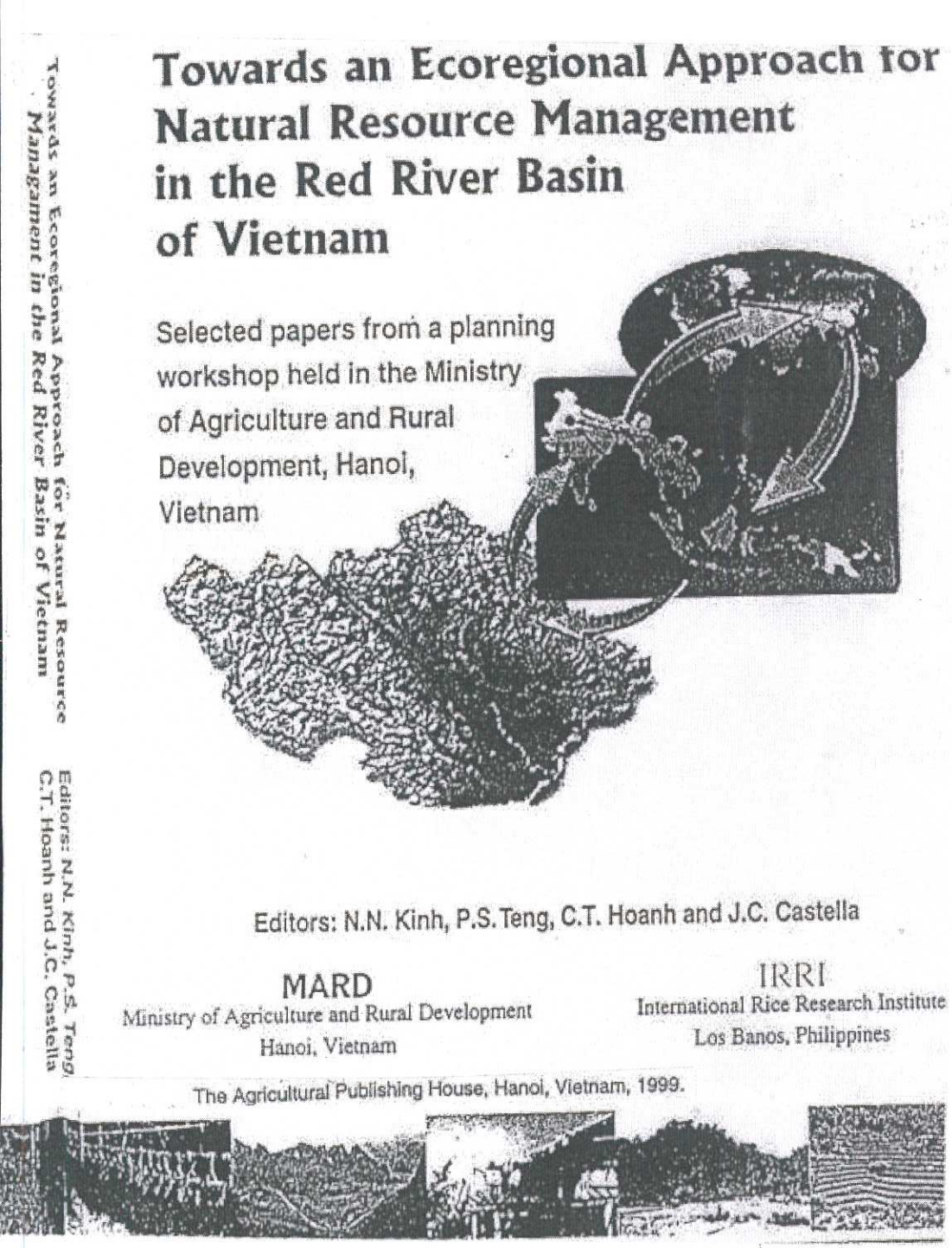

An ecoregional approach for development-oriented research on agricultural systems

Hubert Manichon[1] and Guy Trébuil[1,2]
[1]Annual crop department, Centre de coopération internationale en recherche agronomique pour le développement (CIRAD), B.P. 5035, 34032 Montpelllier Cedex 1, France
[2]International Rice Research Institute (IRRI), P.O. Box 933, 1099 Manila, Philippines

Introduction

This paper is based on the recommendations made by a working group bringing together the French agricultural research institutions (CIRAD, INRA and ORSTOM)[1] and set up at the request of the Ministry of Higher Education and Research to draw up joint proposals in the field of ecoregional research. This concept is currently being developed by the Consultative Group on International Agricultural Research (CGIAR), where it has become an important component in the evolution of development-oriented research. French institutions are already involved in several ecoregional programmes and consider these initiatives as a step in the right direction, providing a means towards more effective development-oriented research. The proposals presented here aim to bring this concept another step forward by defining the principles of a 'second generation' of ecoregional projects that the French research community would like to put to its partners for discussion and implementation, for example in the case of the Red River Basin key site of the Ecoregional initiative for humid Asia, Ecor (I).

Development-oriented research and ecoregional approaches

Logically speaking, it should be possible to measure the effectiveness of development-oriented research, in the developing world especially, through its contributions to economic and social development in the countries

1 The members of this working group were for INRA: B. Vissac, C. Albaladejo and A. Sontot; for ORSTOM: G. Hainnaux, A. Lericollais and P. Gondard; and for

reflecting the multiple interactions of human society with its environment, and such measurements are very difficult to make. Depending on the case, research may be alternately attacked or praised, without any objective proof of its responsibility in success or failure. Indeed, such subjective perceptions often influence the level of resources that communities are willing to invest in this area.

Despite such difficulty, agricultural research institutions are increasingly conscious of the role they must play in responding to social demand. Few are the scientists who now consider that their contribution can be limited to individual work on personally chosen topics. Recent years have seen a growing recognition of the need for collective, multi-disciplinary organization of research planning activities that need to be based on the analysis of needs and hence with clearly defined objectives.

The ecoregional approach is benefiting from these changes. It owes its development to the efforts now being made to improve the transparency and credibility of development-oriented research, its objectives, problems and organization. In particular, it has attracted the attention of funding agencies who view it as a tool for more effective analysis of the economic, social and environmental problems of developing countries.

For the CGIAR authorities, who have been developing this approach over a number of years, it provides a means to take into account, within the framework of the 'green revolution', of the difficulties encountered in regions with multiple constraints and, more recently, in regions with high development potential, and to give greater priority to environmental problems. To achieve this, *not only must the scope of research be extended beyond the biophysical aspects of production but, at the same time, problems must be analysed in terms of their technical and human dimensions* (CGIAR, 1992, 1994).

We must, therefore, define the geographical areas within which this multidisciplinary approach is to be applied. For organizational purposes, the CGIAR has suggested dividing the continents into 'ecoregions' (on the basis of agro-ecological zones defined by FAO). In certain regions, such as south and southeast Asia, consortia have been set up to carry out collaborative research programmes, bringing the concerned National Agricultural Research Systems (NARS) and their comparative advantages into closer and more equal relationships with the CGIAR centres and other Advanced Research

member of the Upland Rice Research Consortium which is entering into its third phase. This institutional approach, providing a tool for renewed collaboration between North and South, will hopefully enhance the coordination and efficiency of development-oriented research projects. However, this approach also involves high 'transaction costs' which at a time when resources are scarce will only be acceptable if the hopes placed in this approach are fulfilled.

A necessary deepening of the ecoregional approach

The various ecoregional programmes already defined cover a wide range of topics; this is logical since the regions concerned are very different in nature. However, a large variety of scientific approaches are also used without any apparent justification for the differences observed. The programmes rarely stay within the limits of particular ecoregions, and indeed there often appears to be little true uniformity, in terms of agricultural and environmental problems, within a single ecoregion.

This problem must be studied more deeply. This need was recognized by the CGIAR authorities, who decided to set up a working group on this subject[2]. For the same reasons, the Dutch cooperation organized a symposium in December 1994 for the benefit of international centres.

The very objective of the ecoregional approach is to contribute to the sustainable development of a geographical region and this is also the necessary starting point for any evaluation of its scientific content. A positive contribution to development cannot be achieved simply by basing research projects in the region concerned. Nor is it sufficient merely to ensure that the issues being studied are related to the region's major development challenges, or to perfect the methods required to disseminate the results of this research. Indeed, experience shows that for innovations to be accepted, the new knowledge produced must be in harmony with the needs and strategies of the people for whom these innovations are destined and must take account the constraints to which they are subject. Furthermore, to ensure that the

2 This group was chaired by Cyrus N'Diritu (Kenya) and its members were: I. Abrol (India), H. Manichon (France), G.Norès (Argentina) and R. Van den Berg (Netherlands); the secretary was M. Collinson (CGIAR secretariat).

solutions to a problem do not, in turn, give rise to new problems when they are applied, their consequences, both direct and indirect, must be analysed in detail.

A given geographical region contains a large variety of situations, both among different categories of actors (farmers, traders, officials, etc.) but also within a single category. Consequently, it is quite unrealistic to imagine that a single solution can be imposed on the entire farming community (assuming that this is possible) to solve any given problem (increased agricultural production, improved product processing, or natural resource management). Though such a solution may be relevant for some, it would never be appropriate for all situations. This is particularly true where agricultural diversification and farm or regional specialization is occurring along the process of integration into market-driven economies such as in today's Vietnamese agriculture. On the contrary, a wide variety of alternative solutions must be provided, devised on the basis of a diagnosis bringing to light the problems affecting an entire region and the strategies of particular actors within it. They must be made available to all those concerned so that they can be used to establish new working methods and practices.

Whether it be to improve food security by increasing production, to reduce poverty by increasing income or to implement sustainable management of natural resources and environmental protection, the very roles of the diversity of stakeholders involved in production or management of resources are brought into question. For example, to improve the coordination mechanisms in key commodity chains being rapidly transformed following important socio-economic reforms like in Vietnam recently, the solutions provided will only be effective if they enable local actors to make positive changes in their activity. Local action is a prerequisite for overall development.

We must therefore acknowledge that no contribution can be made to the development of a geographical region without viewing the land, its people and their activities as a real object of research by itself. This is the message we propose to convey through the ecoregional approach. It involves the integrated study of a region, based on the current local situation, in order to identify the realistic margins for future progress and the means to achieve such progress. Of course, these ideas are not new. However, they are all too rarely applied in research programmes, even when conducted on a

diagnostic surveys and empirical modeling of yield build-up processes,

contribute to the definition of a 'second generation' of ecoregional programmes and projects to complement and reinforce those which already exist.

Proposals for a second generation of ecoregional programmes

The proposals presented here have been drawn up largely on the basis of French experience. This experience is based on an understanding of the physical and human environments of developing countries, built up over time through a tradition of work in the field and long-standing relations with NARS partners. It covers all types of production in these environments: animals and plants, crops for local consumption and for export, food and non-food crops. Lastly, its results from the application, over many years, of a multidisciplinary and multi-scale systems approach with respect to the environment as it is actually perceived at different levels (cropping system at plot level, production system at the household-based unit and agrarian system from the village to the region and beyond). References to these topics can be found in the bibliography.

In the specific case of the Red River Basin, one must recall here the two very early and famous landmark publications, one by Pr. René Dumont's thesis in agronomy published in 1935 on 'Rice cultivation in the Tonkinese delta', followed the year after by Pr. Pierre Gourou's own master work in physical and human geography entitled 'Farmers of the Tonkinese delta'. Closer to the present, two volumes containing each a series of articles on recent changes in the agriculture of the Red River delta and based on the Red River Programme activities at the Vietnam Agricultural Science Institute (see the paper by B.H. Hien, this book), belong to this type of integrated studies on regional agricultural systems to guide development efforts. The very timely release this month of a joint special issue of 'Agricultures' and 'Agriculture et Développement' journals on the recent transformations in Vietnamese agriculture includes twelve articles on agro-economy and agronomy on the various aspects of changes in the agricultural production systems of the Red River Basin.

During the past years, several research methods and procedures have been designed and tested that could contribute significantly to a common 'basket of tools' to be made available to the various partners of the Ecor(I). As far as CIRAD is concerned, the following ones could be cited: agro-ecological

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rarely applied in research programmes, even when conducted on a

diagnostic surveys and empirical modeling of yield build-up processes, household systems typologies based on farmers strategies, commodity chain and stakeholder analysis, multilevel analysis tool for agriculture (MATA model), multi-agents dynamic models and decision making helpers, patrimonial management of renewable natural resources (mediation, coordination, negotiation), etc.

We present below the role that ecoregional research may play in the identification of paths towards socially, economically and ecologically sustainable development in a given region (a more precise definition will be given later) and their practical implementation. The foundations of the ecoregional approach are first defined and certain implementation principles are examined, without seeking to cover every aspect of the question. The proposed approach is broad enough to be applicable either in the case of high productivity areas such as parts of the Red River Delta facing new kinds of natural resource management and socio-economic problems, or (at least until recently) more marginal areas of the hilly and mountainous zones of the Red River Basin displaying very constraining bio-physical and socio-economic conditions. It is also designed to be suitable for those situations characterized by rapid transformations of agricultural production processes.

Contents of the proposed ecoregional approach

A conventional approach would be to examine the following points in succession: (*i*) the identification of the major development challenges facing the region and their order of importance, (*ii*) their expression in terms of scientific questions and the search for answers which may have already been found, in the region or elsewhere, (*iii*) the definition and implementation of appropriate research methods and protocols to obtain solutions if none are available or applicable, (*iv*) the definition of methods for dissemination of results among the populations concerned and their implementation (*v*) the evaluation of results obtained.

Though this list contains many essential activities, it is not sufficient in itself to form the basis for the organization and long-term management of a research system capable of achieving the objectives presented above.

The first task is, of course, to identify regional challenges and real research needs; it deserves particularly careful attention. This identification

data, often relatively abundant thanks to previous studies in the area. However, this exploratory phase alone is not sufficient to guarantee a relevant and useful research programme since, in this form, it is the scientists who impose their own vision upon the farmers and the economic and political decision-makers.

To ensure greater relevance and efficacy, the next task is to construct an overall diagnosis of the current dynamics of the region in collaboration with the various stakeholders concerned and through their direct involvement in the design of the research project and its institutional organization. This construction, not the product of scientists alone, thus results from consultation and negotiation between a social demand (which must be known) and a supply of research (to be constructed). This negotiation must be established from the outset. After constructing this regional diagnosis, additional research needs can be identified to fill existing knowledge gaps and appropriate research protocols combining surveys, testing and syntheses, can be devised.

However, as work progresses, it would be prejudicial to disconnect the knowledge creation phase from its utilization, allowing researchers to hand over the reins to others after achieving the desired results from their research protocols. On the contrary, there are several reasons why research work and practical implementation of new knowledge should take place side by side. Indeed, it may take a very long time to obtain answers to certain problems, whereas the knowledge already acquired in other areas can be transferred immediately. Research partners would not see any justification in delaying implementation until all results were available. Moreover, researchers would miss an opportunity to test their validity under real conditions. Indeed, it is often through the application of apparently well-proven 'solutions' that their shortcomings are brought to light and that new research needs are identified. The practical application of knowledge for innovation must therefore involve the scientists themselves, working in close collaboration with beneficiaries. Action-research interventions are required to achieve this end.

As it is not always possible to test the application of a research result, other strategies must also be available. The appropriate tool for progressive integration of acquired knowledge and simulation of its application is, of course, a model of the dynamics of the region based on the outputs generated during the phase of preliminary diagnosis. The construction of an overall

representation of the structure and current dynamics of the region therefore lies at the heart of the proposed ecoregional approach. It forms the basis for the diagnosis and identification of research and development needs and can be used to simulate any changes that occur. Defined as the integrated study of bio-physical, socio-economic and policy factors of sustainable development in a given geographic area, the ecoregional approach thus corresponds to a long-term iterative process; its implementation is the progressive construction of a partnership project established between research scientists and key stakeholders operating within the geographical area concerned. Clearly, this breaks down the traditional boundaries between fundamental, strategic, applied and adaptive research categories, as it does between research and development; it is an integrated approach to development-oriented research.

Applying the approach

In this section, we propose to examine three questions successively: the type of geographical area within which the ecoregional approach can be applied, the components of the preliminary diagnosis and, lastly, the regional model and its application. Other important questions, such as the characteristics of thematic research procedures, the dissemination of research results and the assessment of their impact are not discussed here.

Choice of a suitable region

Practically, an 'ecoregion', as defined by the FAO classification of agro-ecological zones,i.e. a vast trans-national area whose boundaries correspond to climatic limits established on a somewhat arbitrary basis, would not be an appropriate choice. Indeed, though climatic and ecological factors are essential for assessing the potential performance of livestock and crops and for analysing the reasons behind current land use practices, they are not enough in themselves. The wide variety of agricultural situations co-existing within a single climatic zone demonstrates that climate is not the only factor to be taken into account, and that certain cultural, social, economic and political factors weigh heavily in the choice of production systems.

It is therefore more practical to delimit smaller areas within the ecoregions where all the factors affecting their dynamics can be examined simultaneously. The chosen study area is therefore a 'region', defined as an

in particular) that they can mobilize to this end, (*iii*) their mutual relations (exchange, competition, etc.) and (*iv*) the rules governing these relations.

Based on such a definition, a region comprises rural areas (in which economic activity consists predominantly of crop and livestock productions and forestry) and urban areas, displaying varying degrees of interactions.

It is also convenient, for an initial analysis at least, to use an administrative subdivision of a state. The situation in such areas is generally documented by thematic maps (soils, climate, roads, railways and energy networks) and by a variety of statistics concerning economic activities and population which, though they must be checked for accuracy, are precious sources of information. Moreover, centres of economic activity and consumption, political decision-making centres and potential research partners are clearly and immediately identifiable at such a scale.

The region may be chosen to include several different climatic (sub-)zones, such as in the case of the Red River Basin. This should not be seen as a complicating factor, but more logically as a necessity when the activities performed in these different zones are complementary and interacting, as is the case between the hilly and mountainous areas located around the Red River Basin and the delta itself with its major urban centers.

The collation of existing data and their synthesis by means of a geographic information system provides a spatial view of the region, of its internal variability, and of the relations between sub-groups defined within it. This synthesis document, enriched over time, can be used for example to select the places where particular research projects are needed and will provide the basis for delineating the domain of extrapolation of their results.

This analytical procedure must be repeated to study the relations and interactions between neighbouring regions (such as the Delta, the hilly 'zone moyenne' and the highlands of the Red River Basin for example), within one or more ecoregions, taking each region as a unit: an ecoregional structure may comprise several entities. It would run contrary to the very objectives of the approach to limit the study of regions to partial analyses through which no overall understanding of each region can be obtained and no valid comparisons made.

Components of the regional preliminary diagnosis

characterization of each of these levels. To examine the higher level of organization, a synthesis of data concerning the previous level is needed. This makes it very difficult to avoid potentially dangerous over-simplification when up-scaling. Particularly, we may lose sight of the diverse patterns of reasoning underlying the actions of stakeholders operating at each of these organizational levels or we may ignore the fact that some of these key actors are involved in several organizational levels simultaneously. To avoid such shortcomings, it is preferable to build up a picture of regional realities by combining several complementary, partially redundant 'points of view' in which the patterns of reasoning of the various actors can be included without necessarily associating them with a single level of organization.

Three points of view together form the foundation of a regional diagnosis:

- Commodity chains constitute the first point of view. They include all the functions (production, processing, marketing) and stakeholders involved in the chain leading from a biological raw material to one or more end-products used by human societies. These commodity chains may (or may not) provide appropriate responses to the quantitative and qualitative needs (food, energy, wealth, work, environment, etc.) of rural and urban populations in the region under study. Both local, domestic and export commodities are concerned, all playing a role - which must be assessed - in the economy of the region. By studying each stage (taking account of the production factors used and their use efficiency) in each major commodity chain, their critical segments, strong points as well as shortcomings can be identified.

- The land constitutes the second point of view. Zoning, based on the variability of the region's physical, economic and human characteristics, provides a basis for surveys concentrating mainly on the farm level[3]. The study of farms in a sample group of villages brings to light the range of production processes used to manage natural resources (by farmers, herders, foresters, communities) and the reasons, of whatever kind, behind the choice of such techniques

3 The term 'farm' is here used in its widest sense to mean a decision-making centre concerning the use of natural resources (and other resources) for production and for the needs of a family group. It includes entities with their own land and those without land; in each case, the multi-activity of each of the actors is taken into account.

(agronomic, [illegible], legal, cultural or social): the [illegible] (competition or synergy) between the various stakeholders at the local level (the village territory), their mode of organization, the pressure they exert on land, must be studied in particular detail to gain an overall understanding of land use and of the results obtained. On this basis, diagnoses can be made concerning: (*i*) cropping and livestock production systems and the reasons for differences between their current performances and their potential output levels, (*ii*) the short- and long-term consequences of human activity on the environment, both in natural and cultivated areas and (*iii*) the assessment of the existing use of resources available in the environment.

- Policies must also be analysed. They concern: prices, credit, exchanges, land ownership and development, demography and immigration. This set of policies, like the operation of markets and the organization of agricultural extension, influences the behaviour of stakeholders, affecting their reactions to uncertainty, unexpected events and contributes to the creation of favorable (or not) conditions for the development of the local economic activity.

For each of these points of view, the analysis concentrates on the situation in the region at the present time. However, aspects of its past must also be known in order to obtain a clearer overall picture of the causal mechanisms that are at the origin of the current situation. In the case of the Red River Basin for example, recent changes in the land tenure systems and their impact on land utilization, demographic trends and inter-regional migrations, evolution of crop yields and farm prices, etc. could be important topics to be investigated.

The regional model and its utilization

The preliminary diagnoses drawn up for each component of the regional analysis give an initial list of questions concerning the region's development, thus providing guidelines for the creation of appropriate research and extension organization and plans. Here the approach is largely thematic in nature.

The integration of the findings from three points of view guarantees that the main stakeholders involved in the dynamics and development of the region, and their interactions, are taken into account in the regional diagnosis. This integration is achieved though the identification of key

regional sub-systems and an analysis of their operation, the typological classification of stakeholders and the spatial representation of data synthesized in a geographic information system. This integration must concentrate on the levels where decisions are taken concerning production choices and natural resource management strategies. At this stage, an additional list of key questions to research can then be identified that will deal mainly with the relations between stakeholders and between the systems they manage.

Starting out from the overall diagnosis, a model of the region's current mode of operation is built up. It will then be used to simulate the changes that occur as a result of variations in major factors such as demography, main production and input prices, land tenure and credit policies, for example, or through the introduction of new technologies.

To make these simulations possible, the model must provide explicit information about the relationships among stakeholders, the activities they pursue and their determinants. It must indicate the linkages between the use of production factors and resources and the levels of production obtained, as well as between the types of land use and their economic or environmental consequences, between the behaviour of stakeholders and their economic, social and cultural environment. To achieve this, certain aspects must be taken into account which, though impossible to quantify, are nevertheless essential for the understanding of regional realities: if the regional model limits its scope to quantifiable data, the true complexity and diversity of the situation may well remain hidden.

Such a tool for monitoring the evolution of a regional agricultural system is enriched over time through the integration of ongoing research and development outputs and their impact on the farms. Beyond monitoring, simulations reveal the variability of economic and environmental results corresponding to different evolution scenarios. They thus bring to light key areas where, for example, new knowledge or new modes of social organization may become necessary in the future.

Conclusions

The organization of research efforts within a specified geographic area is not the only means to perform objective-oriented research. General thematic approaches are equally valid and their results are valuable for regional capacity to take into account simultaneously all the stakeholders (individuals, groups, firms and institutions) operating within an area and whose strategies interact to contribute to the development within the region. This development will not be real and sustainable unless there is a certain rationalization of activities, especially as regards the use of available resources within the area concerned. Of course, research alone does not hold the key to development. However, through an ecoregional approach, it is able to contribute to the definition of ways and means to achieve such rationalization. In the case of the Red river basin site, a key question to be addressed by future Ecor(I) activities will be: what types of coordination mechanisms should be put in place between the increasing number of stakeholders in the market driven regional agricultural economy to bend current practices toward a more productive and sustainable use of natural resources?

We must therefore understand the diversity which exists in the current use of natural resources, in the conditions for acceptance of technological progress and in the strategies used by the various actors to adapt to a constantly changing environment. To achieve this understanding, technical, social, economic and political aspects must be analysed together; the geographic area in question must therefore be viewed as an object of research in itself. Such is the concept presented in this communication. Very practically, Ecor(I) activities will need to be structured in a way that facilitates the comparative understanding of the functioning patterns and interactions among adjacent zones (delta, hilly, mountainous) in the basin.

Today, it is clearly necessary to deepen the ecoregional approach as it is applied in order to prepare for the future challenges analysed in the recent report entitled 'Sustainable Agriculture for a Food Secure World' directed by Gordon Conway. This report highlights the urgency of a new agricultural and ecological 'green revolution' to establish an agriculture which is both productive and in harmony with the natural environment. The regions subject to the greatest constraints are most directly concerned, such as the very densely populated Red River Delta or the fast degrading steeplands surrounding it. The ecoregional approach naturally has a major role to play on the path towards this 'doubly green revolution'.

The national and international research institutions of both industrialized and developing countries have achieved results in many areas, providing useful answers to the needs of developing countries. But these results have

level. This question, which cannot be answered without a major review of the organization and content of development-oriented research, is a major concern, and rightfully so, of most research institutions. The CGIAR, which first coined the term 'ecoregional', the universities and research centres in many countries including, in Europe, those of the Netherlands and France, along with regional organizations of the NARS, are all contributing to this debate. Faced with the urgency, complexity and diversity of the problems to be tackled, these various organizations must join forces to establish the principles and methods for more effective research and to enable development-oriented research to face up to future challenges with greater force and vigour.

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