach to Research in the CGIAR". I also attach a copy of both the commentaries of the CGIAR Centre Directors and the Technical Advisory Committee on this report. The report will be discussed at a technical consultation organised by the Special Programme for African Agricultural Research (SPAAR) in Abidjan, Côte d'Ivoire, on 29-30 April 1993, and at a workshop organised by the CGIAR in San Juan, Puerto Rico, on Saturday 29 May 1993.

The Centre Directors and TAC would greatly welcome any comments you have on this paper and its commentaries. Your inputs and the outcome of both the above-mentioned meetings will be considered at TAC 61 which will take place from 28 June to 6 July 1993. The CGIAR will consider TAC's recommendations at International Centres' Week in October 1993.

cc: Dr. Alex McCalla, TAC Chair  
Dr. Hubert Zandstra, Chair, CSE/CDC  
Mr. A. von der Osten, Executive Secretary, CGIAR

**CENTER DIRECTORS' COMMENTARY ON THE REPORT  
OF THE WORKING GROUP  
ON ECOREGIONAL APPROACHES FOR SUSTAINABLE AGRICULTURE**

The Center Directors Committee (CDC) congratulates the Working Group on the quality of its report and acknowledge with thanks the contributions of its principal authors, Drs. Mike Collinson and Guido Gryseels .

Center Directors commend the Working Group for clearly describing a vision for the centers that is motivated by a desire to increase their ability to deal with environmental and natural resource problems. This new outlook seeks to capture more effectively the benefits of participatory research with client countries.

Center Directors acknowledge that the Working Group was itself an experiment, one that brought together divergent views on Natural Resources Management Research (NRMR). Interaction among participating organizations exposed TAC's original ecoregional proposal to the real world realities of developing countries' agriculture and institutions. It also highlighted the somewhat understated extent to which NRMR was already reflected in center programs.

The Working Group benefitted from close interaction with TAC, an experience that demonstrated that more effective center participation is needed in TAC deliberations. The CDC believes that an institutional mechanism is needed to support such participation and that consideration should be given to its establishment.

Specific center comments on the report are as follows:

1. The report presents methods by which TAC's proposed ecoregional approach can be implemented. It does not, however, consider other alternatives that might shift the CGIAR agenda towards a stronger environmental orientation. Center Directors feel that consideration should be given to broadening the environmental mandate of the system, beginning by changing its name to the Consultative Group for International Agricultural and Environmental Research.

2. The document is the result of considerable discussion among Working Group members, but was written by staff of the CG and TAC secretariats. It thus was difficult to accurately reflect Center Directors' views on several important issues. These include priorities, preferences for regional versus global NRMR initiatives, and the feasibility of integrating commodity, factor, and management research with NRMR in particular regions. The task was further complicated by the absence of consensus among Directors on several issues.

3. The report selectively credits centers for their activities in NRMR and their linkages with National Agricultural Research Systems (NARS). For reasons of space, many important center initiatives were ignored. The citations listed in the report should therefore be seen as examples only, even when presented otherwise.

4. TAC's priorities for ecoregionally-based NRMR would benefit from a thorough reassessment. As drafted, they could lead to partial regional and ecological coverage. In addition they do not allow for a grass root response to advancing environmental damage and destructive spill-over effects on adjoining ecologies.

5. TAC's limited number of priority ecoregions will lead to limited coverage and integrated support of NARS. Center Directors believe that TAC's approach may also create orphan regions and may compel the CGIAR to maintain different operational modes in those regions not selected for its ecoregional program. We believe this to be a serious drawback.

6. In most regions, the presence of multiple ecologies will most likely be dealt with by different centers. This is bound to complicate communications with NARS.

7. The document recognizes that bio-physical research on mechanisms and component technologies provides a basis for sustainable agriculture. It gives insufficient emphasis, however, to a continuing need for this type of research either on experimental stations or within farm communities.

8. Several centers are currently addressing global natural resource problems. Integration of these strategic research efforts with ecoregional initiatives may not be efficient. Therefore, Center Directors support the suggestion that existing or new system-wide mechanisms be sought to assure coherence in research on generic and strategic aspects of NRMR.

9. The suggestion that the Center Directors' Committee on Sustainability and Environment be asked to identify and exploit such synergies (as suggested in section 5.4 of the report) is welcome. However, implementation would require the establishment of mechanisms that allow for participation of NARS, donors, and TAC. One possible mechanism would be to authorize IBPGR and the Inter-center Working Group on Plant Genetic Resources (ICWG) to collectively examine biodiversity issues. This might include quantification of inter- and intra-specific diversity in specific ecoregions, and the maintenance, utilization, and monitoring of such diversity under sustainable agricultural production systems. Such a mechanism would allow NARS and NGOs to collaborate with the centers within an ecoregional context. Such collaboration could also be linked to the development of heritage sites and could contribute to ecoregional consortia that might otherwise undervalue the conservation of biodiversity.

10. The centers have insufficient experience working cooperatively on a regional basis. Center Directors feel that what experience does exist should be further analyzed and shared among centers and client institutions.

11. The ecoregional approach, where it combines NRMR initiatives with the integration of support for NARS, should result in a greater concern for participatory research at the institutional and community level. These demands must be reconciled with the desire for centers to emphasize upstream research.

12. The extent to which NARS can contribute to NRMR in a consortium context should not be overestimated. While professional capabilities and infrastructure exists, operational costs would have to be provided through additional funding.

13. There is a need to involve existing sub-regional mechanisms in the governance of ecoregional initiatives. This would include the role of convenors for those institutions that are conducting effective research.

14. Center Directors fear that a sufficiently strong case has not been made for core support to centers for their role in strategic NRMR in an ecoregional or global context.

In spite of these specific observations, the Center Directors believe the report has significantly advanced their understanding of the challenges and options involved in conducting NRMR in an ecoregional context. They wholly subscribe to the organizational principles described in section 5.4:

"Operate on a regional basis, focus on an important agroecological zone with a serious degradation problem, combine natural resources management and production objectives, employ a multidisciplinary approach, include both natural and social sciences, involve national research institutions and other partners in a synergistic way, adopt flexible systems of governance and priority setting, ensure global coherence and flexible funding mechanisms".

Center Directors are convinced that the IARCs can implement these organizational principles in such a way that "pragmatic, non-overlapping" programs will emerge and that programs can effectively address future challenges to sustainable agriculture and food security.

## TAC COMMENTARY ON 'THE ECOREGIONAL APPROACH TO RESEARCH IN THE CGIAR'

TAC is grateful to the Convenor and Members of the TAC/Centre Directors Working Group on the Ecoregional Approach to Research in the CGIAR for their willingness to accept a most difficult and challenging task. The Working Group has produced a useful report that provides valuable insights into the topic and emphasizes the need for more effective approaches to research on sustainable agricultural production. TAC is pleased that the Working Group has endorsed the rationale behind TAC's proposal for an ecoregional approach to research. The report provides general principles for conducting research with an ecoregional perspective and describes what the Working Group terms 'organizational principles' to assist in developing specific ecoregional mechanisms.

TAC accepts the main findings of the report, and recognizes the progress made by the Working Group in sorting out ideas and principles for the implementation of an ecoregional approach. These provide a basis for wider discussions with national programme leaders and the CGIAR so that the broader strategic issues can be developed and clarified. TAC offers the following comments as an input into those further discussions.

### Comments on the Report

Although the report provides general principles for carrying out research within an ecoregional context, it does not provide a complete view of the institutional responsibilities that could be assigned to the CGIAR Centres to facilitate the development of a coherent, System-wide approach.

The report concludes that "no single organizational model will serve the needs of all ecoregions". This conclusion relates to the diversity of Centre mandates, the capabilities of regional organizations and national research systems, and the social and biophysical conditions. TAC accepts this conclusion at this stage in the conceptual development of ecoregional approaches.

As one of its main conclusions, the Working Group states that "owing to the experimental nature of the research methods to be developed by the Working Group, we will have to learn from early experiences both within and outside the System, including those from the field of watershed management, or situations where ecoregional approaches have been used for many years". Again, TAC concurs with this conclusion.

The 'organizational principles' proposed by the Working Group as an aid to developing specific ecoregional activities and mechanisms were listed as follows:

"operate on a regional basis; focus on an important agroecological zone with a serious degradation problem; combine natural resources management and production objectives; employ a multidisciplinary approach; include both

natural and social sciences; involve national research institutions and other partners in a synergistic way; adopt flexible systems of governance and priority setting; and ensure global coherence and flexible funding mechanisms."

TAC is in general agreement with these 'organizational principles', but recognizes that no mechanisms have been proposed for achieving this 'global coherence'.

TAC raises specific questions concerning the report, related to:

- (i) the need to broaden the current agricultural focus of the report in Section 3 to include consideration of the substantial experience available from forestry, watershed management and fisheries research;
- (ii) the desire for greater clarity on how the consortium concept (the preferred mode of operation) differs from other modes of operation such as collaborative research networks;
- (iii) the greater complexity and increased transaction costs of operating with many national, regional and international partners;
- (iv) the increased complexity of incorporating sustainability and equity considerations into collaborative programmes involving national research systems;
- (v) the potential over-emphasis of the suggested approach on the biophysical aspects of sustainability without due regard for the human elements; and
- (vi) the need to introduce, more explicitly, concerns for improving and enhancing the natural resource base.

#### Considerations in Addition to those Contained in the Report

TAC considers that the organizational principles listed by the Working Group need to be supplemented by considerations on operational mechanisms. In particular, TAC makes the following comments.

- The concept of 'agroecological zones' applies primarily to agriculture. The principles need to be extended to include ecological zones that are appropriate for forestry and fisheries.
- There is a need to emphasize that ecoregional initiatives can be driven by concerns about productivity, and not solely by sustainability concerns as might be inferred from the Working Group's principles.

- There is a need for a complementary set of principles and criteria for guiding the allocation of ecoregional and global roles, responsibilities and funding within the System as it moves towards ecoregional research approaches and modalities.
- Consideration of impact must be explicitly incorporated in the operating principles, both as a mechanism for accountability and as a means of learning how to improve the design and implementation of ecoregional initiatives.
- As part of the learning process described by the Working Group, there need to be systematic mechanisms for assessing the efficacy of different modes of operation and organizational structures.
- New review processes will be needed, which simultaneously take into account parts of the work of two or more Centres and consider the work of NARS and other partners.

The report does not probe deeply into the broader principles of defining Centre responsibilities in the context of ecoregional initiatives, as might have been expected from the Working Group's terms of reference. This rationalization is particularly needed for overlaps between commodity and resources management mandates, and between global and regional mandates for particular commodities.

TAC firmly believes that ecoregional initiatives should involve a real change in the basic operations of Centres, rather than merely adding elements to existing programmes. In terms of funding, this means that ecoregional initiatives of the Centres should involve both core activities and core funding. At the same time, consideration should be given to the opportunities for innovative funding mechanisms.

In TAC's view, the ecoregional approach will not be effective without the accumulation of a relevant and integrated pool of knowledge of each designated region and ecological zone. Such knowledge would probably be most useful if vested in a small group of researchers in each ecoregion in which the CGIAR effort is to be concentrated. Such a group would be extremely valuable in helping Centres with global mandates to formulate their research objectives and to sharpen their research priorities. The organizational form that would allow such groups to develop needs more careful consideration.

The Working Group suggested that the Centre Directors Committee might be "the appropriate vehicle to identify convening Centres for priority ecoregions, to reconcile overlapping mandates, and to place responsibilities for regional coordination in the generic activities which have been the other main source of duplication burdening national systems". TAC has reservations about the

appropriateness of the Centre Directors Committee to perform this particular function, and recalls the limited success Centre Directors have had in resolving this type of issue in the past.

### TAC's Suggested Options

Given the Working Group's report and the above comments, TAC suggests that the CGIAR might discuss the following options for implementing the ecoregional approach in the System. In each case, TAC provides its preliminary assessment of the advantages and disadvantages to the System as a whole. The options are not all seen as being mutually exclusive.

#### OPTION 1. The Ad Hoc Option

Centres would continue to develop their own collaborative ecoregional programmes, such as those described in Annex 2 of the Working Group's report.

##### Advantages:

- Centres would build a stronger sense of ownership of the approach;
- there would be no erosion of institutional identity;
- there would be no compelling need to redefine Centre responsibilities;
- it would be flexible and responsive to changing circumstances.

##### Disadvantages:

- there would be no central coordination or governance, and hence no explicit safeguards against duplication of effort and overload on national research systems;
- might not lead to a coherent System-wide plan for implementing the ecoregional approach as set out in Chapter 13 of the TAC 1992 document 'Review of CGIAR Priorities and Strategies', which could lead to competition among Centres, lack of focus on real needs and lower cost-effectiveness.

#### OPTION 2. Coordinated Inter-Centre Model

In this model, the Centre Directors would develop explicit, System-wide mechanisms to avoid duplication of efforts and overload on national partners, as well as to ensure that all relevant production, sustainability and policy considerations were taken into account in a given ecoregion.

##### Advantages:

- there would be no need for additional System governance mechanisms;
- Centres would build a strong sense of ownership of the approach;



- there would be no erosion of institutional identity;
- there would be less chance of duplication of work and overlap in terms of relations with, and demands on, national research systems;
- Centres themselves would assess the need to redefine responsibilities on a System-wide basis.

**Disadvantages:**

- there would be a heavier burden of work and responsibilities on the Centre Directors;
- costs might be higher than in option 1;
- there would be no mechanism to resolve conflicts of interests among Centres.

**OPTION 3. Programme-Funded Model**

Under this model, a limited number of ecoregional initiatives, recommended by TAC, would be funded on a programme basis by the CGIAR. These might become known as 'CGIAR ecoregional programmes' to distinguish them from other initiatives that constitute a normal part of Centre programmes. The programmes would be selected by TAC from the submissions made by Centres in their MTPs. These submissions would be made jointly by the participating Centres indicating their individual contribution. Before endorsing them, TAC could call for modifications related to such considerations as coherence in the overall implementation of the ecoregional approach. Such programmes could be funded by reallocation of resources across Centres, or by seeking to attract new project funding, or by a combination of both.

**Advantages:**

- it would ensure more systematic consideration of ecoregional research priorities;
- it provides a means to test new mechanisms for coordinated funding of inter-Centre activities;
- it could be more cost effective than options 1 and 2;
- it avoids duplication of efforts and monitors the interaction with national systems;
- it might well be possible to begin implementation as part of the current MTP process.

**Disadvantages:**

- it would restrict considerably Centres' freedom to plan and implement ecoregional activities on their own initiative;
- Centres might not develop a strong sense of ownership of the overall ecoregional approach.

#### OPTION 4. System-wide Model

Under this model, TAC and the CGIAR would proceed along the lines proposed in TAC's 1990 paper 'A Possible Expansion of the CGIAR' to redefine Centre responsibilities across the whole System. This would permit a more rational and structured implementation of the ecoregional approach, and would necessitate a much sharper delineation of global and ecoregional responsibilities. To this end, TAC would continue its process of analysis, and propose responsibilities for ecoregional modalities, taking into account the report of the Working Group, Centre planning documents, and the CGIAR medium- and long-term visions of the future.

##### Advantages:

- clear division of responsibilities among Centres;
- a more transparent transition to the System's view of its future;
- a more cohesive vision of priorities for the System.

##### Disadvantages:

- there would be no short-term resolution of the issue of how to introduce ecoregional activities into the System, unless this option was combined with one of the others;
- in a climate of continuing pressure on Centres to adjust to serious funding constraints it could undermine morale and confidence in the System.

#### Conclusions

While TAC is convinced of the need for a strong input into System-wide strategies by the Centre Directors, it is also concerned about leaving the implementation of the ecoregional approach entirely to 'the market'. There needs to be an orderly evolution towards greater coherence and rationalization in the System as a whole, so that the route to the CGIAR's vision of the future is more clearly mapped. TAC sees merit in option 3 while recognizing the longer-term attractiveness of moving towards option 4. Whichever option is adopted, TAC believes that periodic monitoring of progress will be of the utmost importance.

TAC considers that it is important to get the views of the different stakeholders, particularly of national research systems, on the ecoregional approach to research. The implementation of the ecoregional concept is based on a highly participatory process and the early involvement of NARS will be crucial to the success of the ecoregional initiatives.

**THE CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH**

**THE ECOREGIONAL APPROACH TO RESEARCH IN THE CGIAR**

**Report of the TAC/Center Directors Working Group**

**TAC SECRETARIAT**

**FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS**

**March 1993**

## Preface

At the CGIAR Mid-Term Meeting of May 1992 in Istanbul, Turkey, TAC presented its views on ecoregional approaches to research and on priorities for a CGIAR involvement in this area. TAC suggested that the next step would be for CGIAR centers to make proposals on how they intended to incorporate an ecoregional approach to research in their 1994-98 medium-term plans. At the meeting, members of the CGIAR expressed a desire for a mechanism that would assist in developing a coherent CGIAR approach. As a result, TAC and the Center Directors' Committee for Sustainability and Environment (CSE/CDC) worked together to develop such a mechanism.

Under the leadership of Dr. Alex McCalla, the TAC Chair, and Dr. Hubert Zandstra, Chair of CSE/CDC, a Joint TAC/Center Directors Working Group was commissioned to prepare a discussion document in time for the CGIAR Mid-Term Meeting to be held late May 1993. The Working Group was convened by Ambassador Robert Blake of the Committee for Sustainable Agriculture and was composed of individuals from centres, TAC, the TAC and CGIAR Secretariats, and national research and academic institutions. It included disciplines from biological, physical, social and natural sciences. The members of the Working Group were; Michael Arnold, Jacqueline Ashby, Kenneth Cassman, Michael Collinson, Tony Fisher, Louise Fresco, Guido Gryseels, Karl Harmsen, Bob Hart, Krishna Jain and Peter Matlon.

The Working Group used electronic conferencing to explore the methodological and institutional aspects of implementing ecoregional approaches to international agricultural research and, in the process, widened participation to more than 30 contributors. Brian Belcher (University of Minnesota) provided editorial support and Kris Kerrigan from CGNET arranged the communication logistics. The Working Group's terms of reference (Annex 3) and progress were discussed by TAC and Centre Directors during CGIAR International Centres Week in October 1992.

The Working Group met from 2 to 4 February 1993 on the campus of the University of California, Davis to discuss the format and contents of its report. Also present as observers were Alex McCalla, Hubert Zandstra and Rob van den Berg of the Dutch Ministry of Development Cooperation, which has provided financial support to the activities of the Working Group.

After the Davis meeting, individuals from the Working Group prepared draft sections of the report. These were collated by Michael Collinson of the CGIAR Secretariat who circulated subsequent drafts of the chapters and the entire report for comments to the other members. The final editing, production and distribution of the report was done by the TAC Secretariat.

The report will be discussed at TAC 60 in March in Rome, and will be sent for comments to center directors. It will also be distributed to heads of national agricultural research systems and members of the CGIAR. Their reactions and inputs, together with commentaries from TAC and the center directors, will be carefully considered at an Ecoregional Workshop organized by TAC and the Center Directors' Committee, which will be held on Saturday 29 May 1993 in San Juan, Puerto Rico.

# THE ECOREGIONAL APPROACH TO RESEARCH IN THE CGIAR

Report of the TAC/Center Directors Working Group

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# **THE ECOREGIONAL APPROACH TO RESEARCH IN THE CGIAR**

## **Report of the TAC/Center Directors Working Group**

### **1. The Vision: Sustaining Natural Resource Productivity While Increasing Agricultural Production**

In recognition of the urgent need for knowledge to enable sustainable increases in agricultural production and the conservation of natural resources, TAC has proposed an ecoregional approach to focus and coordinate the research skills of the CGIAR in pursuit of this goal. The approach fosters research to relieve constraints at the field, farm, community, land-use system and policy levels. The vision of what is needed must be shared by all the actors involved and therefore the approach also fosters the sharing of responsibilities among collaborating institutions, including donors, International Agricultural Research Centers (IARCs), National Agricultural Research Systems (NARS), non-government organizations (NGOs), private industry and research organizations in developed countries, indeed across the wider global research system. A research approach and the strategy for its organization and implementation are elaborated in the report.

Revolutionary innovations have accelerated the pace of agricultural change during the past thirty years in a race to meet the basic food requirements of a rapidly expanding population. The research system supported by the Consultative Group on International Agricultural Research (CGIAR) was established during this period of change, and the IARCs contributed to the 'green revolution' in partnership with NARS and research institutions around the world. What were experimental cropping systems on research stations in the early 1960s are now the foundation of the food supply for more than four billion people in developing countries.

Looking back, we can distinguish three dimensions of the processes that characterized the green revolution. First, cropping systems were intensified with more crops grown each year, made possible by short-duration, high-yielding cultivars and an extended irrigation period. Second, the use of fertilizers and pesticides increased dramatically in favorable environments. Third, cropping systems became less diverse as farmers specialized in the high-yielding cereal crops in response to economic rewards and government policies. Together, these components of intensification, coupled with expanded areas under irrigation, conferred unprecedented growth in agricultural production and associated economic activities, yet we still know little about their longer-term effects on the land and water resources which are the source of future productive capacity.

Today, the combination of finite natural resources and continued population growth makes it clear that food production systems must further intensify to meet the anticipated increases in food demand. Conservative estimates project the need to double food supplies within the next 25-40 years depending on the rate of population growth and economic development. To sustain production increases of this magnitude will require nothing less than a second green revolution, but without the luxury of a large expansion of irrigated area (perhaps even a contraction in that area), and without further encroachment

on the remnant rain forests, estuaries and wetlands that are needed for the preservation of biodiversity, as refuges for wildlife and in other environmental roles.

Future research must reverse many of the trends in the global condition now being documented with increasing anxiety. For example, soil fertility is mined and the degradation is exacerbated by the loss of nutrients due to erosion of the topsoil. Large areas of irrigated land are threatened by salinity and waterlogging, while additional water for irrigation is becoming limited. Deforestation, estimated by FAO at 15.4 million hectares a year during the last decade, is affecting water supplies and weather patterns as well as aggravating soil erosion and the reduction of biodiversity. The loss of genetic resources through this and other human-induced factors poses a particular threat to agricultural sustainability.

Even the current level of intensification has led to changes in the biophysical resource base of our agricultural systems, which result from complex interactions among chemical, physical and biological components of the agroecosystem. There is a negative impact on productivity, not only in marginal lands where the problems are obvious, but also on the prime lands where recent evidence suggests declining factor productivity due to unknown causes, such as in the continuous irrigated rice systems and the rice-wheat systems of Asia.

The human factors responsible for this degradation are becoming increasingly apparent. High rates of population growth destroy the land and our future capacity to respond to the world's needs. Poverty with poor health and nutrition, insecure land rights, inappropriate policies for land use, prices and taxes, inadequate infrastructure, weak institutions (particularly those servicing the needs of rural communities), and poor education, all threaten sustainable food supply and economic development. Many are the same factors which keep population growth rates high. The challenge, therefore, is to develop food production systems on existing farm land that will double present output levels without degrading the natural resource base on which sustained production depends, without negative effects on environmental quality, and with positive effects on the welfare of rural and urban communities.

When the first IARCs were set up, the strategy adopted was to increase production in the shortest possible time in view of the already critical food shortages in many developing countries. The route taken was the development of shorter-duration varieties with high genetic yield potential to exploit known improved agronomic practices in the bread baskets and rice bowls of the world. It paid rich dividends; green revolution technology helped avert large scale starvation and death. The situation today is dramatically different. With the exception of irrigated rice and wheat, high genetic potential of the major food crops is not, per se, a serious limiting factor, and even in irrigated lands will not, by itself, provide the answer to the challenge of sustainable production. Future productivity increases will require the adoption of more integrated approaches to agricultural production, combining genetic enhancement with the improved management of the natural resource base.

## **2. The CGIAR: Challenges and Responses**

### **2.1 Introduction**

For the CGIAR to meet these challenges, changes in programming and organization that respond both to these changing global circumstances and to past operational inefficiencies are demanded. Two dimensions stand out: to achieve sustainable improvements in agricultural production by balancing commodity improvement research, which is historically dominant in the CGIAR and the basis of its worldwide reputation, with increased research on natural resources management; and to adopt a new spirit of partnership.

Following the Brundtland report in 1987, the CGIAR began to evolve its own sustainability concept. A Technical Advisory Committee (TAC) publication 'Sustainable Agricultural Production: Implications for International Agricultural Research' (TAC 1989) defined sustainability and addressed the major issues. The Center Directors' Sustainability Committee held regional dialogues between the IARCs and the NARS. In 1988, it was proposed that the CGIAR might expand to embrace agroforestry, forestry and fisheries, and to strengthen the Group's capacity for natural resources management research. The TAC paper 'A Possible Expansion of the CGIAR' (September 1990) reviewed ten candidate centers, and by early 1992 five of these had been added to the Group.

The second dimension is to adopt a new spirit of partnership with other research groups, and to design new mechanisms for closer integration across country, regional and international levels, to bring greater coherence and efficiency to the global agricultural research system as a whole. Throughout the history of the CGIAR, TAC papers, Group debates and special task forces have repeatedly addressed two sets of issues at the interface between the IARCs and the NARS. First, the allocation of responsibilities between the two sets of institutions, a dichotomy blurred by diversity in the capabilities of national systems. Second, how to reconcile leadership and creativity in the IARCs with the need for a client-driven research agenda and equality in partnerships. Programming and organizational changes to meet contemporary challenges must resolve these issues.

### **2.2 The TAC Response to the Challenge**

The 1990 TAC expansion paper set out long- and medium-term visions of the CGIAR. In the long term, defined as the time when most national systems are self sustaining, strategic research, with spillover to many countries, will remain a logical focus for global CGIAR activities. The results of this strategic research would be brought to farmers by collaboration with strong regional and national institutions. TAC foresees these future global activities focused more narrowly on germplasm conservation and enhancement, and selected subject matter areas, including policy, management and the maintenance of biodiversity.

In its medium-term vision, TAC sees both global and ecoregional activities as important for the CGIAR and a response to the challenges before the Group. They are, at the same time, a strategy to bring a new balance to international agricultural research to



at the same time, a strategy to bring a new balance to international agricultural research to ensure the sustainable improvement of productivity, and a strategy for gradual transition in the organization of the global agricultural research system to meet future needs and national aspirations.

TAC recognized the inherent appropriateness of the agroecological zone as an organizing framework for research on the physical and biological aspects of the conservation and management of natural resources, including germplasm. In contrast, it recognized that the socioeconomic circumstances shaping such research, and the support needs of national programs, are better differentiated by national and regional boundaries. TAC coined the phrase 'ecoregional' to describe regionally-defined agroecological zones.

A detailed summary of the ecoregional approach to research, as defined by TAC, is given in Annex 1. There are three aspects of the approach:

1. applied and strategic research on the foundations of sustainable production systems in the ecoregion;
2. the improvement of productivity in the ecoregion by drawing in appropriate global research activities; and
3. strengthening of the cooperation with national partners and the development of transnational mechanisms of collaboration.

New modes of operation will be needed for both the implementation of the ecoregional approach and for closer collaboration with other international sources of expertise. These include expertise in the biophysical resource base of the ecoregion, in policy or institution building capacity, and expertise in the improvement of crops, livestock and trees which do or could contribute to the production systems under research. The complexity of the task will demand wider skills than reside in the IARCs, thus the need for wider partnerships, including other international and national institutions. The policy dimension of the approach will require strong political support in participating countries. Consortia of institutions are one possible mechanism for collaboration.

CGIAR success will continue to depend on close working relationships between centers and the NARS on their research targeted to farmers' needs. TAC has remained aware of difficulties persisting in these relationships (many caused by the existence of global and regional mandates for the same commodity at different centers), and of their often one-sided nature. As the CGIAR is restructured, TAC has highlighted the need to rationalize overlapping center mandates, resolve the duplication of efforts in capacity building and modify IARC-dominated planning processes, all of which have aggravated relationships and overburdened weaker NARS. Such rationalization will bring greater effectiveness and efficiency to the global research system.

In the transition from the medium to long term and as national systems become stronger, CGIAR ecoregional activities will be progressively replaced by work in national programmes and transnational networks. As regional entities take on a greater share of responsibility, the winding down of its ecoregional initiatives will leave the CGIAR as a

set of global activities, justified by the wide spillover of results throughout the developing world. The nature and pace of such change would depend on a strengthened political commitment to research in the developing countries, and to cooperation between the countries of a region. Such commitment will grow from a better understanding of the importance of new agricultural technology to human survival and development, and of the benefits of transnational collaboration in agricultural research.

### 2.3 IARC Responses to the Challenge

The IARCs have responded strongly to the CGIAR debate on sustainability issues. Several centers are in the planning stages, and some in the implementation stages, of wholly new initiatives modelled around the natural resources management dimension of the ecoregional approach described by TAC. These centers are adopting consortia, including NARS, IARCs and other institutions, as the operational vehicles for their initiatives. The outlines of current IARC plans and activities are set out in Annex 2 and a brief overview is presented below.

In 1990, CIAT proposed an integrated germplasm improvement and resource management research strategy in three agroecosystems in Latin America and the Caribbean: the cleared forest margins, the mid-altitude hillsides and the savannas with acid soils. During 1994-98, CIMMYT will continue an ecoregional program in the rice-wheat cropping systems of south Asia, in collaboration with IRRI, and has proposed a second, in collaboration with CIAT, in a hillside maize-based cropping system in Central America. CIP is planning to assume a coordinating role for research to manage natural resources in the cool tropical hillsides of the Andes. ICRAF is coordinating an initiative on the integrated natural resources management research for the highlands of eastern and central Africa, with four other IARCs and all the NARS in the region as partners. ICRAF is also the global coordinator of a six-center consortium which is planning the 'Alternatives to Slash and Burn' Program which recently received a first tranche of funds from the Global Environmental Fund (GEF). It proposes research sites in Africa (coordinated in Cameroon by IITA and in Zambia by ICRAF), in Latin America (coordinated by CIAT), and in Asia (coordinated by IRRI).

Several centers have already adjusted their internal organization to better attack the challenge. IITA, ICRAF and CIAT have recently changed their program structures to ones which marry commodity research to the search for sustainable use of the resource base. IITA has been carrying out research on agroecological zones since its establishment, including breeding for those zones. In 1989/90, IITA amalgamated its commodity programs under a single director and established agroecological zone-based working groups, with permanent staff, as an interface to its programs. More recently, ICRAF has articulated a research process which integrates the activities of its four research programs. Within this process, scientists can identify roles for themselves, their program and their colleagues from collaborating institutes. It highlights interdependency for successful outcomes. CIAT has moved in a similar direction: it has built three programs based on important land-use systems in Central and Latin America, each serviced by an umbrella land-use program and by parts of its ongoing commodity improvement programs.

It is not only the centers with natural resources management mandates which have taken up the challenge. Faced with yield erosion in intensively-farmed irrigated rice systems, IRRI has restructured its programs to address the major rice production systems of Asia. CIMMYT reorganized its global germplasm programs in a 'mega-environment' framework in 1988. IBPGR has used an ecoregional approach in planning its own research and uses networks to ensure that crop diversity is available in the search for sustainability. The Inter-Center Working Group on Plant Genetic Resources is one of the few initiatives towards CGIAR-wide coherence on a global issue. IFPRI has established a new program to consider the complex of issues including technology, property rights and communal action, policy, and poverty that affect natural resources management. The program is already under heavy demand for a policy input from consortia for ecoregional initiatives throughout the CGIAR.

#### 2.4 The Need for CGIAR Coherence

CGIAR stakeholders have criticized centers for duplication, and for a failure to exploit complementarities between them. Donors believe that the IARCs need to collaborate more in order to reduce costs, increase efficiency, achieve greater synergies, and to reduce confusion among national systems. They will see the new collaborative initiatives as a move in the right direction.

The current scarcity of funds emphasizes the need for the CGIAR to coordinate across consortia. Competition among centers for funding from new pockets, or for 'territory' will increase duplication and inhibit collaboration. In ecoregional initiatives, only the coordination of site selection and research methods will allow the CGIAR to bring its research experiences to bear on problems with truly global dimensions. The 'Alternatives to Slash and Burn' initiative represents a promising example of new coherence among the IARCs.

If the call for improved collaboration among centers is increasingly audible, the call for improvement in collaboration with NARS has reached deafening levels. National systems are partners in the IARC initiatives in natural resources management research, which in some cases also include other national institutions, both official at the policy level, and NGO or farmers' associations at the grassroots level. Yet the current IARC initiatives do not seem to extend beyond their immediate interest in the ecoregion into the rationalization of the wider interactions with NARS to reduce the weight of collaboration where this is a burden. This is a particular need for those weaker NARS still requiring strong support for capacity building. It is a dimension which has yet to be fully addressed by the centers and another example where the experiences of some centers might be valuable to the system as a whole.

Since the CGIAR was established, the capacities of many NARS have improved significantly (though not all, some have indeed regressed). The CGIAR has made a substantial contribution to this improvement but its methods in working with NARS have not evolved at the same pace, and the benefits of full complementarity in research agendas are being lost.

The historical problems of relations between IARCs and NARS have stemmed from the same sources as the weak collaboration between centers. Overlapping mandates and the duplication of efforts from competition between centers have created a workload for NARS which some manage only at a high cost in scarce personnel. One example is that many IARC-driven networks still employ a 'central source' structure, with policies, direction, and flows of information and technology emanating from the center to participating NARS at the periphery. Only recently have NARS themselves begun to take more active decision making and management roles in the networks. Similarly, many one-on-one IARC/NARS initiatives continue to forego the advantages of an integrated research effort across the countries of a region. There is also duplication among NARS at a time when funds and human resources are critically scarce, thus, also at the NARS level, the opportunities for coordinated programs and technical spillover are rarely exploited.

A new spirit of partnership, animating CGIAR initiatives, will contribute to a rational and acceptable allocation of research responsibilities and resources at national, regional and international levels. This, and a greater client influence on research agendas, will be prerequisites for realizing the longer-term TAC vision of the CGIAR: a set of global activities bringing its products to farmers through collaboration with regional and national institutions.

### **3. Towards a Research Model for Sustainable Agricultural Production**

#### **3.1 Introduction**

One important new set of activities within the ecoregional approach is the integration of commodity improvement and natural resources management research to achieve sustainable increases in food production. As elaborated in the introduction to this report, the increased attention to sustainability stems from three related needs: to significantly increase agricultural production to meet the demands of a growing world population; to arrest the increasingly obvious degradation of the resource base; and to check deterioration in the quality of the environment.

Historically, a commodity model has dominated international and national research efforts, both in the NARS and in the IARCs. In the past 20 years, however, systems thinking has played a larger role in agricultural research. The CGIAR has contributed much to this trend and has a considerable history of experimentation with systems-based research models. TAC has made a convincing case that natural resources management is a function of higher level systems than the commodity. The dual role seen for farming systems in both raising productivity and husbanding resources is expressed in an extract from TAC (1991, 'An Ecoregional Approach to Research in the CGIAR', page 13):

"Farmers produce by managing their resources in ways they find attractive and feasible for their farming systems. The plant varieties and animal breeds, the techniques used in their production and the soil and water management practices are the component

tools for wider resource management. As components they are necessarily shaped by criteria important to the productivity of the whole farm system and to farmers' perceptions and priorities, especially in relation to issues such as risk of crop failure. The successful amendment of soil and water and other ecological processes to achieve sustainability depends on the identification of new materials and management techniques for the components that also improve system productivity."

TAC now sees commodity improvement, both the manipulation of the germplasm and its management in the field, as a tool for resource management. TAC has also recognized that land degradation and the reduction of environmental quality are results of human interaction with the natural resource base, and that the human issues need research in parallel with the physical and biological problems.

As yet, there is no accepted research model which embraces the physical, biological and human dimensions of long-term sustainability. Developing such a model is a goal of truly international importance. It has to be acknowledged, however, that the process of model development is itself research and, as such, will include failures.

### **3.2 Research Approach for the Sustainable Improvement of Production**

As noted earlier, centers' experiences with systems-based research approaches have created a store of knowledge across the CGIAR. Now is the time to exploit this capital in a coordinated, effective way.

The reason for widening the research approach to the higher systems at the farm, agroecosystem, community and national policy levels is to enhance understanding of the interactions between people and the natural resource base. These higher-level systems include a much wider range of parameters; physical, biological and human, and the interactions within them are vastly more complex than the lower-level systems; the crop, the plant and the gene, engaged by the traditional commodity model. The corollary of this need to understand higher-level systems is that both the manifestations of the degradation problem and the options for its solution are location-specific. The model must be based on research at local sites. Yet a full understanding of the influence of the physical and human systems that extend beyond the site, but that influence the situation at the site, will be crucial to success. The research approach must understand the natural circumstances of the agroecological zone, the economic circumstances of national policy, and the production system influenced by both of these. From that understanding, it will focus on parameters central to natural resources management and productivity issues, and research on these will need appropriate tools for the development of mitigation strategies and improved technologies.

GIS (Geographical Information Systems) and databases will be important to identify agroecological zone boundaries and the different natural resource niches within these, and to characterize the production systems and populations that control them. Such analyses will provide the basis for site selection and for subsequent extrapolation of site results. At the level of the resource niche exploited by discrete farming systems, cropping systems and plant communities, there is a need to develop new methods that link the performance of the agroecosystem with physical, biological and socioeconomic attributes.

To achieve this objective, monitoring studies of system performance will be required, which generate 'minimum data sets' for use in simulation models to predict and extend the information beyond the site under study. Classical reductionist experimentation will come into its own at the component level, with laboratory techniques and biotechnology important at the soil, pest, plant and gene levels. Modelling techniques, both descriptive and quantitative, will be needed to integrate knowledge of processes and mechanisms at the different levels, to identify constraints and to test and extrapolate eventual solutions.

Research outputs will be evaluated at their own level in the hierarchy, and aggregated to assess their impact on higher system levels. Results will provide technologies for farmers, and suggest changes in policies and in community rules that foster conservation of the natural resource base and improved productivity in the production systems represented by the research sites. Strategic research at the sites will improve understanding of climate, soil, water and biology, and of the germplasm characteristics required for 'sustainability breeding'. These results will be useful throughout the agroecological zone of which the ecoregion is a part. Finally, experience in the approach and methods at each site will contribute to a global model for research and development in the sustainable improvement of production. This will include a better understanding of the intergenerational problems of resource-poor communities, and of the links needed for policy formulation and for mobilization of enabling institutions to acquire leverage on these problems.

### 3.3 Research Priorities and the Identification of Ecoregional Sites

It has been noted earlier that the process of model development is itself research and, as such, will include failures. This, as well as the current shortage of funds, demands CGIAR-wide coherence in the development of new research models and the careful and collaborative planning of the location of initiatives.

In its 1992 paper 'Review of CGIAR Priorities and Strategies' (Chapter 13), TAC identified six ecoregional programs as being particularly justified: two in sub-Saharan Africa, one in West Asia and North Africa, two in Asia and one in Latin America and the Caribbean. In arriving at these priorities, TAC weighed a range of criteria which included the increasing pressure of population, continuing dependence on agriculture and the rate of resource degradation, and the strength of national programs. TAC also considered the importance of particular commodities and the comparative advantage of the CGIAR in each ecoregion. These are broad priorities. They indicate that sites located in these ecoregions will potentially benefit large numbers of farmers and consumers. Identifying specific sites remains a formidable challenge since broad ecoregions contain a diversity of local situations. Clearly, sites chosen must feature the problems which the ecoregional approach is designed to address and must be based on a consensus among collaborating partners. There is the need to study the production systems under pressure within the ecoregion and prioritize the need for research on the basis of clear criteria. The use of GIS and databases and local knowledge will be important tools in this process.

The question of how far sites should be replicated and how far they should sample diversity in local circumstances to widen understanding, is a difficult one. Within an agroecological zone, even within a production system, communities' circumstances vary

enormously; soils change, population densities differ widely due to a variety of reasons, for example, proximity to infrastructure or urban markets. Replication within the site will be important for many aspects of the work. One principle to apply in site selection is that experiences of communities under dense population pressure, unless distorted by a uniqueness in their location, are relevant to an ever-widening number of communities as populations continue to grow and human pressures increase. Extremes, as long as they are not atypical for the future, have a clearer tale to tell.

### 3.4 The Research Approach at a Local Site

Within sites, initial research will seek to understand physical and biological processes in the resource base on the one hand, and economic and social circumstances underpinning farmer decision making on the other.

Understanding of the physical hierarchy will start from a land-use unit and identify the range of resource niches (a land area with a discrete set of characteristics including its thermal regime, water availability, soil type, slope, and aspect) that the terrain offers for farming. Diagnosis will determine what these resource systems are being used for by the community and farm households, how land and water are being managed in each, and how households coordinate their use of the different resource systems within their production system. At the same time, the biological resources available will be inventoried to determine the options these offer for research and development. Diagnosis will move down to field and enterprise (crop or animal) level, again identifying the way in which climate and soil in the field are used and managed in the production process and how the available plant and animal diversity is mobilized and maintained. Diagnosis uses both survey and experimental methods to identify and understand causal factors at each system level. The required techniques narrow as the likely causes of the degradation problem are brought into focus. Measurement for example, of the rates of change of key parameters that govern productivity and the quality of the natural resource base then becomes important.

At each level, three facets of the interaction between the resource base and human management will be important for understanding the causes of problems:

- the mechanical, chemical and biological consequences for the resource base of the management practices in use;
- evidence of degradation and the practices (or lack of practices) causing this;
- evidence of externalities; identifying when practices at one level of the hierarchy, for instance the field, bring degradation at a higher level, for instance the watershed.

Parallel to this, is the diagnosis of the human hierarchy, which seeks to understand how the production environment which farmers face influences what they produce and how they produce it. It also begins to clarify how decisions from the community level influence farmer behavior, and how decisions from national policy and institutional levels influence both community and farmer behavior. The production environment is made up

of the opportunities and risks presented by the climate and the markets that farmers have to manage, on the one hand, and the natural resource base and service institutions farmers can access on the other. Community customs and rules, and national policies play significant roles in changing these opportunities and in controlling farmers' access to markets, to the local resource base and to service institutions. Understanding how the community and national level systems impinge on household decision making is a prerequisite to understanding farmers' current priorities, management strategies and production decisions, and, importantly, to understanding how to influence these.

Resource degradation and its likely causes will be identified at several levels of the physical hierarchy and will often lead back, through a causal chain, to human factors. Options for arresting degradation will range from changes in policy, institutional organization and community custom, to new technologies, both materials and management practices, for use by farmers. Not all will be discrete options. Policy measures to change farmers incentives will be needed to mobilize technologies which will restore natural resources as well as increase productivity.

Understanding both physical and human hierarchies is the starting point for researching solutions; for an inventory of relevant technologies available either from farmer practice in other systems or from earlier research, for specifying new research thrusts and, in turn, for identifying the research skills needed to implement the new research. Ideas for solutions, and for research on improved solutions, will be evaluated by criteria such as:

- the potential to restore and enhance the resource base,
- the potential to increase productivity,
- compatibility with the existing production system, and
- amenability to influence by community, institutional and policy decisions.

The evaluation will identify a research and development agenda for the site. Fuller understanding of physical and biological processes central to sustainable improvements in productivity or socioeconomic processes vital to farmers' decisions will require special strategic research initiatives. These will aim to establish and model relationships between processes in agroecosystems and environmental and socioeconomic conditions. These models will be calibrated and validated using datasets from benchmark sites. Once models have been tested, the results can be extrapolated to other environments using GIS.

This longer-term research will be paralleled by the immediate adaptation and mobilization of appropriate technologies already available, and by new applied research thrusts to generate improved technologies for further intervention in the near future. Strategic research questions will require classical research skills in climate, soils and biology, both crop- and factor-related, as well as in social science. These will have to be drawn from national institutions, including universities, the IARCs and other appropriate advanced institutions. The duration of commitment required for strategic research at these sites has led the Working Group to encourage the idea of 'Heritage Sites for Natural Resource Research'.



Applied research thrusts will be implemented under controlled conditions both on the station and on farmers fields within the site. National expertise will often need supplementing, again from the IARCs and other international centers. Adaptive research will follow a systems-based on-farm research approach using participatory methods to bring the ownership of the research and development process to the local community. Adaptive work is logically the responsibility of national institutions; the NARS, local NGOs involved in community-based initiatives and farmers' associations. Again, because many national research institutions have developed a more applied than adaptive research capacity, there will often be an initial need for the IARCs to supplement national efforts and to build local capacity for adaptive research in the course of the program.

### **3.5 Conclusions**

New ecoregional initiatives will build on the ideas drawn from past experiences in evolving models for research into the sustainable improvement of productivity. The Working Group cautions against premature limitations on the type of centers' responses. Variety among early ecoregional initiatives will be a learning experience from which improved models will evolve.

It is clear that geographical organization will be a key dimension of any model. Field sites will probably be based on a major land-use unit as a research domain, and replicated in a production system within the ecoregion. In a vertical dimension, three human decision-making levels will be important to models because of their influence on what happens to natural resources; the farm household, the community, and the wider enabling and policy-making institutions. A major land-use unit is perhaps the smallest spatial scale on which the interactions between natural resources and human decisions can be identified as causes of degradation. Changes initiated at the three decision-making levels can mobilize technologies and stimulate community action and policy revisions to implement solutions.

## **4. Operational Mechanisms for the Ecoregional Approach**

### **4.1 Introduction**

The ecoregional approach is also a strategy for gradual transition in the organization of the whole global agricultural research system, beyond the CGIAR, to meet future needs and national aspirations. TAC timescales for devolution are long but the Working Group sees the direction as clear and appropriate. Yet the urgency of the land-degradation and biodiversity issues, the desire of the donors for greater efficiency and new directions in the CGIAR, and the rapid responses by the centers have brought vigorous change. Although a fast pace is already a reality, immediate short-term arrangements should be shaped by keeping long-term goals in clear view.

The CGIAR needs mechanisms (and TAC itself places emphasis on mechanisms rather than new centers) that will stimulate dynamic and equitable partnerships, mobilize a novel research model for sustainable improvement in production and natural resources

management, and bring system-wide synergies. The Working Group has two main operational conclusions: First greater national and regional responsibility for the global agricultural research system must find its roots as soon as possible in more collegial partnerships and in greater sense of national participation in collaborative responsibilities. Second, the experimental nature of the research model, and of the organization of its implementation, demands that we learn from early experiences. The scarcity of funds means that experiments must be efficient, and must be seen to bring solutions to important global problems of resource and environmental degradation. Ad hoc initiatives risk exacerbating the old problems of overlapping mandates, duplication of efforts and competition for resources. The ecoregional approach offers a starting point for new collaborative principles.

#### 4.2 Guiding Principles and Mechanisms for Collaboration

At least three principles should guide CGIAR centers in implementing the ecoregional approach and in their interactions with the national level of the global agricultural research system.

- Improved efficiency in the CGIAR and the wider global system. By reducing duplication among global system partners, through effecting greater complementarity to research efforts and by efficient task allocations based on the principle of institutional comparative advantage, the CGIAR and the global system will stimulate a greater spillover of benefits.
- Greater participation and transparency in decision making. Equal partnerships will reduce perceptions of conflicts of interest held by some national institutions, both NARS and NGOs, and stimulate their commitment to collaborative programs.
- Mobilization of additional resources. Open and flexible organizational mechanisms to identify, attract, focus and facilitate the efforts of collaborators to work together on jointly-defined problems will increase donor confidence and open up new sources of funds.

The new mechanism adopted by the centers to implement ecoregional initiatives is the consortium, defined as a partnership of diverse institutions to create critical mass and jointly plan and implement an integrated research program of common interest.

Characteristics found among existing consortia which deserve consideration include:

- Institutional Openness. Membership is open to all institutions that can contribute to and benefit from research collaboration.
- Administrative Leadership. Formation has been catalysed and supported by at least one IARC which has provided seed money to support early review and planning activities. An early step in implementation has often been a steering committee for priority setting, further fund raising and task allocation.
- Financial Support. Planning, research and review activities are either funded from the budgets of collaborating institutions or through supplementary funding provided

through a special consortium mechanism. Fund allocations are made on a joint basis consistent with responsibilities.

- Problem Identification. The research problems to be addressed are identified and prioritized in a joint planning exercise.
- Allocation of Research Tasks. The relative capacities of consortium members to address identified problems are jointly and critically examined. Specific research responsibilities are assigned to each on the basis of institutional comparative advantage.

Organizational challenges lie not only in the need for new mechanisms but equally in the need for a new style in their operation. Clearly, leadership and initiative are imperative for success, but both are compatible with partnership when all the collaborating institutions identify with the problem, and each brings unique advantages to its solution. The key to operational success is leadership which allows partners to feel shared ownership of the initiative and does not frustrate the NARS by an obvious imbalance in available resources.

These attributes are already in evidence in some collaborative activities with the NARS: CIP's networks and CIAT's African Bean Steering Committees, have long been recognized as client-driven. ICRAF's Agroforestry Research and Education Networks for Africa (AFRENAs) with their national and regional steering committees, are more recent examples. In the last year or two, some IARCs have responded to criticism by proposing a restructuring of NARS/IARC relationships based on region-wide partnerships, for example, WARDA's Task Forces. Their goal is a cost-effective means of generating and transferring technologies through transnational collaboration across an entire region.

The guiding principles of efficiency and participation recognize the need for integrated work and an acceptable leadership style, both to underpin the ecoregional approach and to guide reorganization of the relations between IARCs and NARS. The Working Group suggests that the program-based consortium mechanism can provide a flexible vehicle to reinvigorate the CGIAR system and to link its ecoregional and global activities with country and regional needs. If a positive effort is made to involve the islands of excellence in strategic and applied research at existing national institutions, consortia membership can also raise the morale of national scientists, enable their professional advancement, and provide them with experience to manage wider responsibilities as they devolve to national and regional organizations.

#### **4.3 Implementing the Ecoregional Approach: Local Organization**

The causes of resource degradation are unique to particular local circumstances and particular farming systems and production opportunities offer unique paths to solutions. It is clear that the success of the work at field sites will be crucial to overall success and heavily dependent on national commitment to partnership; by bodies at the national policy level, by the local community and its leaders, and by local households. Such commitment is best earned through shared ownership of the initiative by the national agencies.

To get the process started, the Working Group envisages agreement on a convening center, normally located in the ecoregion and with a sound knowledge of the institutions of the countries it touches. It may or may not become the research leader. With systems concepts driving the research approach, centers and institutes mandated to commodities and factors with a major presence in the ecoregion are obvious candidates as consortium partners. Early diagnostic work bringing a closer understanding of the problem will be important in finalizing membership. The need to integrate the activities of a number of international collaborators at in-country sites requires innovative thinking on country agreements. Many centers lack legal agreements with potential host countries. Other centers with these agreements find that they cannot readily host staff from other centers. Group-level help, from the CGIAR Chair or cosponsors, may be required to persuade host governments to extend center agreements to staff of collaborating organizations for the purpose of ecoregional initiatives.

#### 4.4 Building Coherence and Synergy

We have noted that site results should be useful at three levels: the local production system, the agroecological zone, and the international or global level. To make efficient use of the heavy investments in consortia and site development, results must be aggregated and used effectively at each level. This demands collaboration in planning, implementation and assessment to capture the synergies from cross-site experiences.

Coherence at sites within a country is a top priority. Implementation will include institutions covering all the operational dimensions important to success: policy and enabling institutions from the national level, the local research station, and NGOs or local associations from the community level. Although the crop improvement centers have traditionally interfaced with NARS, the environmental and cross-sectoral dimensions of the resource-degradation problem will carry collaboration to a wider range of national ministries. The national steering committee mechanism used effectively by ICRAF, and 'umbrella planning' through the Prime Ministers Office or the Economic Planning Ministry, used by ICLARM in its Coastal Area Management Program, offer important learning experiences here.

At the ecoregional level, the consortium will have several countries as members. Care will be needed to ensure representation at this level is agreed among the national institutions active at country sites. Again, the experience of centers with regional and network steering committees is pertinent. The promotion of transnational collaboration and high-level commitment and the incremental devolution of responsibilities to the region will be an important role for an ecoregional level steering committee. The dissemination of results, and training and networking on the organization and implementation of the research approach, will be most appropriately managed from this level.

Beyond the ecoregion, at the agroecological zone, regional and global levels, there is the need for a mechanism to exploit synergies. Results from different ecoregions will accumulate an understanding of climate, soils, water and biological interactions for the agroecology as a whole, and contribute to the evolution of a global research model. This requires coordination in the mandates, research approach and methods used across

ecoregional consortia. ICRAF's successful leadership of the 'Alternatives to Slash and Burn' Program, though a global rather than an ecoregional construction, has useful lessons here. It was planned by a global steering committee with representatives from sixteen institutions. Any such committee should have a continuing role for coherence in implementation and comparability in results. It will be important that ecoregional initiatives are seen to address globally acknowledged problems. These include water- and nutrient-use efficiency, soil loss, biodiversity, reduction of agriculturally-derived toxins in the environment and the impact of climate change. The initial success of the slash and burn proposal suggests the value of known terminology as a global platform to capture the imagination of the international community.

#### **4.5 Towards Regional Coherence: The Wider IARC/NARS Interface**

The report has emphasized a sense of national ownership of the ecoregional initiatives as vital to their success. However, these initiatives will reach only a limited number of countries and, by their nature, will touch only parts of those countries. As reported earlier, there are a wider range of activities with NARS which, historically, have overburdened the smaller, less-organized NARS, and need to be coordinated across centers.

Of prime importance in this area are the less-specialized training activities. Training in farming-systems diagnosis, on-farm research and experiment station management, for example, are generic activities which, historically, have been undertaken independently by several centers in the same region but deserve regional coordination. New topics, such as the use of GIS and research approaches in biotechnology, will be important for the future. Similarly, germplasm testing has often been organized independently by centers in a number of countries in the same agroecological zone. Agreed zonal testing in close association with heritage research sites of ecoregional initiatives may be more cost effective and will give greater clarity of germplasm by environment interactions and better extrapolation possibilities.

The goals of improving CGIAR efficiency, reducing burdens on national institutions and evolving mechanisms for regional responsibility mean that national participation and the guiding principles set out for the ecoregional mechanism are equally relevant at this wider interface. As in the case of ecoregional mechanisms, a locally-based IARC, knowing the region and its institutions, has a clear advantage for the organizing of regional initiatives and their associated steering committees. As in the case of the ecoregional initiatives, such a center might act as a convener or carry the leadership of the committees. Such committees will assist centers in coordinating ecoregional and other IARC activities in the region. A range of topics may be more efficiently networked across a region through a single mechanism which could eventually form the foundation for wider and more permanent transnational collaboration. The Working Group emphasizes that research agendas and the roles for different partners will be decided by consensus with particular weight to be given to the views of national collaborators.

#### 4.6 Funding and Accountability: Some Implications and Options

It is clear that the complex of research activities required at each site will be costly. It is also clear that donors prefer short horizons with highly-visible results. The fact that a major dimension of ecoregional research will be seeking to guarantee future production by maintaining the resource base intact, rather than raising production in the short term, will add to its expense. The research approach detailed in section 3.4 will provide short-term impact by taking up technologies already available to address the key constraints. Acquiring a fuller understanding of natural processes to design more effective technologies will take more time.

The normal external review process will evaluate the relevance of each consortium against the mission and goals of the center and the CGIAR, and assess the effectiveness of the center's contribution to the consortium program. Obviously, clear milestones towards the longer-term objectives will be important. The budget and review process will treat consortia in the same way that the older links with clients and partners have been treated, from the perspective of the role of the centers in the global agricultural research system.

Initiatives in the ecoregional approach now in the process of implementation draw on core, restricted-core and extra-core funding. As described, several centers have restructured their core programs to initiate ecoregionally-based initiatives. Some funding for new ecoregional initiatives will appear in centers' 1994-98 medium-term plans and be dealt with by the normal CGIAR budget process. New funding identified during the period to 1998 will probably be consolidated into budgets in the next round of planning.

Donors appear uncertain as to how to deal with ecoregional initiatives, and are proving cautious in their support. The Working Group feels that they should fully endorse the goals and mechanisms for the ecoregional approach, and make funding commitments long enough to build the confidence to encourage partners to collaborative planning. To allow an effective response to Agenda 21, and place the CGIAR in a position to capitalize on its unique capability to deal with the issue of sustainable resource use for future needs from agriculture, donors need to support individual consortium from grants over and above their CGIAR core contributions. CGIAR members might help centers seek domestic sources of funds outside agricultural research, particularly from those sources directed at Agenda 21 objectives. Consortia may have to be presented as discrete programs for funding to those donor sources identified as interested. The narrow, specific mandate of the GEF needs to be more easily accessible to the CGIAR system to support its increased environmental initiatives.

The contributions of the NARS to past collaborative work with the CGIAR centers must be acknowledged. It must also be acknowledged that much of the friction between IARCs and NARS is generated by the differences in the levels of resources enjoyed by their scientists. In collaborative research programs, the resulting dependency is demoralizing for the NARS. Again, in the ecoregional initiatives, the NARS will be a major contributor of staff, sites and facilities. Bilateral donors might enlarge their perspectives to ensure that bilateral support programs and consortia plans are in harmony and permit funds targeted to national programs to be used for activities designed to achieve extra-national impacts. Both bilateral and multilateral donors need to provide

flexible blocks of funds for allocation to national programs in support of consortium related activities. It had been suggested that individual countries may be a driving force to seek funding for a regionally-based effort. However, the costs of mobilizing bilateral funding to implement a coherent regional research program suggest that this is impractical.

It is possible that the success of changes in CGIAR operational mechanisms and the expansion of transnational collaboration in research will depend on innovation in donor funding mechanisms.

## **5. IARC Plans Revisited**

### **5.1 Introduction**

As indicated earlier, it is hoped that the systematic implementation of an ecoregional approach to research will bring a more effective focus to the sustainable improvement of production, and greater coherence and synergy to the whole global agricultural research system through new partnerships, particularly with national institutions, but also through strengthening the collaborative bridge with institutions in Europe, North America and Asia. TAC and the CGIAR need a clear conceptual framework and a set of guiding principles to ensure that the ecoregional approach is implemented in a coherent, synergistic fashion. This Report has attempted to expand the framework set out by TAC and to provide guiding principles for implementation. This final section of the report takes stock of center responses to the ecoregional initiative in the light of these principles.

### **5.2 Center Coverage of the Main Ecoregions**

Table 1 shows current center activities by agroecological zone and by region, and identifies those centers with their headquarters, or a substantial station, in each zone. Not all of these centers plan their research in an agroecological zone framework but all work on factors, land-use or land-management systems, commodities or subject matter important to the countries within the zone. Centers listed in Table 1 would be the logical consortium members for the particular ecoregions, together with national program partners and other major actors (such as French research agencies in sub-Saharan Africa or Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE) in Latin America). Some regions already have regional research organizations (such as the South African Center for Cooperation in Agricultural Research (SACCAR) in Southern Africa, Institut du Sahel (INSAH) in West Africa, and the Inter-American Institute for Cooperation on Agriculture (IICA) in Latin America) which would play a strong role, given the ultimate aim of devolution.

Table 1: An Overview of CGIAR Activities by Centre, Agroecological Zone and Region

	SSA	WANA	Asia	LAC
Warm arid and semi-arid tropics and sub-tropics with summer rainfall (AEZs 1 + 5)	ICRAF <u>ICRISAT</u> IIMI IITA ILCA WARDA		<u>CIMMYT</u> <u>ICRISAT</u> IIMI IRRI	
Warm sub-humid tropics and sub-tropics with summer rainfall (AEZs 2 + 6)	<b>CIMMYT</b> <b>CIP</b> <b>ICLARM</b> <b>ICRAF</b> <b>ICRISAT</b> <b>IITA</b> <b>ILCA</b> <b>ILRAD</b> <b>IRRI</b> <b>WARDA</b>		<b>CIMMYT</b> <b>ICRAF</b> <b>ICRISAT</b> <b>IIMI</b> <b>IRRI</b>	<b>CIAT</b> <b>CIMMYT</b> <b>ICRAF</b>
Warm humid tropics and sub-tropics with summer rainfall (AEZs 3 + 7)	<b>ICLARM</b> <b>ICRAF</b> <b>IITA</b> <b>ILCA</b> <b>ILRAD</b> <b>IRRI</b> <b>WARDA</b>		<b>CIP</b> <b>ICLARM</b> <b>ICRAF</b> <b>IIMI</b> <b>IRRI</b>	<b>CIAT</b> <b>CIMMYT</b> <b>ICRAF</b>
Cool tropics and sub-tropics with summer rainfall (AEZs 4 + 8)	<b>CIAT</b> <b>CIMMYT</b> <b>CIP</b> <b>ICARDA</b> <b>ICRAF</b> <b>ILCA</b> <b>ILRAD</b>			<b>CIAT</b> <b>CIMMYT</b> <b>CIP</b> <b>ICRAF</b>
Cool sub-tropics with winter rainfall (AEZ 9)		<b>CIMMYT</b> <b>CIP</b> <b>ICARDA</b> <b>ICRISAT</b> <b>IIMI</b> <b>IRRI</b>		

- Not including activities of IBPGR (genetic resources), IFPRI (policy) and ISNAR (institution building).
- Double lines and bold lines indicate a priority ecoregion as defined by TAC. Dotted lines indicate that it is not a priority ecoregion but justifiable if an inter-regional mechanism is possible and if opportunities exist to institutionally combine the programme with other mechanisms.
- Centres underlined have their headquarters or major infrastructural facilities in this particular ecoregion.



All major ecoregions given priority by TAC have a number of active IARCs. Areas such as the subhumid tropics and subtropics in sub-Saharan Africa and Asia do not have a resident center as a 'natural convener' for initiatives. These are the areas with the greatest danger of overlapping responsibilities and duplication in their relations with national institutes. In West Africa, there may be overlaps in mandates and responsibilities between ICRISAT and IITA, between IITA and WARDA, and between CIMMYT and IITA. IITA's proposed expansion of responsibilities to East and southern Africa, as outlined in its draft medium-term plan, has the potential to increase overlap. There is also a potential risk of duplication between ILCA's activities in the Ethiopian highlands and ICRAF's proposal for the eastern and central African highlands, though planning activities appear to be collaborative and the centers involved seem willing to coordinate their activities. In Asia, efforts appear to be well coordinated between the natural 'convener' centers of ICRISAT and IRRI. Several centers (CIAT, CIP, IFPRI and CIMMYT) have proposed initiatives for the hillsides of Latin America and, here again, planning is collaborative, giving the opportunity for close coordination.

### 5.3 Current IARC Ecoregional Initiatives

The proposals submitted by the centers and summarized in Annex 2 reflect a variety of views as to how they intend to implement an ecoregional approach to research. Some proposals are comprehensive and cover the major dimensions of the approach defined by TAC, including inter-institutional collaboration (CIAT, CIMMYT, CIP, ICARDA, ICRAF, ICRISAT, IITA, IRRI). Other proposals refer to individual center activities at the commodity, factor or subject-matter level which are contributions to a broader initiative of other centers (IBPGR, IFPRI, ISNAR, IIMI). Further proposals refer to the agroecological dimensions of global or regional commodity research activities (ILCA, ILRAD, INIBAP, ICLARM, WARDA).

Few of the center proposals meet all of the criteria stated in the guiding principles. The ICRAF consortium proposal for the eastern African highlands probably comes closest. It has a focus on natural resources management research with a strong global center input. It is proposed as a consortium involving many partners, has a multicommodity perspective involving every center operating in the zone, and makes a major effort at streamlining relations with national programs. Other proposals such as the IRRI/CIMMYT wheat/rice work and IRRI's consortium for upland farming systems have many elements of the ecoregional approach to research, but do not yet draw in a wider range of commodities. CIAT, IITA, ICRISAT and ICARDA have also made proposals that integrate research on natural resources management with commodity improvement, but do not yet have a mechanism to integrate a commodity perspective beyond that of their own mandate, or to streamline relations with national programs within the ecoregion. The ICRAF-led program on slash-and-burn farming systems provides a good illustration of a program which addresses an issue of worldwide importance to be implemented through an ecoregional approach. Biodiversity is clearly a global issue of equal importance which could be addressed in the same way. The Inter-Center Working Group on Plant Genetic Resources has explicitly recognized the relevance of collaborative activities on an ecoregional basis and sees an important role for both itself and IBPGR.

A major gap in the proposals is the lack of a comprehensive treatment of the needs of irrigated agriculture. Aspects of irrigation are addressed by IIMI (management), IFPRI (policy), ICARDA, IRRI (factor productivity decline) and WARDA. IIMI has expressed its interest in collaborating with IRRI and CIMMYT in their initiative on the rice/wheat cropping system and with IRRI on its lowland rice program, but there may be a need for a wider effort on irrigation. In the commodities, there is a clear need to further address the needs of livestock research in an ecoregional context. While livestock research is clearly an important part of ILCA, ILRAD, CIAT, ICRAF and ICARDA's proposals, none of the 'comprehensive' initiatives deals with the issue explicitly. Yet livestock are an important component of the production systems under pressure. Similarly, little attention is given to crops which are not part of the participating centers' mandates but which, nevertheless, are important components of the ecosystems under study. This needs to be addressed further. Again, although ICLARM offers valuable experience in the management of coastal areas, fishery resources per se are a unique dimension of the natural resource problem which cannot readily be organized within the ecoregional framework developed for agriculture. This is another issue for further consideration.

Finally, the diversity of ecoregional initiatives is placing heavy demands on the global factor, policy and management centers, IFPRI and ISNAR in particular. Their responsibilities in the ecoregional context require CGIAR-wide consideration, since they have their own global mandates to fulfil.

#### 5.4 Next Steps

The centers are rapidly grasping the opportunities for greater collaboration, and the possibilities for ecoregional and regional coherence are clear. The Working Group would add a final note of caution on the proliferation of initiatives; first because the approach itself is still evolving, and second, because cost effectiveness demands that the whole system learns from the lessons of experience. There is already significant experience among centers of several dimensions of the ecoregional approach; ICLARM's coastal area management experience in coordinating line ministries, ICRAF's experience with national and regional steering committees, also across several line ministries, IITA's experience of internal restructuring and CIAT's detailed paradigm for ecoregional research.

There is, as yet, no mechanism for exploiting these experiences by the CGIAR as a whole. The Inter-Center Working Group on Plant Genetic Resources is an example of where the IARCs have set up a mechanism for CGIAR-wide coherence on a major issue. Perhaps the Center Directors' Committee on Sustainability should accept the mandate to identify and exploit such synergies for the various dimensions of new ecoregional initiatives. It is a mandate which will be important, not only in the planning of new initiatives, but also, once experiences with implementation accumulate, for synthesizing a research model for the sustainable improvement of productivity.

Perhaps the Center Directors' Committee as a whole is the appropriate vehicle to identify convening centers for priority ecoregions, to reconcile overlapping mandates, and

to place responsibilities for regional coordination in the generic activities which have been the other main source of duplication burdening national systems.

Clearly, no single organizational model will serve the needs of all ecoregions; the diversity in NARS capabilities, the varying mandates of the IARCs and the local-specific manifestations of the degradation problem preclude uniformity. There is, however, a valuable set of organizational principles: operate on a regional basis; focus on an important agroecological zone with a serious degradation problem; combine natural resources management and production objectives; employ a multidisciplinary approach; include both natural and social sciences; involve national research institutions and other partners in a synergistic way; adopt flexible systems of governance and priority setting; and ensure global coherence and flexible funding mechanisms. These, used as a template, will provide a pragmatic, non-overlapping set of coordinated programs, and a new dimension to the CGIAR.

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# **Annex 1 - Synthesis of TAC's Views on an Ecoregional Approach to Research**

## **1. Introduction**

### **1.1 History**

TAC developed the concept of an ecoregional approach to international agricultural research while reviewing the potential expansion of the CGIAR in 1990. The Committee elaborated the concept subsequently.

This annex is compiled from five TAC papers:

- A Possible Expansion of the CGIAR (1990)
- Relationships between CGIAR Centres and National Research Systems (1991)
- An Ecoregional Approach to Research in the CGIAR (1991)
- Review of CGIAR Priorities and Strategies (1992)
- An Ecoregional Approach to Research within the CGIAR System: Summary of the TAC Concept (1992).

Historically, the CGIAR has played a 'bridging', a 'gap filling' and a leadership role in agricultural research for less-developed countries. It has served as a bridge between strategic research institutions in advanced countries and national research institutions in developing countries. It has filled gaps in the basic-strategic-applied-adaptive research continuum to keep it intact across developing country, regional and international collaborators. It has been a leader in international germplasm improvement, in the development of research methods, and in the training of developing country scientists.

The concept of an ecoregional approach to international agricultural research was proposed during TAC's review of the possibility of expanding the CGIAR system (TAC, 1990). In planning for the expansion of the CGIAR, TAC defined the long term as the time when most national research systems will be strong enough to meet their national needs for technology, either by their own efforts or in collaboration with others. Once there are strong national systems and strong transnational collaboration, the CGIAR should not be active in location-specific applied and adaptive research. Strategic research, with spillover to many countries, should remain a logical focus for global CGIAR activities, brought to the field by collaboration with regional and national institutions.

Such a vision may seem at variance with current calls for an increased emphasis on resource management, which is often perceived as location-specific by nature. The apparent anomaly is addressed in a medium-term vision of internationally-supported

research in which TAC sees both global and ecoregional activities playing important roles in the CGIAR.

## **1.2 Concepts**

The TAC concept of an ecoregional approach is at once a strategy to bring a new balance to international agricultural research to ensure the sustainable improvement of productivity, and also a strategy for gradual transition in the organization of the global agricultural research system to meet the sustainability challenge.

While considering the modified goal of the CGIAR with its new emphasis on sustainability, TAC recognized the inherent appropriateness of agroecological zones as an organizational framework for research on the physical and biological aspects of the conservation and management of natural resources, including germplasm. In contrast, it recognized that the socioeconomic circumstances important to such research, as well as the support needs of national programs, are better differentiated by national and regional boundaries. TAC coined the phrase 'ecoregional' to describe agroecological zones, regionally defined.

This definition evolved into an ecoregional approach to international agricultural research, with ecoregional mechanisms as the means for its implementation. TAC identified three dimensions of the approach:

1. applied and strategic research on the foundations of sustainable production systems in the ecoregion;
2. the improvement of productivity in the ecoregion by drawing in appropriate global research activities; and
3. strengthening of the cooperation with national partners and the development of transnational mechanisms of collaboration.

The focus on the foundations of sustainable production systems directly reflects the heightened emphasis on natural resources management in the CGIAR. TAC foresees future global activities focused more narrowly on germplasm enhancement and conservation, and selected subject-matter areas, including policy, management and the maintenance of biodiversity. Such global activities offer economies of scale from their global relevance across agroecological zones.

The utility of both globally- and ecoregionally-organized research at the international level will remain dependent on their links with local research targeted to farmers' needs. Thus, underlying both long- and medium-term visions, was the recognition that CGIAR success would always continue to depend on close working relationships between centers and the national research institutions, and that these should increasingly dominate applied and adaptive research. TAC has remained aware of difficulties persisting at the interface between the IARCs and NARS and, as the CGIAR is restructured, seeks to correct past weaknesses.

### **1.3 The Future**

Beyond the medium term, as national systems become stronger, different scenarios are possible: the interface between ecoregional activities and CGIAR global activities could shift to other mechanisms, perhaps with a greater emphasis on networking between national programs or, eventually, direct interaction between the strong national systems and both CGIAR global and ecoregional activities. Another alternative would be the reduction of ecoregional activities at CGIAR centers as responsibilities are devolved to national systems.

The nature and pace of such change would depend on a strengthened political commitment to research in the developing countries, and to cooperation between the countries of a region. Political commitment will grow from a better understanding of the importance of new agricultural technology to human survival, and of the benefits of transnational collaboration in agricultural research.

## **2. Research on Sustainable Production**

### **2.1 Sustainability**

Productivity research in the CGIAR has traditionally been implemented through a commodity approach which has focused on germplasm enhancement and agronomy, particularly the management of the genotype's immediate growing environment. Concern about widespread degradation of the lands used for agricultural production has grown over the past two decades. The loss of genetic diversity, depletion of water sources, soil erosion, salinization, waterlogging, deforestation, desertification and environmental pollution all threaten the sustainability of the agricultural resource base. The increases in production needed to accommodate the population growth anticipated in the next three decades will exacerbate these problems unless new research strategies are identified and vigorously pursued.

### **2.2 Towards the Sustainable Improvement of Productivity**

In advocating an ecoregional approach embracing natural resources management research, TAC was aware of the contributions to sustainable production already made by commodity-based research. Looking to the future, however, TAC saw this approach as increasingly limiting, primarily because research towards the improvement of sustainable production systems would have to be multicommodity in its coverage and to move into areas wider than those dealt with in commodity programs.

The experiences of the CGIAR centers and other research institutions are used here to highlight the elements of a broader approach to research on natural resources management and the basis for the sustainable improvement of productivity.

It is the human interactions with the agricultural resource base which cause land degradation. It is, therefore, important that the physical and human elements of the

degradation process are researched in parallel. Within agriculture, soil and water processes are largely managed through the commodities and enterprises that farmers find attractive for their farming systems. The crop varieties and animal types, and the techniques used to manage these commodities in producing food and income, are also the tools for resources management. As system components, these commodities and techniques are identified and shaped by criteria important to the productivity of the farm as a whole, and not the commodity alone. Successful amendment of the natural soil and water processes to achieve sustainable production will depend upon the identification of new commodities and management techniques that also improve system productivity.

Several CGIAR centers have a long record of experience in systems-based research at the level of the farm household. Latterly, some centers have pioneered the participation of farmers in adaptive and applied research. The systems approach to research which has evolved over the last twenty years and the new participatory methods which help articulate the human dimension of agriculture, are tools which provide new confidence that the threat of unsustainable production can be challenged.

The ecoregion, combining as it does the physical, biological and socioeconomic dimensions of the production environment, represents a more logical level of a hierarchy of systems to deal effectively with resource management problems than the individual farm level. Research at these broader levels of the hierarchy (the catchment area, the community, and the agroecological zone), as well as instilling a more equal and deliberate partnership with policy formulation to promote technology dissemination, will break new ground and will require new skills, both in the IARCs and in the partnerships they join.

### ***2.3 Links: Global Activities and the Ecoregional Approach***

TAC sees the integration of research on commodity improvement with the conservation and management of natural resources as one of the organizational challenges facing the future of international agricultural research. This deserves emphasis because the need for increased productivity to feed the burgeoning populations in developing countries has sometimes been neglected in the international debate on environmental concerns. Resource conservation is not an end in itself.

Ecoregional mechanisms would help to develop understanding of the human interactions with the natural resource base and build knowledge bases in the regions. This understanding would be shared with global centers which would take account of it in their germplasm-enhancement programs. To complement the interchange between ecoregional needs and global programs, ecoregional mechanisms would also serve as sites for testing, adapting and packaging the technological components generated from global research. In the global germplasm centers of the future, TAC sees less priority for research on the management of germplasm in specific situations. This would be a logical role for the ecoregional mechanisms with their knowledge of their local operating environments.

Strong links between global and ecoregional activities are a prerequisite to the sustainable improvement of productivity. Some centers with genetic responsibilities for one or more commodities already employ approaches that are, in part, ecoregional in



character. Their global activities have an agroecological zone focus and strong links with national programs, organized on a regional basis. Some of these links facilitate research on production systems and natural resources management. In some cases, outpostting at other centers is already in evidence. These programs might well evolve into full ecoregional approaches, as envisaged by TAC, in which all CGIAR centers with relevant global activities could actively collaborate. A systems-based research approach would demand strong coordination at the ecoregional level and less commodity-driven, independent center initiatives.

#### **2.4 NARS - the IARCs Links with Farmers**

Clearly, the biggest challenge in the medium term is to strengthen national research programs and transnational mechanisms for scientific collaboration in the developing countries. Success here is an absolute prerequisite to CGIAR success. However, TAC does not see the CGIAR as the dominant agency in this task. The proposed ecoregional mechanisms can help in research and research capacity building, but technical assistance, infrastructure development, revised policies and financial commitment require the attention of the wider international development community.

Historically, the global commodity centers have involved themselves in building capacity of national research systems as the vital links to their clients. Widespread training of national staff and the promotion of a farming-systems approach to adaptive research have been two major investments, and centers have collaborated widely with national scientists in agronomic, postharvest processing, and other applied and adaptive research activities. Centres' involvement in these wider activities has sometimes blurred their focus, diverting the attention of management and donors from their central mandate. At the same time, it has often overburdened and even aggravated some national systems, owing to uncoordinated and sometimes duplicated efforts by several centers in the same country.

In TAC's view, a sharper delineation of responsibilities between global and ecoregional mechanisms will improve the interface with the NARS. Ecoregional mechanisms will be better able to understand and help coordinate the needs of national systems within their mandate regions and ensure that IARC interactions are tailored to country capacities and are not duplicated. They will be better placed to organize and coordinate general CGIAR activities in training, networking and information among the NARS of the region. Where the weakness of the national systems is a decisive factor in their establishment, ecoregional mechanisms could act as a full intermediary between the global centers and the countries of the region.

### **3. Implementing the Ecoregional Approach**

#### **3.1 Priority Ecoregions**

All ecoregions have locations in which population pressure has already exceeded traditional knowledge and the ability of communities to manage their natural resource

base, and where current production activities are not sustainable. TAC has given highest priority to ecoregions where there is an urgent threat of widening land degradation and a continuing dependence on the land as a source of livelihood. TAC gives priority to:

1. Warm humid and subhumid tropics and subtropics with summer rainfall in Latin America.
2. Warm humid and subhumid tropics in sub-Saharan Africa.
3. Warm semiarid tropics and cool (highland) tropics in sub-Saharan Africa.
4. Subtropics with winter rainfall (dry areas) in West Asia and North Africa.
5. Warm semiarid tropics and subtropics with summer rainfall in Asia.
6. Warm subhumid and humid tropics and subtropics with summer rainfall in Asia.

There may also be justification for other ecoregional programs in the cool tropics in Latin America and sub-Saharan Africa where inter-regional mechanisms are practical.

### **3.2 *Operating Mechanisms for the Ecoregional Approach***

Collaborative programs with NARS are the obvious mode for implementation. The site specificity of the research, and the necessary links with community organizations, national institutions and policy makers will demand political support from the highest national level, and funding support for both research and key complementary activities.

Ecoregional mechanisms should adopt organizational forms appropriate to the type and level of research needed and the strength of collaborating national systems. Where national systems are weak, the ecoregional mechanism will need to implement research through the full continuum, from strategic understanding of physical processes down to the introduction of technology onto farms at the selected field sites in the region. It seems likely that ecoregional mechanisms in such regions will be centers of the traditional CGIAR type, coordinated, perhaps, in a consortia with other IARCs and agencies with complementary programs and skills.

Site selection within designated ecoregions will be vital. Each ecoregional mechanism will have the capacity to research only a limited number of sites. Each site needs to represent a physical unit, often a watershed, and the unit of social cohesion, usually the community which manages it. Research at each site will require close collaboration between CGIAR centers, the national research system, national policy agencies and grassroots organizations, all working with local communities, to cope with the many dimensions of the challenge to evolve sustainable production systems.

The global community does not yet have an effective paradigm for the sustainable improvement of productivity. The global comparison of experiences demands coordination in site selection and in the use of new methods. The synthesis of site experiences will bring synergies to the search for a research paradigm. Identifying the most appropriate paradigm and making it operational is a goal of truly international relevance and significance.

Other outputs from the research sites will be of immediate value. At the level of the agroecological zone, understanding of the soil, water and biological processes from the representative field sites will be relevant to the whole zone. At the local level, in the communities represented by the field sites, implementation of the approach will provide technologies, and guidance on changes in social organization and policy for the sustainable improvement of productivity in the existing farming systems.

The same sites will offer a training venue for research managers and scientists from the countries of the region and of the agroecology beyond the region. At the sites, they will gain first hand experience of the dimensions of natural resources management research and the coordination, national and transnational, required for its planning, implementation and the mobilization of the research outputs into farmers fields.

### *3.3 Future IARC/NARS Relationships*

In relations with national programs, ecoregional mechanisms would build on the diversity of useful experiences already gained from the evolving relationships with national research systems across the world. A major aim would be to move to a set of relationships in which priorities for work with national systems were determined by regional or sub-regional associations of countries or scientists, organized either under the umbrella of a political entity or as an officially-approved steering committee. Contractual relationships, required either by ecoregional or commodity mechanisms to meet the needs of their own programs, could be facilitated through the same consultative procedure. TAC suggested exploring modifications of existing mechanisms and using existing means of transnational collaboration where these are available. Beyond the medium term, TAC's view is that CGIAR ecoregional mechanisms would pass greater responsibility to national systems and transnational collaborative mechanisms as these matured.

The major gain from restructuring the CGIAR into global and ecoregional dimensions is expected to be greater coherence in its continuing roles of bridging, filling gaps and providing a model for agricultural research in developing countries. Bringing the concept of the sustainable improvement of productivity to operational reality, and moving towards a closer integration of national needs with the global research agenda will both add coherence. National needs will be addressed more effectively by negating the duplication in IARC activities and removing the burden on weak national systems of multiple-IARC interaction.

## **Annex 2 - Current and Proposed CGIAR Activities in an Ecoregional Context**

This annex presents an overview of centers' programs and proposals for the implementation of an ecoregional approach to research.

### ***CIAT***

CIAT proposes an integrated germplasm-development and resource-management research strategy in selected agroecosystems in Latin America and the Caribbean; the cleared forest margins, the mid-altitude hillsides and the savannas with acid soils. This strategy is to be supported by institutional development activities

Rather than 'ecoregional', CIAT prefers to label its approach as a 'land-management approach' which integrates three dimensions:

- development of sustainable technologies for multispecies production systems to increase farm productivity and avoid on- and off-farm land degradation;
- design of policies to provide incentives/disincentives for the sustainable management of land resources; and
- building of decentralized institutional mechanisms for developments that can manage the trade-offs between the private and social benefits/costs.

CIAT's proposals are based on a systems approach, focus on land-use based agroecosystems, will be carried out by multidisciplinary teams, and rely on close inter-institutional links among IARCs, NARS, NGOs and consortia arrangements based on 'peer partnerships'.

### ***CIMMYT***

CIMMYT has increased its efforts in research on sustaining natural resources through an approach that focuses on cropping systems which are currently dominated by maize and wheat. Since 1989, the Center has been developing two ecoregional programs; one in the erosion-prone maize-based cropping systems in the hillsides of Central America, and another in the substantial rice-wheat cropping system of the Indogangetic plain of southern Asia. The research is being undertaken in close collaboration with national programs and other IARCs, particularly IRRI, and probably CIAT in the future. It will be supported within the framework of a newly-formed Natural Resources Unit comprising a small multidisciplinary research team. Other major wheat and maize cropping systems have been proposed for attention (e.g. mid-altitude maize systems in southern Africa and temperate irrigated wheat-upland cropping systems), but such mechanisms are still under discussion.

### **CIP**

CIP proposes to assume a principal role in the coordination of research to develop sustainable systems for the management of natural resources in the Andean agroecosystem (cool tropical hillsides of the Andes). The research will be in two general areas; natural resources management and biodiversity. CIP intends to act as a catalyst and coordinator of a research network. The work will seek intervention points at the commodity level, at the cropping/land-use system level and at the policy level. CIP considers that to conduct research for the development and implementation of alternative land-use systems, the major drive comes from improved component technology, which can be crop-, system- or land management-based, or policy and institutional in nature. The research will be conducted by a multidisciplinary team in close collaboration with NARS, other IARCs, NGOs and universities.

### **IBPGR**

IBPGR has a global mandate for the conservation and use of plant genetic resources, and works in partnership with other organizations, including NARS, regional institutes and other IARCs. The work is carried out as a single integrated program through eight groups which are either regional or thematic. The primary focus of IBPGR's work is natural resources management and conservation, particularly of crop genetic resources, but with increased attention to forest genetic resources. IBPGR is the only CGIAR center solely concerned with work on plant genetic resources which, as recognized at UNCED, provides a key element of the natural resources management research agenda. IBPGR's planning recognizes that an ecoregional focus on conservation and use of plant genetic resources will facilitate the integration of many different regionally-important species into a proper context of sustainable agricultural development. IBPGR's activities in regional networks have served to facilitate collaboration between different organizations and workers from different disciplines to address sustainable conservation and use of plant genetic resources. The Institute's Medium-Term Plan (MTP) for 1994-98 envisages specific ecoregional initiatives, particularly the location of staff at a number of other CGIAR centers to consolidate collaborative work on ecoregionally-important species, the provision of assistance in collecting evaluation, documentation and storage of important germplasm, and the development of additional training and research activities.

### **ICARDA**

ICARDA's work has had an ecoregional emphasis almost since its inception, facilitated by the fact that much of the agroecological zone it serves in West Africa and North Asia (cool sub-tropics with winter rainfall) is geographically continuous, relatively compact, and consists of countries with strong cultural and political links. ICARDA's research program is formulated in the context of this agroecological zone, disaggregated into five major zones; deserts, steppe and native pasture, barley/livestock, wheat-based and horticultural/mixed farming zones. ICARDA's research approach is characterized by an integration of research on natural resources management and conservation and germplasm improvement, and has major socioeconomic and policy-oriented dimensions. During the next medium-term planning period, areas receiving increased attention are soil

conservation and management, water conservation and harvesting, nutrient management, environmentally-friendly plant protection, and agroecological characterization. Conservation of plant genetic resources will remain an integral part of ICARDA's work. ICARDA's involvement with irrigation has been an outstanding issue, but the Center currently proposes to allocate a maximum of 5% of its resources to irrigated agriculture.

### ***ICLARM***

ICLARM proposes to focus its research on three aquatic resource systems (i.e. ecosystems plus users): inland aquatic systems (small freshwater bodies including ricefields); coastal systems (including lagoons and estuaries); and coral reefs. Initially, the ecoregional mechanism is most appropriate to inland aquatic resource systems research, but analytical tools developed in the other programs are also likely to be transferable. ICLARM has already developed a conceptual framework for aquatic resources management research that spans all of its programs, and thus all three resource systems. Natural resources management research in the inland program will be conducted in the following regions and ecosystems; Southeast Asian ricelands, South Asian floodplains, and eastern and southern African 'dambo' lands. Plans are also being made to include West African wetlands and East Asian river deltas. At each 'ecoregional' site, ICLARM aims to transform existing farming systems through integrated resources management, including water resources, fish and other aquatic biota, as catalysts for positive and sustainable ecological change on farms using farmer-participatory research supported by socioeconomic and ecological studies. Farming systems performance indicators are being developed to monitor and assess the impact of integration on households and natural resource systems. The biophysical, economic, institutional and policy environments necessary for such a transformation of farming systems will also be defined. Operating under a common 'integrated resource systems approach', it will be possible for both ecoregional and global generalizations to emerge. Moreover, this approach may permit the extension of ecoregional mechanisms over marine ecosystems as well.

### ***ICRAF***

ICRAF is coordinating an initiative on integrated natural resources management research for the highlands of eastern and central Africa. While the initiative is still at the formulation stage, it will grow out of ICRAF's current AFRENA network. The purpose of the initiative is to integrate and rationalize existing programs and to identify new areas of research relevant to the problems of managing natural resources of the region. The research will focus on the major land-use systems (both agriculture and forestry) and integrate productivity-improvement and resource-management activities. The approach will be multidisciplinary and multicommodity. While ICRAF will assume project leadership, implementation will be collaborative, involving every other center operating in the region and the national research systems. ICRAF also intends to contribute to the ecoregional mechanisms of humid and semi-arid West Africa, the humid tropics of Latin America, and the humid tropics of southern Asia.

ICRAF is also the global coordinator of a six-center consortium planning the 'Alternatives to Slash and Burn' Program which recently received a first tranche of funds

from the Global Environmental Fund. It proposes research sites on slash and burn agriculture in Africa (coordinated by ICRAF and IITA), in Latin America (coordinated by CIAT) and in Asia (coordinated by IRRI).

### *ICRISAT*

ICRISAT carries out research on six crops: sorghum, pearl millet, finger millet, groundnut, chickpea and pigeonpea. Even so, ICRISAT's mandate is fundamentally ecoregional: its primary responsibility is the semi-arid tropics (SAT) of the world. As the SAT are the target of ICRISAT's research, both resource management and crop improvement research is essentially ecoregional. The resources management program, perhaps more closely aligned with the geographic mandate, focuses on key resource management issues in the SAT, e.g. soil erosion, nutrient depletion, moisture conservation, low-input use, etc. These topics are studied within the context of specific production systems. Further characterization of major production systems within the SAT of Asia and Africa is planned during the next five years. This will involve multidisciplinary teams of agroclimatologists, agronomists, soil scientists, economists and ecologists. Methods such as GIS, reconnaissance surveys, agroeconomic surveys, farmer-participatory methods will be employed. A major output of this research will be the identification of constraints which limit land or labor productivity in these systems. Meanwhile, work continues on identifying principles and developing improved methods that make more efficient use of low inputs in systems where constraints are already identified and fairly well understood. With the exception of two specific activities, all resources management research is targeted to the SAT. The two exceptions are where economists and agronomists are supporting initiatives of the crop improvement programs in specific non-SAT regions of Asia where the crop mandate is relevant.

### *IFPRI*

IFPRI is proposing a new and focused research program on environmental and natural resources management issues. The research will take a holistic approach to technology, property rights and communal action, policy and poverty issues that affect natural resources management. It will consist of rigorous analyses of the incentives that affect household decisions about land-use and technology choices and how these decisions affect the state of resources. IFPRI's focus will be on developing conceptual and analytical approaches for analysing the issues involved and then testing these approaches through a small number of in-depth case studies of important ecosystems; the forest margins in the humid tropics, fragile rainfed lands, and high-productivity irrigated areas. Research on property rights and communal action is considered the most critical policy issue cutting across ecoregions. The research will be conducted by multidisciplinary teams which will be formed by collaborating with other IARCs, NARS, NGOs and universities of both developing and developed countries.

### **IIMI**

IIMI has not proposed specific ecoregional activities but is involved in research on irrigation management in all the major ecoregions where irrigation is considered of strategic importance. The center has expressed interest in full collaboration with consortia established in those ecoregions which have irrigated agriculture as a focus.

### **IITA**

IITA's evolving paradigm of ecoregional research uses a holistic approach which incorporates the farming-systems perspective with a sustainability (long-term) research perspective, with a focus on particular agroecosystems in sub-Saharan Africa. The farming systems perspective has led to the development of three interlinked multidisciplinary research activities: characterization of environment and farming systems; identification of farm-level constraints; technology development and on-farm studies. IITA is conducting a full range of ecoregional activities in the lowland moist savannah and the humid forest zones, including the inland valley agroecosystem. In the mid-altitude and highland savannah and woodlands of Africa, IITA proposes to carry out germplasm evaluation and improvement and plant health management research on its major mandate crops. The three ecoregional agroecosystem programs were created last year by adding a resource management capacity to the crop management capacity. The research programs include substantial inputs from other IARCs and research agencies in developed countries. Close collaboration with NARS is the foundation of IITA's ecoregional research model. IITA provides a focal point for collaborative efforts between international, regional and national research programs.

### **ILCA**

ILCA considers that sustainable improvements in livestock productivity necessarily involve attention to those agroecological and socioeconomic factors which establish the environments in which livestock products are marketed. ILCA has established at least one research team in each of the four agroecological zones of sub-Saharan Africa. ILCA's research involves interdisciplinary teams with scientists drawn from the environmental (plant, soil, ecology) and socioeconomic sciences, as well as team members from the animal and veterinary sciences. Critical mass is achieved through collaborative partnerships with national and international organizations.

In its 1994-98 MTP, ILCA has proposed that its research be organized under six themes, each of which involves ecoregional activities: mixed crop-livestock farming systems; market-oriented smallholder dairying; conservation of biodiversity; biological efficiency of livestock; livestock production under the trypanosomiasis challenge; and livestock and resource-management policy. ILCA classifies five research activities as being directly relevant to natural resources management: nutrient cycling in crop-livestock systems; incorporation of legumes in cropping systems; use of animal power; characterization and conservation of genetic resources; ex-ante impact assessment and policy.



### **ILRAD**

ILRAD's research programs on tick-borne diseases and trypanosomiasis have ecoregional elements in them. Tsetse-transmitted trypanosomiasis affects livestock in every major agroecological zone of sub-Saharan Africa, while the improved control of east coast fever is directly aimed at livestock in the sub-humid and cool tropical areas of eastern and southern Africa. The research is multidisciplinary and has a socioeconomic component. ILRAD's research is conducted in close collaboration with other IARCs and international agencies, advanced research institutes and national research systems. With respect to research on natural resources management, ILRAD has been very active in the development of GIS databases and their use for modelling.

### **INIBAP**

INIBAP's proposals are still in the conceptual stage. INIBAP considers that there is a clear need for existing breeding programs to agree to target breeding efforts and allocate responsibilities in specific ecoregions. There is an urgent need to understand, develop and enhance different types of Musa including true plantains, traditional desert bananas, cooking bananas, beer and cooking bananas, pisang mas and other diploids. INIBAP expects to continue encouraging the concept of a truly 'breeders' network with a division of labour based on comparative advantages and complementarities. As yet, only broad ecoregions, such as the East African highlands and Central America have been identified. In addition to its research, INIBAP intends to also target its information, documentation and training services by ecoregion and type of Musa.

### **IRRI**

In 1988, IRRI introduced a rice ecosystem-based program structure. These rice ecosystems are defined by landform and hydrology (irrigated lowland, rainfed lowland, upland, and deepwater/tidal wetland ecosystems) and form the basis for the planning and implementation of research. Within these ecosystem programs, research is focused on germplasm improvement, soil, nutrients, water, and pest management for sustained productivity and the conservation of the resource base. In irrigated rice ecosystems, research during 1994-98 will focus on understanding the causes of declining factor productivity through the development of methods that link input/output efficiency with changes in the soil resource base and the socioeconomic environment in which farmers operate. In the less favourable environment of the rainfed lowland and upland ecosystems, abiotic stresses remain a major challenge to rice germplasm improvement research. Drought, flooding and soil deficiencies of nitrogen, phosphate and zinc are the major constraints in the rainfed lowlands, while soil erosion, poor soil fertility and weeds are the primary constraints in the uplands. For both these less favourable environments, IRRI launched a 'research consortium' mode of operation in partnership with NARS to address strategic research issues and to improve coordination between productivity improvement and natural resource conservation.

IRRI intends to have an ecoregional approach to research in all the major agroecological zones of Asia except the cool tropics and sub-tropics. In addition to the projects and consortia already referred to, IRRI plans further work with CIMMYT on

rice/wheat cropping systems and environmental characterization (with a strong GIS component) in the humid and sub-humid tropics of Asia. Both consortia and networks will be used as vehicles to implement ecoregional activities.

### **ISNAR**

In its 1994-98 MTP, ISNAR argues that the institutional implications of increasing research on natural resources management is an issue of strategic importance to national systems and, therefore, of importance to the Center's work, particularly for: research evaluation and priority-setting methods; incorporating research on renewable natural resources into the agendas of national agricultural research organizations; and reviewing and synthesizing management and institutional issues. ISNAR's activities primarily consist of policy research and organization/management counselling. Collaborative efforts with NARS are central to ISNAR's approach, while cooperation with other IARCs and advanced institutions on ecoregional and resource management issues is in the planning stage.

### **WARDA**

WARDA's 1994-1998 MTP proposals were developed around five points that define the essential ecoregional aspects of the Association's research approach: its ecoregional mandate, the priority to resource and crop management research, the farming systems perspective, sustainable production systems and partnerships with other institutions.

**Ecoregional Mandate.** At the Institutional level, WARDA's mandate covers the warm sub-humid and warm semi-arid tropics within West and parts of central Africa; at the program level, WARDA scientific teams focus on each of the major rice-growing environments in the region: the continuum, Sahel irrigated rice, and mangrove swamp rice; and at the project and sub-project levels, WARDA focuses on distinct agroecosystems.

**Priority to resource and crop management research.** WARDA's approach assumes that improvements in soil, water and pest management research represent the essential precondition for gains in overall rice productivity.

**Sustainable production systems.** WARDA's emphasis on resource management responds to the unsustainable transition from extensive to intensive cropping systems occurring throughout sub-Saharan Africa. Through interdisciplinary team projects, WARDA will develop more productive and sustainable systems which integrate rice with other farm enterprises to exploit potential complementarities and enhance the natural resource base.

**Farming systems perspective.** Recognizing that, for most rice farmers in West Africa, rice is only one enterprise within mixed farming systems that include a diverse range of crop, livestock and non-farm activities, WARDA researchers will apply a holistic farming-systems perspective rather than a single-commodity focus. Farmers will participate fully in diagnostic and technology development research.

**Partnership.** WARDA will increasingly take on the character of an 'open center', i.e. it will provide a permanent institutional framework within which it can attract, focus and facilitate the efforts of a range of national and international collaborators working together in partnership. WARDA will serve as catalyst for identifying the priority themes and partners for collaborative research. Leadership in specific research themes will be based on institutional comparative advantage. The complementary skills and resources contributed by WARDA's partners will provide a synergistic addition to WARDA's core program.

### **Annex 3 - Joint TAC/Center Directors Working Group on the Ecoregional Initiative: Terms of Reference**

The Working Group has been asked to consider changes in structure and approach which would allow the CGIAR centers:

- to plan, organize and implement natural resources management research effectively and collaboratively in selected agroecosystems;
- to link germplasm research to the improvement of productivity and better resource management in selected regionally-defined, agroecological zones;
- to link CGIAR centers more efficiently with NARS partners in identifying research priorities, delivering research products, and implementing collaborative research programs.

Specific Terms of Reference are:

1. To assemble information on current center programs of research on the conservation and management of natural resources. Assess the extent to which these programs incorporate an ecoregional approach (as defined by TAC) and evaluate their effectiveness in supporting national programs, especially in research that combines productivity with sustainability.
2. Review the objectives of natural resources management research (NRMR). Assess comparative advantages of CGIAR on specific research topics in relation to these objectives. Develop a research agenda to address resource management and sustainability issues.
3. Develop a methodological framework for research on sustainability of NRM and its operationalization. Identify strategic research issues for international research on biophysical, socioeconomic and policy aspects of resources management. Develop methodological approaches that link strategic research with farmers responses to production-conservation tradeoffs under different policy scenarios.
4. Assess the organizational and operational implications and appropriateness of implementing the TAC concept of an ecoregional approach, especially in relation to the proposed division of responsibility into 'global', 'subject matter' and 'ecoregional', the nature of the strategic research to be undertaken in both contexts, and the need for coordination of center activities across commodities, agroecological zones and geographical regions.
5. Consider, in general terms, possible operational relationships to implement desirable patterns of activity among the three types of centers, as well as between centers and other international organizations (including regional organizations).

6. Review objectives of center collaboration with national research systems, consider the most desirable points of linkage, and assess mechanisms for avoiding duplication and overload.
7. Identify appropriate mechanisms for monitoring impact and criteria for assessing the success of research related to the conservation and management of natural resources and its contribution to national systems.