CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

TECHNICAL ADVISORY COMMITTEE

ROLE OF THE CGIAR IN

NATURAL RESOURCE CONSERVATION AND MANAGEMENT

TAC SECRETARIAT

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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2. Need for CGIAR Involvement in Natural Resource Conservation and Management

The Interim Report (TAC 1989a) presents an overview of the problem of resource degradation in the developing world; only the main points are reiterated here.

In Asia, over-population has increased demand for food and fuelwood but the area of land is limited, so farmers are forced onto more fragile soils. In the irrigated areas of Asia - the mainstay of
the food supply - sustainability of production is threatened by poor irrigation system management, waterlogging, salinization and the depletion of water resources. In some areas erosion from deforested upland soils is causing siltation of water reservoirs, exacerbating the problems in the lowlands. Large areas of acid soils which have been cleared are now infested with pernicious weeds such as *Imperata cylindrica*.

In West Asia and North Africa, land degradation is a widespread problem caused by devegetation of rangelands, bare cultivation of erosion-prone soils and salinization of the limited areas with irrigation. In Africa, where until recently there was generally enough land in reserve to accommodate population growth, too rapid agricultural expansion and inappropriate agricultural practices have depleted soil nutrient reserves, exposed soil to water and wind erosion and led to the desertification of rangelands and widespread deforestation. Extensive clearing of tropical forests for agriculture is also occurring in Latin America where large areas are being cleared for pasture production. Like Africa, Latin America has considerable land resources in reserve but population pressure in some areas is having detrimental environmental effects. A characteristic of the land degradation problem in Latin America, and in the other regions in the developing world, is the strong, possibly causal, link between land degradation and rural poverty in areas with low potential.

The Interim Report (TAC 1989a) lists in Annex I, the major international research needs in the NRCM area and indicates the regions in which particular categories of research are needed. A striking feature of the list is the widespread nature of resource problems which have to be addressed, although research in some categories is inappropriate in particular regions on agro-ecological grounds.

In addition to the NRCM category per se, a number of other research needs are particularly relevant to this study. These are listed in Appendix I. This listing of research needs is both long and complex so it is not possible (or desirable) in this study to attempt a detailed analysis of priorities and strategies. However, some key issues influencing priority setting and some aspects of the unique characteristics of research on NRCM which bear on strategic planning are briefly discussed.

(a) **Long-term nature**

Many problems with resource degradation develop slowly and require long-term, often painstaking research. Benefits and impacts are much harder to measure than in the case of research on commodities, especially varietal improvement.

(b) **Inadequate data for priority-setting**

Unlike research focussed on particular commodities for which economic quantitative models are available to assist priority-setting, research on NRCM is difficult to prioritize. Data on the impact of resource problems such as soil erosion or salinization on crop or animal production are difficult to gather and the added dimension of off-site effects adds to the difficulty of prioritization on an economic basis. Other criteria such as ecological impacts, loss of biodiversity, area affected and numbers of people, especially the poor, can be included in
the analysis of priorities. Such an analysis is currently being carried out by the TAC Standing Committee on Priorities and Strategies.

(c) **Favoured versus less favoured areas**

The sustainability paper (TAC 1988) states that increased attention should be given to less favoured areas. These areas are particularly subject to resource degradation processes because farmers there are poor and may have an exploitive view of land husbandry. Nevertheless, resource degradation in favoured areas, such as salinization of irrigation areas, should also be given high priority because large numbers of urban poor rely on the marketable surplus from these areas. Research strategies have to strike a balance between the favoured and less favoured areas.

(d) **Location specificity**

This issue bears on both the nature of the problems and the research needed to help solve them. Each farm does have a unique resource base (TAC, 1989a) but the processes of land degradation which farmers face are widespread. Research on these resource problems can be dealt with at the sub-national, regional or global level, but the work is difficult unless agro-ecological classification schemes, which provide a framework for problem definition and research planning, are used.

(e) **Multidisciplinary systems approach**

Resource problems generally can only be tackled effectively by research with a farming systems perspective. The productivity of a farm over time will be determined by the farmer’s resource endowment and socio-economic environment, both of which are strongly interdependent. Research on resource management is component research, in FSR terms, just as commodity research is largely component research (Lynam and Herdt 1988); research on both components should have a farming systems and a sustainability perspective.

Taking stock of the issues discussed so far, we can conclude that major problems with natural resources are detrimentally affecting agricultural productivity in the developing world; that research on a number of key issues (See Annex I, TAC 1989a) is needed to help overcome these problems; but that the research needed is made difficult by its long-term nature, location specificity and complexity. These characteristics may explain the relative neglect of research on natural resources within the CGIAR Centres which have generally and successfully capitalized on a multidisciplinary commodity approach which is more clear-cut in terms of prioritization, research organization and impact assessment. However, the question arises as to whether or not research organized on a commodity basis can adequately deal with the multicommodity, and generally more complex problems of NRCM.

Since NRCM research is usually location-specific, national agricultural research systems must take primary responsibility for work on resource degradation problems. Nevertheless, as stated in the Interim Report (TAC 1989a) international research centres can contribute by (1) clearly defining the magnitude and potential future consequences of the process; (2) by contributing methodology for characterizing, analyzing and evaluating interventions in major ecological zones; (3)
collecting, evaluating and disseminating available information from the
global research community that is relevant to national policy choices;
(4) doing actual research on a selective basis to both develop
methodology and basic information and to provide examples of how to do
it; (5) providing training; and (6) exploring appropriate institutional
and management approaches.

3. Current and Planned CGIAR Activities

In addition to the stock-taking of NRCM research in Annex II,
information is available in the reports and strategic plans of the
Centres, in the March 1989 Consultants’ Report on NRCM (TAC 1989b) and
in Annex I of the TAC (1988) paper on sustainability; panel members are
referred to these documents for a detailed listing and analysis of
research activities.

The proportion of current budget and senior research staff at
CGIAR Centres devoted specifically to NRCM research is listed in
Appendix II. This information is based on a more detailed analysis than
Appendix II gives the impression that the CGIAR Centres are not doing
much on NRCM. However, this is to some degree misleading. For example,
ILCA is active in research on animal traction aspects of Vertisol
management and on alley-cropping but only the specific soils research
component is captured in the 3% budget allocation indicated in
Appendix II. Using ILCA again as an example, it should be noted that
research on biological nitrogen fixation is not included in the 3% but
is categorized under crop productivity (plant nutrition). However, the
soil microbiologist involved in the work is included in the analysis of
staff in Appendix II. Thus, the detailed analysis of budget allocation to
NRCM and the other research categories relevant to this paper (See
Appendix I) is complicated and difficult given the multidisciplinary mix
of commodity agro-ecological and resource management programming in the
CGIAR system.

The commodity improvement programs at the CGIAR Centres are
generally very strong and have tended to emphasize genetic tolerance as
a solution to various resource-related constraints (See TAC 1989b). For
constraints such as soil salinity and acidity, and nutritional
deficiencies, some progress has been made in developing tolerant
varieties for some of the major crops. This is an attractive approach
from the farmers point of view but in some cases it can only be a
stop-gap measure. For example, developing varieties which are more
efficient at absorbing a major nutrient such as phosphorus may be
effective in the short-term but will ultimately exhaust soil phosphorus
reserves to the extent that inputs of phosphorus fertilizer will be
required to sustain yield.

Although a detailed mechanistic analysis of Centre activities and
budgets in the NRCM area is not feasible, the following aspects of the
current and planned activities of the CGIAR Centres should be considered.

The commodity mandates of the Centres are the major driving force
in the programs of all Centres. For CIMMYT and CIP, crop productivity
improvement is by far the dominating activity. Even in Centres with a
regional or agro-ecological mandate - CIAT, ICARDA, ICRISAT, ILCA, IITA
and WARDA - the largest proportion of research expenditure is devoted to
commodities for which particular Centres have been given global or
regional mandates. The relative neglect of research on NRSM at the Centres could in a way have led to the creation of non-associated Centres which developed programs on agroforestry (ICRPF), soils (IBSRAM), fertilizer (IFDC) and irrigation (IIMI) and thus filled gaps in research coverage by the CGIAR System. Consequently, the CGIAR Priorities and Future Strategies paper (TAC 1987) recommended that the CGIAR Centres retain their commodity focus but at the same time work closely with the non-associated Centres.

TAC's past strong encouragement of a multidisciplinary commodity approach to research has tended to reinforce the commodity improvement programs in the CGIAR Centres, although the farming systems research programs did counterbalance this trend. Farming systems programs in some Centres were the repository for research on natural resources (and for quite a number of economists) but Centres such as ICRISAT, ICARDA, IITA and ILCA have recently reorganized and re-titled these programs as Resource Management Programs. Furthermore, the medium-term (5-year) plans of a number of these Centres include a request for an expansion of the budgets of their Resource Management Programs, although this expansion is commonly categorized desirable rather than essential.

A number of Centres, including a commodity-based Centre like IRRI, have strong programs aimed at characterizing the agro-ecological environment of their mandate areas, devising sustainable production systems for these areas, and, in a few instances, measuring the impact of these improved systems on the resource base. Technology options under development include pasture-cereal rotations (ICARDA), alley-cropping (ILCA and IITA), pastures for cleared acid forest soils (CIAT) and soil surface management for Vertisols (ICRISAT and ILCA). However, very few studies of the impact of these technologies on the soil resource have been undertaken to provide a sound scientific basis for improvement and extension of such technologies. When the widespread importance of erosion is considered, it is somewhat surprising that programs of research focused specifically on soil erosion management have been conducted at only three Centres (IITA, ICRISAT and CIAT). The IITA and ICRISAT research has made invaluable contributions to the understanding of the effects of land management on soil erosion in the humid and semi-arid tropics respectively. Research in this area in these Centres is currently under review but recent staff changes have led to a major reduction in research on soil erosion at IITA. A key issue will be the extent to which the past on-station research can be extended to on-farm experiments.

Agroforestry has an important role in stabilization of the landscape, so within the CGIAR System, production-systems research by some commodity/resource-management centres has incorporated trees as well as livestock. Examples are, IITA's alley farming; ICRISAT's pigeon-pea or widely spaced acacia trees in millet/sorghum farming systems; ILCA's multipurpose trees as part of its feed-resources thrust; CIAT's alternative silvi-pastoral technology or the use of support trees for bean-poles; IBPGR and its forest tree or tree cash crop gene pool; and IFPRI and its policy study with CIAT in Peruvian Amazon.

Centres are currently engaged in a review of their activities on the issue of sustainability through a committee chaired by Dr. Swindale of ICRISAT. The first draft report of the committee has recommended that long-term experiments aimed at measuring the impact of technologies on the resource base be established, although the funds for such
research would have to be found. A revision of the report after a recent meeting of the committee will soon be available.

Research on irrigation water management is restricted to rather limited activities at IRRI and WARDA although ICRISAT has undertaken some research on water storage in the SAT. On the other hand, fertilizer management is a research topic on the program of virtually every Centre. Because of the location specificity of fertilizer agronomy, much of this type of research has been left to national programs. For rice, the International Network on Soil Fertility and Sustainable Rice Farming (INSURF) network provides a mechanism for supporting innovative research on nutrient management amongst national programs; INSURF involves IFDC as joint coordinating agency with IRRI.

Much of the training in the CGIAR Centres is focussed on aspects of research on their mandate commodities, so relatively few individual or group training programs on NRCM research are available at the Centres. However, a number of such programs are carried out in collaboration with the non-associated Centres. The support from the CGIAR for national programs in the NRCM area is also relatively small. In many countries, research institutions working on NRCM issues are administratively separate from the crop research institutes which CGIAR Centres normally support.

Policy analysis on NRCM issues has recently been given increased emphasis at IFPRI where a major expansion of such research is under consideration. IFPRI has been actively engaged in research on policy aspects of irrigation and fertilizers for some time because the analysis of policy options and impacts of these two inputs to crop production is of vital interest to developing country governments. Currently, IFPRI is looking particularly at research on forestry and land-use policy.

4. Current and Planned NAC Activities

4.1. IBSRAM

IBSRAM was created in 1983 to "promote and assist applied soil research into the identification, development, use, management and protection of soils and lands for food production and other agricultural or agroforestry purposes, so as to enhance economically sustainable production in developing countries". IBSRAM’s programs, strategy and mode of operation is described in detail in the report of the TAC Fact-Finding Mission. IBSRAM is based in Bangkok in offices provided by the Thai Department of Land Development, perhaps underlining IBSRAM’s close association with national programs.

IBSRAM does not undertake research itself but promotes research on soil management problems by national programs in developing countries. Through a series of global and regional workshops on soil constraints, national programs have been organized into enabling networks* coordinated by IBSRAM to focus on a few major land management problems.

* Defined in TAC (1990)
To varying degrees dependent on donor support, these networks have been established on a regional basis in Africa and Asia. The network members undertake a common core experiment designed at inaugural network workshops by national program scientists in collaboration with scientists from the CGIAR Centres and other experts in the field; these include biometricians, social scientists, agronomists and soil scientists. IBSRAM advocates a multidisciplinary approach but the main emphasis of the research is on soil and crop management practices designed to overcome the key constraints which are the topics of the network, e.g. 

(a) management of vertisols
(b) management of acid tropical soils
(c) tropical land development and management.

The field research conducted by national programs in the core experiments is adaptive research but some of the detailed measurements, at the site and the associated satellite experiments, designed to address particular issues, are applied research (See Appendix IIIa-d). As the networks identify gaps in more basic understanding of soil management issues, IBSRAM would like to become involved in strategic research, presumably through contracts to universities and other advanced institutions.

IBSRAM has been quite active in the publication of workshop proceedings and recently published the first of a new series of soil management abstracts. IBSRAM also publishes methodology manuals tailored for particular networks and uses these in the training courses which precede each network program. These activities are designed to strengthen the capability of national programs, a central function of IBSRAM.

Because IBSRAM's fledgling activities have not yet borne fruit, it is difficult to assess the effectiveness of their role as broker and promoter of soil management research by national research agencies. Obvious problems have been the fact that IBSRAM does not have a large enough core staff and the difficulty of gaining sustained core donor support, which reflects in the staffing pattern and programming. It should be remembered that the original model for IBSRAM was that of a small agency like IBPGR - "a body coordinating what others do and a provider of some resources to get the job done" (Brady 1980). On this point, it should be noted that, whereas IBPGR began with the mandate of being a facilitator of research on germplasm collection rather than being an active research agency, TAC and the CGIAR subsequently supported the development of a critical mass at IBPGR of research on germplasm collection and preservation. TAC might require IBSRAM similarly to develop a critical mass in house or, as a minimum, require that one or more national programs in each IBSRAM network provide a strong scientific input.

4.2. IFDC

Established in 1974 in Muscle Shoals, Alabama, IFDC focuses on the research, development and transfer of appropriate fertilizer technology and related know-how that can increase and sustain food and agricultural production in developing countries at the lowest possible cost. IFDC programmes in research, technical assistance and training are designed to achieve three major objectives:
- to improve efficiency in fertilizer production, procurement and marketing, and to increase the availability of appropriate fertilizers to farmers at the lowest possible cost while emphasizing the use of indigenous raw materials;

- to increase fertilizer use efficiency in food production;

- to assist in the training of personnel needed in developing countries in the production, marketing and use of fertilizers.

As described in the report of the TAC Fact-Finding Mission to IFDC, the Centre has a long list of research achievements and activities and has recently expanded its African programs through the establishment of an Africa Division based in Lomé, Togo.

At IFDC research accounts for 52% of the budget (See Appendices IV a-d). According to IFDC, the research effort is divided evenly between strategic, applied and adaptive research categories. Much of the research on fertilizer efficiency is organized to focus on three basic nutrients—nitrogen, phosphorus and sulfur. Collaborative arrangements with CG Centres and national programs, commonly organized into networks, have been made to handle the agronomic aspects in the field. IFDC’s comparative advantage lies with its unique multi-disciplinary teams of chemical engineers and agronomists. The engineers and fertilizer technologists are able to characterize indigenous phosphate deposits in the developing countries, devise low-cost processes for treating such deposits and develop improved nitrogen and sulfur fertilizer products. In addition, IFDC has developed a capacity for research on socioeconomic and policy aspects of fertilizers and on modeling crop response to fertilizer. A comprehensive listing of IFDC’s research can be found in Appendix IVb.

IFDC has recently initiated four networks in Africa (Appendix IVc). Probably because a number of the collaborating national programs are relatively weak, two of these programs are enabling networks and one also involves institution building. In the fertilizer efficiency area, the networks involve testing and evaluation of new indigenous fertilizer sources and management practices in multi-location trials. A recent feature of the experiments in Africa is the consideration of aspects of nutrient cycling from organic nutrient sources as well as chemical fertilizers. IFDC’s move into this area and into research on aspects of environmental pollution is foreshadowed in the Centre’s 10-year plan.

In addition to its involvement in the core research programs aimed at improving fertilizer use efficiency, the IFDC Fertilizer Technology Division is heavily involved in one-off activities which involve some research on fertilizer processing but are more appropriately described as technical assistance. For example, a private or government sector fertilizer producer may contract IFDC to develop or test an improved process for beneficiating an indigenous phosphate ore. Such activities are short-term in nature and are done by IFDC on a reimbursable cost basis. The Fertilizer Technology and the Outreach Division take major responsibility for the various technical assistance projects which have totalled 300 since the Centre’s establishment in 1974. These projects covered aspects of fertilizer use, fertilizer marketing and distribution, and fertilizer sector planning and institutional development in addition to the fertilizer production area mentioned above.
IFDC has a major training program which covers aspects of fertilizer use, production and marketing. Both general (group) and specialized (customized) training programs are organized. The general programs are held on a fee-paying basis to help defray IFDC's costs. Some of the training materials are published and are widely used as resource materials. IFDC has published a number of technical bulletins, reference manuals and selected proceedings of IFDC workshops. Research results are widely published in international scientific journals. IFDC staff have access to literature on all aspects of fertilizers through the library of the National Fertilizer Development Centre of TVA at cost, provide the main justification for basing IFDC in Muscle Shoals.

4.3. IIMI

IIMI was established in Sri Lanka in 1985 and has the mandate to strengthen national efforts to improve and sustain the performance of irrigation systems in developing countries, through the development and dissemination of management* innovations. The strategy of IIMI is described in their publication "Managing Irrigation in the 1990's". IIMI's approach is to undertake multidisciplinary research and projects with a systems approach to irrigation management. The Institute's strategy is to develop management innovations through research and help national irrigation management institutions to originate, implement and adapt such innovations independently under national and more localized conditions.

The core research of IIMI has been termed thematic research and is concerned with seven main program themes.

- Institutions for irrigation management
- Management of change in the institutions of irrigation
- Management of water resources for irrigation
- Management of irrigation facilities
- Management of irrigation organizations
- Management of financial resources for system sustainability
- Management of irrigation support services for farmers

The research on these themes includes aspects of the management of organizations, of financial resources and of institutional change as well as broader socio-economic and, to a lesser extent, technical aspects of irrigation management. The extent to which these themes are researched depends to a large extent on the levels of core funding and the time and facilities available to Headquarters staff to undertake field operations in Sri Lanka. IIMI Headquarters recent move to Colombo may have necessitated some re-organization of the thematic research activities. Appendix V a provides a listing of the proportions of IIMI's budget devoted to different activities.

* IIMI defines irrigation management as the process that institutions or individuals employ to set objectives for irrigation systems; establish appropriate conditions; identify, mobilize and use resources to attain these objectives while ensuring that these activities are performed without adverse effects.
The majority of IIMI's program resources are devoted to research projects in collaborating countries chiefly in Asia. The large number of projects in Pakistan led IIMI to create a separate Division to direct programs in that country. The size and duration of these special projects varies considerably as do the topics covered. Brief descriptions of these projects can be found in Annex 3.1 of the report of the TAC Fact-Finding Mission. Many of the country projects listed are location-specific and appear to involve a large measure of technical assistance and institution building as well as action research. It is not possible at this stage to gauge the impact of these projects because most of them have been initiated only in the past 3-4 years.

IIMI has developed a collaborative network on irrigation management for diversified farming in rice-based farming systems in which IRRI also plays a role (see Appendix V b). Other networks include one on farmer-managed irrigation systems and another with the Overseas Development Institute which provides a mechanism for information exchange on irrigation management. IIMI has established an Information office which publishes a wide range of reports, newsletters and seminar proceedings. IIMI's training program promotes opportunities for training in irrigation management at the postgraduate and post doctoral level as well as through on-the-job training and training courses. However, in 1989 IIMI devoted only 7% of the total budget to training.

4.4. ICRAF

The mandate of ICRAF is to initiate, support and collaborate in research leading to the productive and sustainable land-use systems through the integration of woody perennials into crop and livestock systems. The overall mission is to increase the social, economic, and nutritional well-being of the peoples of developing countries through the promotion of agroforestry systems to achieve better land use.

ICRAF has evolved over the years from an information council function to hands-on research on systems emphasizing multipurpose tree species (MTP) and the tree-crop-pasture-animal interface.

ICRAF operates through three separate but collaborative divisions: The Research and Development Division, developing and applying methodology for strategic and applied research at the tree/crop interface. The Collaborative Programme Division, developing and adapting agroforestry technologies in selected ecozones, and providing training for national collaborators, and the Communication and Information Division targeting information for a variety of audiences including national programmes and the world scientific community. All three Divisions are contributing to national institution-building in agroforestry.

During the period from 1986 to 1990 ICRAF's operational expenditure increased at an annual average rate of 29%. Expenditure for research has shown the most dramatic increase from $0.52 million (20.1% of total operating expenditures) in 1986 to a projected $4.15 million expenditure (50.2%) in 1990. Expenditure for development of national research capacity increased from $0.97 million in 1986 to a projected $2.58 million in 1990. Expenditure on general administration has declined from 42.5% of the budget in 1986 to 23.6% in 1988 and a projected figure of at around 18% in 1990. The norm for the CGIAR Centres is 55% for research and 21% for research development capacity and administration respectively.
ICRAF has provided a focal point for the development of agroforestry as a discipline and in generating research methodology in the diagnosis of agroforestry systems and the design and implementation of agroforestry experiments. ICRAF has a wide area of formal and informal links with other IARCs, i.e. the alley-farming network in Africa with IITA and ILCA (AFNETA) and a formal agreement with ICRISAT. ICRAF has also been working with other international bodies (e.g. FAO, THSS, TUFRO, NFTA and WMO); regional organizations (e.g. CATIE, IITA, Searca) and national research institutions (e.g. KEFRI, ICAR, BARC, etc) (see Appendix VI a-c).

The location specificity of agroforestry research demands a rather high proportion of research being devoted to learning from farm-situations. This and the absence of any institutional framework for agroforestry in most developing countries have required ICRAF to mobilize policy support as well as technical and financial resources to work across existing national research and development institutions in both agriculture and forestry.

With the withdrawal of IDRC as an executing agency and divestiture by the donor groups of all power to appoint trustees on the ICRAF board as of April, 1981, ICRAF's legal status and governance have been brought in line with those that typically exist for CGIAR Centres. Trustees to the board are appointed in their own capacities while the donor-support group provides the secretariat to the Centre.

A serious problem for ICRAF, highlighted by the External Review Panel and the Donor Support Group, has been the balance between core and project funds and the financing of core commitments from project funds. The management is taking a number of steps to erase the core-fund deficit and to build a working capital fund of $600,000.

5. Overview of Gaps and Overlaps

Annex II in the Interim Report (TAC 1989a) provides a provisional detailed listing of research needs and indicates which research categories are covered by CGIAR and Non-Associated Centres, and therefore provides a useful framework for this discussion of gaps and overlaps.

5.1. Global environmental concerns

The two-sided coin of impacts of global change on agriculture and contributions of agriculture to global environmental change is currently the mandate of a number of national and UN agencies - e.g. International Committee on Climate Change - and of non-government organizations - WRI, ITED, IIASA. This is an important and controversial area on which TAC and the CGIAR should maintain a watching brief. The current lack of a major CGIAR research involvement is probably appropriate given the uncertainty surrounding the predictions of global climate change.

5.2. Soil conservation and management

Gaps in this broad category, as with a number of others, are evident in depth of coverage as well as in breadth. For example, FAO has recently developed a Soil Conservation Strategy for Africa which documents the rapid degradation of that continent's soils. Under
research needs, FAO points out that basic research data on the effects of soil erosion on crop productivity are lacking in most countries. Research is needed on the effects of crop residue management and on traditional African soil conservation measures. Although IITA, CIAT and ICRISAT have undertaken some work on soil erosion management, and IBSRAM’s networks are supporting national programs in this area, more research is needed. Since the problems are location specific, national programs must undertake the adaptive research needed to solve the problem. However, international centres can help by organizing supporting networks and undertaking research on methodology and on the basic principles governing soil loss and the conservation of soils using various practices. The geographic coverage of this research should also include areas of Latin America and Asia where the cultivation of marginal steeplands is causing serious environmental problems. Hydrological processes and surface runoff effects in steepland areas with high rainfall intensities are not well understood and require further strategic research.

Other aspects of research in this category, such as acid soil management and the study of the soil nutrient economy, may be subject to some overlap, particularly in West Africa where IITA, IFDC and IBSRAM have active programs. The relatively weak national programs in this region may be having some difficulty in satisfying the competing demands of the network programs of the different centres. The same research categories are however relatively neglected in the upland areas of Asia, where the national programs are generally stronger than those in Africa and are likely to benefit from further network activity.

5.3. Water conservation and management

According to a recent in-depth review by the ICID and World Bank as background to a proposal for a new research institution, IRRI and IIMI research on irrigation management leaves a number of gaps on technical aspects of irrigation and drainage. The report gives highest priority to research on design for water control; waterlogging and salinity; maintenance of irrigation systems; and the adaptation and adoption of modern irrigation technologies (World Bank 1990).

5.4. Land-use management

As pointed out in the Interim Report, this is a neglected area especially in the sub-category of watershed management. The forestry research initiative and this consideration of natural resources research are concerned with a number of common areas but watershed management is perhaps the most important common topic which has been neglected by both CGIAR Centres and NACs. This neglect raises the question as to whether a special study of research needs in the field of watershed management in the context of the CGIAR should be commissioned by TAC.

5.5. Development of production systems for sustainable resource management

A number of CGIAR Centres and NACs are engaged in this field which like watershed management links across to the agroforestry area. A major gap highlighted by Dr. Swindales’ committee on sustainability is the lack of long-term experiments designed to determine the sustainability of the production systems being developed by the various research centres.
5.6. **Plant nutrition**

With the establishment of IFDC African Centre in Togo there appears to be a risk of overlap in research designed to improve nutrient use efficiency in the farming systems of West Africa. Cooperation between IITA and IFDC will reduce this risk which was not a potential problem until IFDC established its own field agronomic research capability at the Togo Centre.

5.7. **Afforestation techniques for wasteland reclamation**

This is another field with links to the forestry initiative. Wasteland reclamation has not received much attention from the CGIAR Centres yet large areas of the WANA and Asian regions are covered with saline soils while vast areas of the humid tropics have a problem with the weed *Imperata cylindrica*. More work on some aspects of wasteland reclamation would appear to be warranted particularly in Asia where the people affected are amongst the poorest in the region and where land is scarcest. The focus of any additional research would have to be carefully planned to avoid overlap with the programs of existing national and regional institutions, some of which have a long history of research in this area.

5.8. **Human health hazards**

In the Interim Report reference is made to research on human disease hazards in irrigation agriculture and in relation to water and pesticide management. It would be inappropriate for the CGIAR to take up a major program on these human health issues which are the responsibility of other international agencies like WHO. Nevertheless, pesticides can have other negative ecological effects in intensive production systems so this research gap has direct implications for the CGIAR mandate and further research in this area is warranted.

5.9. **Policy research**

Increased research on a wide range of resource issues is needed (TAC 1988). IFPRI has recently proposed a major expansion of research in this area including forestry policy issues. This expanded activity should adequately fill this gap if funds are found to support it.

5.10. **Institution building**

This general category includes training, information dissemination, research on institutional systems, strengthening national systems, technical assistance, and networks. IBSRAM, ICRAF, IFDC and IIMI spend a large proportion of their budgets on institution building activities and relatively less on NRCM (See Annex VII and Page 61 of the Interim Report). However, it should be noted that the institutions assisted by the CGIAR Centres are generally involved in crop or livestock research whereas IBSRAM, ICRAF, IFDC and IIMI generally support NRCM institutions in developing countries.

5.11. **Transnational/global issues**

As discussed on Page 50 of the Interim Report (TAC 1989a), some major resource problems transcend national boundaries. Examples are siltation and salinity problems which occur in major rivers flowing...
through a number of countries. Pollution, wind erosion, and the migration of pests are other important examples. Intergovernmental or UN agencies play a key role in organizing development activities to remedy such problems but the research needs are less well supported by international agencies. The CGIAR could play a greater role in such research aimed, for example, at gaining a better understanding of policy and technical aspects of river basin problems. However, some reorganization of the CGIAR on a regional agroecological basis might be a precondition to justify CGIAR taking on such work.

6. Research by Other Organizations

6.1. National research programs

Research on NRCM is largely location specific so it is particularly important that national research programs develop a strong capacity in this area. All developing countries have established programs on some aspects of research on natural resources which in the context of this paper, is very much multi-faceted and includes research on soil and water management, agroforestry, land-use, plant nutrition, fertilizer production, human linkages in irrigation systems/health aspects, livestock systems and resource and environmental policy. In many developing countries research and development aspects of these issues are commonly handled by a number of different ministries and agencies such as Departments of Land Development, Forestry, Resources and the Environment, Minerals and Mining, Irrigation and Water Resources, Industrial and Chemical Development, etc., as well as the Departments of Agriculture. A detailed analysis of the organization and effectiveness of these agencies is beyond the scope of this paper; ISNAR undertakes such analyses in some of their country studies.

In many Latin American and Asian countries, the strong crop research institutions which have been developed have benefitted greatly from the support, training and collaboration provided by the existing CGIAR Centres. National programs in the NRCM field have however been relatively neglected and their capability in terms of research staff trained at the Ph.D. level is commonly far weaker than those in the crop improvement area. This difference in capacity for research is somewhat paradoxical since the national programs are weaker in the area of NRCM research which, on the argument of location specificity, is the area for which they should be taking a major responsibility. This raises again the argument about the role of international research Centres in the NRCM (See section 2).

It is clear that research networks have an important role in providing effective support to national programs in the NRCM area. The various types of networks are described in the paper on Activities and Modes of Operation within the CGIAR (TAC 1990). Because national programs of different countries vary considerably in their capability to conduct research, they need different amounts and types of financial and technical assistance to be effective. Enabling networks are obviously considered by some NACs (e.g. IRISRAM, ICRAF and IFDC) and donors, to be a cost-effective way of assisting national programs in NRCM. Other NACs (IFDC and IIMI) also support national programs on a bilateral basis in what are essentially technical assistance programs. These activities are "difficult to reconcile with the basic precepts of the CGIAR" (TAC 1990).
6.2. International research programs

Donors are supporting NRCM research through a wide range of bilateral, multicountry bilateral, and multicountry mechanisms and agencies. Some of programs with a more international mode of operation are briefly described below.

(a) **UN Agencies**
- FAO has major programs in the areas of soil and water management, forestry, fertilizers and resource inventory. A number of networks coordinated by FAO support research by national programs in these fields.
- UNEP has conducted programs concerned with environmental protection and resource conservation. The plan to combat desertification is a major UNEP activity as is their organization of the International Committee on Climate Change. The latter also involves WMO.
- UNESCO supports a number of resource conservation activities including the Man and the Biosphere program which covers issues such as the ecodevelopment of degraded lands. The Tropical Soil Biology and Fertility Programme (TSBF) based in Nairobi has recently initiated a network to research changes in soil fertility and biology in different natural and agricultural ecosystems.
- UNIDO is involved in the fertilizer production and data collection area.

(b) **World Bank** - In recent years the World Bank has greatly strengthened its activities in the environmental and resource conservation area. Recently the Bank has sponsored a new initiative with ICID to review irrigation and drainage research needs with a view to establishing a new institute in this field. This initiative is discussed in Section 5.3.

(c) **IUCN** - The IUCN is heavily involved in the conservation of soil, water and living resources, which is supported through information exchange and field operations.

(d) **IIED** - The IIED is involved largely in information and data collection, analysis and dissemination. Their publications on the economics of sustainability and on agro-ecosystem analysis are very relevant to the NRCM field.

(e) **IIASA** - IIASA has a small but important program in the resources/environment area; publications on the impact of climate change and on water resources are very relevant to the issues under consideration.

(f) **WRI** - WRI has established a reputation for data collection and analysis in the resources field and has played a key role in the formulation of the Tropical Forestry Action Plan.

(g) **ISRIC** - ISRIC has undertaken a number of international programs including a recent UNEP-funded project on the Global Assessment of Soil Degradation (GLASOD).
ICIMOD - ICIMOD is concerned with mountain environmental management and farming systems.

CSC - The CSC has recently launched a network program on the Amelioration of Soil by Trees.

IBSNAT - The IBSNAT program is concerned with the use of crop growth models in the transfer of technology, is funded by USAID and employs a network approach.

TROPSOILS - TROPSOILS has developed and tested a number of new cropping systems largely on acid soil sites in the humid tropics of Africa, Asia and Latin America and is funded by USAID.

SMSS - The SMSS has endeavoured with USAID funding to encourage the use of the US Soil Taxonomy by national programs.

ACIAR - ACIAR has developed a number of multicountry collaborative research projects on aspects of forestry and fertilizer and soil management.

Fertilizer Associations - A number of international fertilizer associations, many of which are groupings of fertilizer producers, conduct market and economic research on fertilizer production and trade.

IILRI - Based in the Netherlands, IILRI’s program concerns aspects of land reclamation and drainage including assistance to an International Waterlogging and Salinity Institute in Pakistan.

7. **Preliminary Conclusions and Future Institutional Options**

This review of research needs on NRCM has revealed a number of key areas in which CGIAR programs might be strengthened in order to fulfill better the stated goals of the CGIAR. These areas are:

- soil conservation and management;
- water conservation and management;
- land-use management;
- development of production systems for sustainable resource management;
- afforestation techniques for wasteland reclamation;
- human health and ecological hazards from agrochemicals;
- policy aspects of irrigation, environmental degradation and land-use management; and
- institutional building in the NRCM field.

A number of these areas are covered by IBSRAM, ICRAF, IFDC and IIMI but this complementarity in program area coverage is not clear cut because the modes of operation of these NAC differ from that of the "traditional" model of a CGIAR Centre. This issue is discussed in detail in the paper on Modes of Operation (TAC 1990). However, it is pertinent to the specific issues covered by this paper to point out that (1) IBSRAM was created to coordinate and support national programs along the lines of IBPGR rather than an IRRI or CIMMYT; (2) IFDC has a major program of technical assistance to fertilizer industry which is quite different from any existing CGIAR Centre activity; (3) IIMI’s program involves a large
number of bilaterally funded projects involving technical assistance to irrigation agencies.

On the question of IIMI's program, it is noteworthy that TAC's Conclusions and Recommendations on Water Management (TAC 27 in 1982) included the statement.

"The programme of the institute must be innovative and imaginative in its conceptual approach by which it will address complex problems in a comprehensive and integrated manner, in close collaboration with national programmes but with relatively limited means in terms of staff and facilities. It would differ considerably in this respect from the existing model of international Centres. It will also differ from it by the nature of its output which will be essentially in terms of methodologies and know-how in management of present and future irrigation systems."

Thus, in 1982, TAC considered that a departure from the traditional CGIAR Centre model was warranted in the case of irrigation management. Of course, the extent to which IIMI - and IBSRAM, ICRAF and IFDC for that matter - have been able to plan and implement programs with a long-term perspective has been greatly hampered by the lack of the assured core funding which goes with membership of the CGIAR.

In the context of these comments the following tentative institutional options are proposed. These options are in a sense examples only and the panel should not feel constrained from proposing entirely different options. Note that institutional options for agroforestry and forestry are considered in the companion paper referred to above.

(a) status quo option

The NACs could continue to operate outside the CGIAR and to cooperate with the CGIAR Centres. The CGIAR Centres could continue to strengthen some aspects of their NRCM programs but without any major change in mandate or focus. Under this option the NAC's might decide to join with other resource Centres to form a separate but similar group to the CGIAR. Such a resources-oriented CGIAR would provide donors with a more efficient mechanism for oversight of the NAC's and would possibly provide the NACs with a more assured funding base. An arrangement like this was proposed at the mid-term CGIAR Meeting in Berlin.

The main pros of this status quo option are that the CGIAR system would retain its current focus and a major reorganization would be avoided. The main cons are that CGIAR research on NRCM would not be strengthened, donors would have to set up an alternative structure for review and monitoring of the NACs, and the programs of the NACs would continue to be diverted from their long-term strategies by bilateral and other short-term funding.

(b) NAC inclusion option

When deciding whether or not IBSRAM, IFDC or IIMI should be taken into the CGIAR, TAC would have to consider carefully whether, as discussed above, all of the current programs fit the CGIAR mandate and comparative advantage. For example, the technical assistance programs of IFDC and IIMI, and the weight given them by these organizations,
would constitute a change in approach were these activities included in a CGIAR Centre. It is possible that parts of the NAC programs could be taken into the CGIAR whereas others could continue to be funded independently but remain part of that NAC's program. For example, the agronomic, economic and fertilizer technology research and training at IFDC and the network program of their Fertilizer Centre in Togo appear to be compatible with CGIAR goals and could be taken into the CGIAR as a core part of IFDC's programs. Other more commercial parts of IFDC's program could continue but be funded separately and not be subject to TAC and CGIAR processes of review and monitoring. At IIMI, activities in the category of thematic research are more international in character and would more appropriately be taken into the CGIAR than the location specific, bilaterally funded country projects which are IIMI's main mode of operation. In the case of IBSRAM, the network mode adopted by this Centre involves financial support to national programs but, depending on how TAC's policy on this evolves, this approach may not preclude membership of the CGIAR.

Selective rather than total inclusion of NACs might be difficult to engineer. Furthermore, this could raise problems of critical mass which could be overcome by strengthening and expanding those parts of the NAC programs which were included in the CGIAR. This strengthening would be facilitated by the assured core funding which CGIAR membership would bring and might also attract high calibre staff to these Centres. One alternative way of handling this problem would be to recommend amalgamation of two or three of the NACs into one large Centre, although the compatibility of the research programs would have to be considered carefully. Another alternative solution to the problem of critical mass would be for one or more of the NACs, or parts of their programs, to be based at, even subsumed within, one of the existing CGIAR Centres. Admission of IBSRAM, IFDC and/or IIMI in part, or amalgamated with one another, or with CGIAR Centres, would require a careful consideration and allocation of mandates for various aspects of NRCM. TAC would have to play a role in sorting out these issues possibly through a stripe review of research on NRCM (See Option (d) below).

The main pros of the NAC inclusion option are that the CGIAR system would strengthen its research effort on NRCM and broaden its modes of operation to include institution building of national programs in the NRCM area. The main cons are that the CGIAR could be diverted from its current focus and that the system could become too large to be manageable.

(c) regional centre option

Since the natural resource problems and research are largely location specific, the organization of CGIAR research in this area would benefit greatly from an agro-ecological approach grouped by region into Regional Agroecological Research Centres. In this way the national programs, which are directly responsible for much of the location-specific research, could be strengthened and coordinated most effectively. Enabling and collaborative networks could be organized to tackle key resource management problems. With a regional agro-ecological basis for organizing the research, the problem of competition between CGIAR and NACs for the participation of weak national programs in networks and other collaboration would be reduced.

A regional Centre could be based at an existing NAC or at a CGIAR Centre. The supporting strategic research on methodology and technology
development could be based at the regional Centre and a critical mass of researchers, working closely with the network coordinators, would be developed. These regional Centres would also provide a base for commodity programs. This option would require a major re-organization of the CGIAR system but would provide an excellent opportunity to reduce overlaps and inefficiencies and to assist national programs to take a larger share of responsibility for agricultural research. The forestry research initiated in the CGIAR could also be coordinated through the regional Centres, adding to the multidisciplinary mix in these Centres.

The main pros of this regional Centre option is that it would provide a more rational basis for organizing NRCM research while reducing the current problems created when CGIAR Centres with commodity mandates operate in regions far from their Headquarters. The main cons is that the option requires an extensive reorganization of existing CGIAR programs as well as of NACs.

(d) stripe review option

If the panel feels that there is insufficient information to decide between these options, or other new and different options, a further special review or study could be commissioned by TAC. This might take the form of a stripe review of natural resource conservation and management in the CGIAR to determine in more specific detail, and on a more up-to-date basis, what the CGIAR Centres are doing in this field, and to pinpoint gaps and overlaps with NAC programs. The panel would need to define clearly the terms of reference for such a study.

8. Key Issues/Questions

- Is more research needed on natural resource conservation and management?

- Is the current CGIAR multidisciplinary commodity-oriented approach appropriate and adequate for research on natural resources?

- Should TAC change its long-held position that separate Centres focussed on factor-oriented research are inappropriate within the CGIAR system?

- How could institutional responsibilities between current CGIAR Centres, non-associated Centres and national programs be re-arranged to strengthen research in this area?

- Are all of the programs and modes of operation of IDSRAM, IFDC and IIMI appropriate for inclusion in the CGIAR?

- Does the panel have sufficient information to answer these questions or is a further stripe review of research on natural resources in the CGIAR needed to provide a better basis on which to make recommendations to TAC? What terms of reference would be appropriate for such a review?
REFERENCES


<table>
<thead>
<tr>
<th>Acronym</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACIAR</td>
<td>Australian Centre for International Agricultural Research</td>
</tr>
<tr>
<td>CSC</td>
<td>Commonwealth Science Council</td>
</tr>
<tr>
<td>IBSNAT</td>
<td>International Benchmark Sites Network for Agrotechnology Transfer</td>
</tr>
<tr>
<td>ICID</td>
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<td>ICIMOD</td>
<td>International Centre for Integrated Mountain Development</td>
</tr>
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<td>IIASA</td>
<td>International Institute for Applied Systems Analysis</td>
</tr>
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<td>IIEED</td>
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</tr>
<tr>
<td>IILRI</td>
<td>International Institute for Land Reclamation and Improvement</td>
</tr>
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<td>ISRIC</td>
<td>International Soil Reference and Information Centre</td>
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<td>International Union for the Conservation of Nature</td>
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<td>Semi-Arid Tropics</td>
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<td>Soil Management Support Services</td>
</tr>
<tr>
<td>TROPSOILS</td>
<td>Tropical Soils Program of Cornell, Hawaii and North Carolina Universities</td>
</tr>
</tbody>
</table>
Appendix I

RESEARCH CATEGORIES, OTHER THAN CATEGORY I, RELEVANT TO RESOURCE ISSUES AND THE REVIEW OF IBSRAM, ICRAF, IFDC AND IIMI

(1) Category II - Crop Productivity Research
   4. Plant Nutrition
   5. Fertilizer production methods from indigenous materials especially P

(2) Category III - Livestock Productivity Research
   2. Livestock systems

(3) Category V - Forestry Research
   2. Forestry systems and establishment methods
      Afforestation techniques for wasteland reclamation.
   3. Tree Nutrition

(4) Category VII - Research on Human Linkages
   2. Other linkages
      Understanding of human disease hazards from:
      - Irrigation agriculture
      - Crop, animal, water and pesticide management implications as they relate to human health.

(5) Category VIII - Socio-economic and Policy Research
   3. Policy analysis
      - Irrigation policy
      - Equity concerns
      - Assessment of underlying causes of ongoing environmental degradation processes and identification of policy issues.
      - Land-use management policies

(6) Institution Building and Research Related Activities
   1. Training
   2. Conferences and seminars
   3. Documentation and dissemination of information
   4. Research on institutional systems e.g. irrigation systems
   5. Strengthening national systems
   6. Technical assistance
   7. Networks
## PROPORTION OF CURRENT CGIAR CENTRE RESEARCH BUDGET AND STAFF

**DEVOTED TO RESEARCH ON NATURAL RESOURCES (OTHER THAN GENETIC RESOURCES)**

<table>
<thead>
<tr>
<th>Centre</th>
<th>Allocation to NRCM *</th>
<th>Senior Research Staff **</th>
</tr>
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<td>Average</td>
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<td>11</td>
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</table>

* Data obtained from centre medium-term plans and funding requirements. The NRCM allocation is the sum of CGIAR/TAC Categories. 1. Water Management; 2. Soil Management; and 3. Agroclimatology - in the essential program category.

** Senior core staff in the fields of agrometeorology, soil science and water management as a proportion of total research staff - data taken from lists of staff in most recent Centre Annual Reports/Research Highlights.
RESEARCH AND RELATED ACTIVITIES

Proportion of budget allocated to:

Research
- strategic - *
- applied 25%
- adaptive 75%

Development of research capacity:
- training 30%
- technical assistance ++ 10%
- financial assistance ++ 30%
- information & communications 30%

(+++) To individual national programmes and through networks

Proportion of budget allocated to:

(i) research 56%
(ii) related activities 15%
(iii) administration 29%

* IBSRAM submitted figures suggesting a 20% allocation to strategic research but the Secretariat felt that this may have been due to a misinterpretation of the definition of strategic research and changed the numbers accordingly.
## RELATIONSHIPS WITH NATIONAL PROGRAMMES

### A. COLLABORATION WITH INDIVIDUAL COUNTRIES (DEVELOPED OR DEVELOPING)

<table>
<thead>
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<th>Country or Project</th>
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<td>- Strategic research</td>
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<tr>
<td>- Applied research</td>
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<tr>
<td>- Extension</td>
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<td>Type of relationship:</td>
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<td>- Collaborative</td>
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<td>- Contracting</td>
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<tr>
<td>- Leader/controller</td>
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#### List of Projects:

1. **AFRICALAND** - Land development - management of acid soil network
2. **AFRICALAND** - Management of Vertisol network
3. **ASIALAND** - Management of sloping lands network
### RELATIONSHIPS WITH NATIONAL PROGRAMMES

#### B. PARTICIPATION IN NETWORKS

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<th>Networks</th>
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<td><strong>Role(s) of Centre in the network:</strong></td>
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<td>provider of germplasm</td>
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**Title of networks, objectives and the participating countries.**

1. **AFRICALAND** - Land development and management of acid soils.  
   **Objective:** find appropriate solutions to replace shifting cultivation by continuous cropping.  
   **Participating countries:** Burundi, Cameroon, Congo, Côte d'Ivoire, Ghana, Madagascar, Nigeria, Rwanda, Tanzania, Uganda and Zambia.

2. **AFRICALAND** - Management of Vertisols.  
   **Objective:** Improve crop production by superficial drainage and rainfall concentration.  
   **Countries involved:** Burkina Faso, Benin, Ethiopia, Ghana, Kenya, Mali, Nigeria, Tanzania, Togo, Zimbabwe.

   **Objective:** Obtain soil management technologies which increase returns, while conserving soils.  
   **Countries involved:** Indonesia, Malaysia, Nepal, Philippines, Thailand and Vietnam.
TRAINING AND INFORMATION SERVICES

Analysis of training in terms of:

- Production
- Research 100%
- On-farm research
- Advanced degree
- Post-doctoral
- Sabbatical

Analysis of information services in terms of:

- Production/Extension
- Research 80%
- Education 20%
## RESEARCH AND RELATED ACTIVITIES

Proportion of Budget Allocated to:

<table>
<thead>
<tr>
<th>Percent</th>
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<tbody>
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<td>A. Research</td>
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<td>1. Training</td>
</tr>
<tr>
<td>2. Technical assistance</td>
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<tr>
<td>3. Financial assistance</td>
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<td>4. Information and communications</td>
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Proportion of total budget allocated to:
- Research 52
- Related activities 29
- Administration 19

*These figures, supplied recently by IFDC, differ from the numbers in the Fact-Finding Mission report which cited a 31% allocation to Administration and Operations.*
<table>
<thead>
<tr>
<th>Purpose of Collaborator's Res. Project</th>
<th>Participating Countries</th>
<th>Types of Relationship</th>
<th>Role of Center in Collaboration</th>
<th>Basic Objective to:</th>
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<tbody>
<tr>
<td>Strategic Headquarters S Res.</td>
<td>Thailand, Togo, Philippines, Buikina Faso, Bangladesh</td>
<td>Collaborative</td>
<td>Leader/controller</td>
<td>Evaluate S source and their transformation in soil.</td>
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<tr>
<td>Headquarters N Res.</td>
<td>Philippines</td>
<td>Collaborative</td>
<td>Leader/controller</td>
<td>Improve N use efficiency by management/product development.</td>
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<tr>
<td>Headquarters P Res.</td>
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<td>-</td>
<td>-</td>
<td>Evaluate and utilize indigenous resources.</td>
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<tr>
<td>Headquarters crop modeling</td>
<td>None</td>
<td>-</td>
<td>-</td>
<td>Develop fertilizer component of crop models.</td>
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<td>Nutrient efficiency</td>
<td>Colombia, India, Philippines, Vietnam, Thailand</td>
<td>Collaborative</td>
<td>Partner/collaborator</td>
<td>Field test fertilizer management/products practices</td>
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<td>Crop modeling</td>
<td>Kenya, Malawi, United States, Philippines, Thailand, Australia, Trinidad.</td>
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<td>Partner/collaborator</td>
<td>Conduct field trials to validate crop models for rice, barley, wheat, taro, sorghum, maize and for N and P fertilizer responses.</td>
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<td>Socio-economic</td>
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<td>Leader/controller</td>
<td>Identify fertilizer use strategies to restore soil fertility and study constraints to fertilizer use with special emphasis on role of women in agricultural production.</td>
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<td>Purpose of Collaborator's Res. Project</td>
<td>Participating Countries</td>
<td>Types of Relationship</td>
<td>Role of Center in Collaboration</td>
<td>Basic Objective to:</td>
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</tr>
<tr>
<td>Fertilizer trade and market info. network</td>
<td>Benin, Togo, Burkina Faso, Côte d'Ivoire (network)</td>
<td>Collaborative</td>
<td>Leader/controller</td>
<td>Provide current information on fertilizer marketing and supply systems.</td>
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<td>IFDC/IFPRI policy res.</td>
<td>Senegal, Malawi, Zaire, Togo, Cameroon</td>
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<td>Conduct studies on fertilizer-related policy issues.</td>
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<tr>
<td>N research</td>
<td>India, Philippines, Bangladesh</td>
<td>Collaborative</td>
<td>Leader/controller</td>
<td>Conduct on-farm research of deep placement of urea as supergranules.</td>
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<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Socio-economic</td>
<td>Ghana, Niger, Togo, Mali, Nigeria, Bangladesh</td>
<td>Collaborative</td>
<td>Leader/controller</td>
<td>Conduct on-farm research to identify constraints to fertilizer use and adoption.</td>
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<tr>
<td>Policy research</td>
<td>Bangladesh</td>
<td>Collaborative</td>
<td>Leader/controller</td>
<td>Assist government to develop a more efficient fertilizer marketing system through implementation and evaluation of policy reforms.</td>
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<tr>
<td>Fertilizer marketing and information (network)</td>
<td>Benin, Togo, Burkina Faso</td>
<td>Collaborative</td>
<td>Leader/controller</td>
<td>Conduct country-specific studies of fertilizer supply systems.</td>
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### B. PARTICIPATION IN NETWORKS

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<tr>
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</table>

**Name of Network**

1. **WAFMEN** – West African Fertilizer Management Evaluation Network
2. **AFTMIN** – African Fertilizer Trade and Marketing Information Network
3. **West Africa Geology** Network
4. **East/Southeast Africa** Geology and Agronomy Network
5. **INSURF** – International Network on Soil Fertility and Sustainable Rice Farming.
TRAINING AND INFORMATION SERVICES

Analysis of training in terms of:

- Production  x
- Research     x
- On-Farm research  x
- Advanced degree  x
- Post-doctoral  x
- Sabbatical   x

Analysis of information services in terms of:

- Production/Extension  x
- Research    x
- Education   x
RESEARCH AND RELATED ACTIVITIES

Proportion of budget allocated to:

Research

- strategic
- applied
- adaptive

\[ \begin{align*}
45\% \ast \\
30\% \\
\end{align*} \]

Development of research capacity:

- training 7\%
- information and communications (includes network coordination) 13\%

Proportion of budget allocated to:

(i) research 60\%
(ii) related activities 20\%
(iii) administration 20\%

* IIMI's estimate for their recent external review was basic research 15%, strategic research - 10%, and applied research - 10%. These three figures have been combined under strategic and applied research in the Table.
### ADDITIONAL INFORMATION ON RESEARCH AND RELATED ACTIVITIES AT IIMI

**RELATIONSHIP WITH NATIONAL PROGRAMS**

**A. COLLABORATION WITH INDIVIDUAL COUNTRIES (DEVELOPED OR DEVELOPING)**

| COUNTRY OR PROJECT | SL | SL | SL | SL | SL | IND | P | P | B | N | N | IN | M | S | WA | WA | PK | PK | PK | PK | PK |
|--------------------|----|----|----|----|----|-----|--|--|---|---|---|----|---|---|----|----|----|----|----|----|----|----|
|                    | 1  | 2  | 3  | 4  | 5  | 6   | 7 | 8 | 9 | 10| 11| 12  | 13 | 14 | 15  | 16  | 17  | 18  | 19  | 20  | 21  | 22 |

**PURPOSE OF COLLABORATION:**

- **Strategic Research**
  - 50  80  25  10  25  15  20  50  35  10  80  10  5  25
- **Applied Research**
  - 70  15  15  10  10  30  30  30
- **Adaptive Research**
  - 30  20  30  70  20  40  30  20  25  30  30  20  50  25  10  40
- **Extension**
  - 20  15  20  45  10  5  40  10  40  5  25
- **Institution Building**
  - 10  5  10  50  5  10  50  20  20  10  15  50  60  10  15  20  25

**TYPES OF RELATIONSHIP:**

- **Collaborative**
  - 60  65  60  -  - 70  60  50  50  70  50  75  50  50  40  70  75  50  70  75  70  75
- **Contracting**
  - 20  -  -  35
- **Enabling**
  - 40  35  20  -  - 30  40  15  50  30  50  25  60  60  60  30  25  50  20  15  10  25

**ROLE(S) OF CENTER IN THE COLLABORATION:**

- **Leader/Controller**
  - 60  50  50  -  - 70  60  60  50  60  70  30  50  60  60  75  75  75  75  50  50
- **Customer**
  - **Partner/Collaborator**
  - **Donor**
  - **Channel for Funding**
Field Operations Division

SRI LANKA

1. **Title:** Action Research on Irrigation Management for Crop Diversification in North Central Province, Sri Lanka.

   **Objectives:** To test management interventions that would promote reliability and equity of supply at turnouts along distributaries, and proper sharing of irrigation supply below turnouts.

2. **Title:** Irrigation Management and Crop Diversification in Southern Province, Sri Lanka.

   **Objectives:** The overall objective is to strengthen the long-term sustainability of irrigation systems and to optimize use of existing land, water and infrastructure resources through identifying improvements that could be made in the processes of design, rehabilitation, system management, and operation and maintenance, with particular attention given to requirements for crop diversification.

   The specific objectives are to identify key organizational and management factors which influence the performance of irrigation systems, and design and rehabilitation innovations and alternative system management practices with particular attention given to requirements for crop diversification.

3. **Title:** Irrigation Systems Management (ISM) Project.

   **Objectives:** To provide research results which strengthen implementation of the USAID-funded ISM project; and to strengthen national capacity for carrying out effective applied research on irrigation management problems in a mode that enhances the likelihood of implementation.

4. **Title:** Development of an Analytical Framework for Irrigation Management.

   **Objectives:** To develop an analytical framework for irrigation management that covers all management concerns that are related to water delivery; for the development of irrigation capacities; determination of general objectives, feasible objectives, functional and technical requirements, and for the development of irrigation capacities; seasonal and in-seasonal water management and operational methods and plans.

5. **Title:** Irrigation Investments Trends in Sri Lanka.

   **Objectives:** To provide the policy makers and IIMI with better understanding of relative economic profitability of different investment alternatives among new irrigation construction, irrigation rehabilitation, and irrigation management improvement.
6. Title: Efficient Irrigation Management and System Turnover in Indonesia.

Objectives: (a) To develop procedures and methodologies for more effective irrigation management in government-managed irrigation systems; (b) to assist in the development of a process for turning over O&M responsibilities in irrigation systems less than 500 ha from government to farmers.

THE PHILIPPINES

7. Title: Study on Irrigation Management for Diversified Crops.

Objectives: The overall objective was to determine irrigation management practices most likely to enhance cultivation of selected non-rice crops in limited parts of the irrigation systems, during the dry season and to field test the most promising of these practices. The specific objectives were to: (a) develop a methodology for identifying those parts of irrigated areas with comparative advantage for growing selected diversified crops; (b) compare the profitability of selected diversified crops under irrigated versus rainfed conditions and their irrigated performance with that of irrigated rice; (c) determine the primary factors and their interaction which condition how farmers prepare land for irrigated rice in the wet season and for one or more diversified crops in the dry season; (d) develop on-farm irrigation methods for at least one upland crop, design and field test operating procedures for publicly-managed portions of irrigation systems; and (e) recommend those policies which are likely to support more profitable farming practices and investment in irrigation development as related to diversified crops, and prepare a set of specific guidelines and practices to be carried out by irrigation managers and farmers for the productive irrigation of diversified crops in association with rice in the dry season.

8. Title: Accelerated Agricultural Production (AAP) Project, Irrigation Component - Research on Special Studies.

Objectives: (a) To evaluate, refine and improve NIA’s present package of management innovations; (b) to identify new innovations to strengthen irrigators’ associations (IAs) and to improve and sustain the performance of irrigation systems; and (c) to strengthen NIA’s capacity to conduct and manage applied research.

BANGLADESH

9. Title: Support to Bangladesh in Research and Training for Irrigation Management.

Objectives: To strengthen the capacity of relevant institutions and people in managing irrigation systems and irrigation development in Bangladesh.
NEPAL

10. **Title:** WECS/FORD Project in Sindhupalchok.

**Objective:** The primary objective of this action-research project is to develop a viable process by which to assist farmer-managed systems in overcoming the constraints limiting intensification and expansion of irrigated agriculture.

11. **Title:** Performance Evaluation of a Large-Scale Farmer-Managed Irrigation System.

**Objectives:** Examine the agricultural system to determine if (a) cropping decisions and constrained by lack of dependable irrigation water; and (b) special variation in yield of each crop is related to water stress. Evaluate the performance of the irrigation system by monitoring (a) access to water both among systems competing for the same source and by potential new members, (b) equity of access by members of the system with the right to use water, (c) the effectiveness of organized response to water stress and conflict among members.

INDIA

12. **Title:** Collaborative Research and Training Activities with Indian Institutions.

**Objectives:** To explore, initiate and implement collaborative research and training projects by IIMI in association with Indian institutions engaged in research and training activities, and exchange information in irrigation management through exchange of visits and scientific literature. The principal objective is to strengthen the research and training capabilities of selected Indian institutions to contribute to the improvement of irrigation performance in India.

MOROCCO

13. **Title:** Morocco Program Development.

**Objectives:** The two basic objectives of the program development in Morocco are: (i) tapping the skills and working capacities of Moroccan input; and (ii) "exporting" Moroccan innovations outside the country and "importing" foreign innovations in Morocco. Three projects are now under discussion with Moroccan clients and partners: (a) local application of a multi-country project on the implementation of the techniques, methods and principles of management to irrigation agencies (other countries involved: Burkina Faso and Nigeria); (b) improvement of farmer management in a traditional irrigation system included in a large-scale project on the Tessaout Valley (this project could benefit from IIMI experience in Nepal); and (c) increase of water productivity through the development of water delivery system following the water requirements of crops. Exploratory contacts have been made with Pakistan to evaluate the interest of "exporting" Moroccan expertise on distributary canal regulation and on on-demand systems to Pakistan.
14. **Title:** Sudan Establishment and Program Development.

**Objectives:** Promote and participate in research in irrigation management, provide training and professional development to Sudanese irrigation staff and provision of advice on irrigation management.

**WEST AFRICA**

15. **Title:** West Africa Establishment and Program Development. (Regional Program covering Burkina Faso, Niger, Mali, Senegal and Nigeria).

**Objectives:** Develop methodologies to achieve effective management of irrigation systems and farmer participation in small, medium and large systems. Develop research agendas relevant to the countries in the region and provide training and management support to enhance national capacities. Arrange for cross-country transfer of information and synthesize management innovations and training to facilitate dissemination across borders by development of network programs.

**NIGERIA**

16. **Title:** Collaborative Research with Ahmadu Bello University on "Diagnostic Analysis of Large Irrigation Project and Development of Farmer Managed Irrigation Systems".

**Objectives:** To develop and evolve farmer-managed irrigation package for large scale surface irrigation systems and pilot testing in selected projects. (The study is proposed to be implemented under two phases. The first part of the study is diagnostic analysis which is being implemented under phase-1.)

**PAKISTAN DIVISION**

17. **Title:** Irrigation Constraints to Crop Production

**Objectives:** (a) Investigate irrigation-related constraints and their impact on production of principal crops; (b) assess from existing information optimal patterns of irrigation for major crops; (c) investigate farmers' decisions regarding irrigation to ascertain how and why their practices differ from the optimal and to assess the impact of such differences upon crop yield.

18. **Title:** Impact of Lining Secondary Channels and Rehabilitation Strategies.

**Objectives:** (a) Evaluate impact of rehabilitation strategies upon surface water deliveries; (b) determine most cost-effective approaches for distribution system rehabilitation through comparative analysis of actual rehabilitation strategies.
19. **Title:** Combined Surface and Groundwater Irrigation Systems.

**Objectives:** (a) Determine existing distributary command water budgets and de facto conjunctive use irrigation operations; (b) define institutional constraints and solutions for more effective private tube well operations and management and in varying hydrologic environments; (c) identify groundwater quality conditions and management options that reduce or minimize negative impacts; (d) identify potential impacts of public tube well turnover on overall irrigation system performance; (e) determine options to balance groundwater extraction and maintenance of water tables.

20. **Title:** Distributary Performance: Variability and Equity in Secondary Canals.

**Objectives:** (a) Determine distributary channel performance in terms of water supply variability minimization and distributional equity objectives in different hydrologic environments; (b) identify causes of poor distributary performance in achieving operational objectives; (c) assist IDo in identifying management options to better achieve operational objectives of distributional equity and minimum variability in water supply; (d) adapt computerized hydraulic model to support management decision-making in secondary canal operations.

21. **Title:** Managing Irrigation Systems to Minimize Waterlogging and Salinity Problems.

**Objectives:** (a) Identify and define linkages between irrigation and drainage systems management and the incidence of waterlogging and salinity (W&S) problems; (b) design, test and refine irrigation and drainage system management strategies to minimize W&S.

22. **Title:** Irrigation Efficiencies in Farmer Managed Irrigation Systems in Hunza Gojal.

**Objectives:** (a) Comparative assessment of irrigation system goals and efficiencies in new and previously existing Gojal FMIS; (b) identification of major factors (both physical and operational) that govern irrigation efficiencies in Gojal FMIS.
### R. PARTICIPATION IN NETWORKS

**Networks**

<table>
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<tr>
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**List of Networks:**

1. **ODI/IIMI Irrigation Management Network.** To promote information exchange on irrigation management in developing countries. Not specific to a country. Has individual and organization members totalling 1,750.

2. **Farmer-Managed Irrigation Systems Network.** To promote information exchange on farmer-managed irrigation systems. Not specific to a country. Has individual and organization members totalling 450.

3. **Crop Diversification Network.** To promote research and information exchange on crop diversification in rice-based irrigation systems. Countries participating: Bangladesh, India, Indonesia, Malaysia, Nepal, Philippines, Sri Lanka, and Thailand.
**Appendix VI a**

Centre: ICRAF

**NATURE OF MANDATE**

Mandate defined mainly in terms of:

- **Discipline(s)**
  - Agriculture/forestry
  - social science/animal science

- Resource management

- **Commodity(ies)**
  - MPT(s)

- **Geographical region**
  - global

- **Agro-ecological zone**
  - five zones in Africa
  - upland plateau
  - bimodal highland
  - humid
  - sub-humid
  - semi-arid

- **Institution-building**
  - a feature highlighted in ICRAF's mandate
## RELATIONSHIPS WITH NATIONAL PROGRAMMES

### Centre: ICRAF

#### B. PARTICIPATION IN NETWORKS

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<th>AFRENA S.A.</th>
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<td>x</td>
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</tr>
<tr>
<td>-- Scientific consultant/ provider of germplasm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-- Partner/collaborator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(no funding from Centre)</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>-- Channel for funding</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>

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**AFRENA** - Agroforestry Research Networks for Africa (E.A. and S.A. Eastern and Southern Africa)

**SALWA** - Semi-Arid Lowlands of West Africa

**AFNETA** - Alley Farming Network for Africa (IITA/ILCA/ICRAF)
TRAINING AND INFORMATION SERVICES

Analysis of training in terms of:

- production
- research x
- on-farm research x
- advanced degree x
- post-doctoral
- sabbatical
- short-term specialized courses x

Analysis of information services in terms of:

- production/extension
- research x
- education x