THE CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

TECHNICAL ADVISORY COMMITTEE

ROLE OF THE CGIAR IN BANANA AND PLANTAIN RESEARCH

TAC SECRETARIAT

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1. Introduction

Banana differ from plantain and starchy cooking banana by their genomic formula (AAA for dessert banana and the East African cooking banana, AAB for true plantain, and ABB for starchy cooking banana). Genome A is derived from Musa acuminata and genome B from Musa balbisiana. Plantain is starchy even when ripe, and is only eaten after cooking. Dessert banana and the East African cooking banana have low starch and high sugar content when ripe.

When combined banana and plantain are the eleventh top ranking in terms of their gross value of production (TAC 1989a). According to FAO, total annual world production is estimated to be over 68 million tonnes, of which banana account for 41 million tonnes. Latin America and the Caribbean, with an annual production of 26 million tonnes, is the largest producer of banana and plantain. This is followed by Africa, with 25 million tonnes, and then Asia and the Pacific, with 17 million tonnes. Lack of improved cultivars, and the prevalence of pests and diseases are the main constraints to increased production. Other important production constraints include slow suckering, lodging, perishability of the fruit, and cultural practices.

Banana and plantain are major food staples for millions of resource poor people in developing countries. Over 90% of the crop is consumed in the producing countries by small-holders and low income urban dwellers. Only about 10% of the production enters world trade as dessert bananas (TAC 1989b). The bulk of the export crop is produced on commercial plantations owned by the private sector.

The International Network for the Improvement of Banana and Plantain (INIBAP) was established in 1984 to coordinate international research on these commodities. ICIPE is the only other non-associated centre working on these crops. Among CGIAR centres IITA has a mandate for plantain while IBPGR has a mandate for both banana and plantain. Hitherto, research on plantain at IITA has been confined to the humid West and Central Africa. In its 1985 review of CGIAR priorities and strategies, TAC recommended that the CGIAR should increase its efforts on starchy bananas research in sub-Saharan Africa in collaboration with INIBAP.

This paper assesses the need for CGIAR support for research on banana and plantain, and outlines the main research and research related activities by international institutions, both within and outside the CGIAR, as well as in national research systems. The paper also identifies current overlaps, duplication, and gaps in current, and planned activities by IBPGR, IITA, INIBAP and ICIPE. Finally it outlines possible future modes of operation and institutional arrangements.

2. Need for CGIAR Involvement in Banana and Plantain Research

Banana and plantain are mainly grown and consumed by subsistence farmers. These crops provide a cheap but rich source of carbohydrate
for millions of people on marginal diets in developing countries. They are also rich in vitamin C, and essential minerals. In some parts of Africa and Latin America, average consumption is estimated to range from 150 grams to 300 grams per person/day. In some locations they provide more than 25% of the total calorie intake in the diet (INIBAP, 1989). The crop residues provide excellent mulching material. The leaves can also be used for several domestic purposes, such as thatching material, and for making handicrafts. Banana beer is an important local drink in East Africa.

These commodities have a perennial habit and produce reasonable yields year after year with relatively low levels of external inputs. However, given the increasing trends in demand, as a result of population growth and urbanization, higher yielding cultivars, and better husbandry practices, must be developed.

In 1986 ACIAR, INIBAP and the Queensland Department of Primary Industries co-sponsored a workshop on banana and plantain research. It was attended by 40 scientists from 16 countries (Persley and De Langhe, 1986). The regional research needs identified by the workshop are shown in Table 1. The list of research and related needs suggested by the workshop fall under four of the nine research categories identified by TAC for emphasis within the CGIAR (TAC 1989a): resource conservation and management, particularly germplasm collection, evaluation, and conservation; crop productivity research; commodity conversion and utilization; and socio-economic and policy research. Breeding strategies were also discussed at the workshop.

Past research efforts focused on improving commercial plantations. The French Government supported research in francophone West Africa and the Caribbean. The British Government and the United Fruit Company supported significant breeding programmes in the Caribbean and Central America. Although the impact of these efforts on the small farmer has yet to be determined, a number of promising experimental hybrids and synthetic diploids have been developed. However, these materials are not yet freely available for international testing due to proprietary rights. INIBAP has been negotiating with the institutions concerned to facilitate international testing of these experimental hybrids and synthetics.

The proprietary rights of clonally propagated crops such as banana and plantain cannot be adequately protected. Therefore private sector involvement in banana and plantain breeding is likely to decrease in future. Indeed the United Fruit Company has already suspended its breeding programme in Honduras. Public sector support for a coordinated international research effort might be the best way of dealing with the research related production constraints. Although INIBAP might provide the right mechanism for dealing with the problem, it would require more financial support. In the absence of additional resources for INIBAP, the CGIAR offers the most feasible and viable international mechanism.

All cultivars currently under production are natural selections, many of which still have the wild parentage. The scope and potential for yield improvement through breeding is therefore high. Other than the wild diploids, and the edible group of banana belonging to the AA genome, there are three major sub-groups of triploids among the edible types of banana and plantain. The triploids very rarely produce seed.
Therefore banana and plantain breeding requires good knowledge and wide application of cytogenetic techniques. Further, the classification of banana and plantain cultivars is still not very clear. An international agreement on the classification of the existing cultivars would enhance international collaboration in research on banana and plantain.

Pests and diseases have been identified as the main constraints to banana and plantain production in all developing countries. The major diseases are Black Sigatoka, Panama disease (Fusarium wilt), bacterial wilt, and Banana Bunchy Top Virus (BBTV). Black Sigatoka is a virulent fungal disease which threatens plantain and cooking banana production in many countries. It causes plantain leaves to wither, resulting in sharply reduced yields. Its fungal spores are dispersed by wind and water, and are therefore beyond the control of quarantine measures. Nematodes and weevils also cause serious damage in some areas.

Most of the major pests and diseases can be controlled by chemicals, such as fungicides for Black Sigatoka. But the costs are high and beyond the reach of small-holders. Breeding for host-plant resistance, combined with integrated pest management, would therefore be the best strategy. In this regard, the CGIAR has an impressive record of achievements.

A major research effort on banana and plantain is justified, considering their importance as a food and cash crop, and as a component of farming systems throughout the tropics, the upward trend in demand, the need to develop new and more efficient production systems, and the need to find economic solutions to the problems of storage, transportation, and processing (TAC 1987). Further, there has been relatively little research on banana and plantain.

An international research effort would contribute significantly to the CGIAR mission and goals, and particularly to the goal of "improved productivity of important crops and their integration in sustainable production". In addition to IBPGR, IITA, ICIPE, and INIBAP, a number of regional and national institutions are also doing research on banana and plantain.

3. Current and Planned CGIAR Activities

3.1. IITA

Research on plantain at IITA began in 1973. The early work concentrated on collection and testing of cultivars; use of plantain in the Centre’s alley farming systems; in-vitro preservation; and rapid multiplication. In 1981, IITA started the West African Regional Cooperative Research Network on Plantain (WARCORP) involving Côte d’Ivoire, Nigeria, Ghana, Gabon, Zaire, Guinea, and Cameroon. IITA has recently expanded its research activities on this commodity. The major activity concentrates on breeding for resistance to Black Sigatoka. All plantain cultivars are known to be susceptible to Black Sigatoka, but resistance has been found in some banana cultivars, and wild species such as Musa burmannica. IITA has been screening East African cooking banana for resistance to Black Sigatoka as a possible substitute should plantain be completely wiped out by the disease.
**TABLE I** REGIONAL RESEARCH NEEDS FOR BANANA & PLANTAIN

<table>
<thead>
<tr>
<th>Latin America/Caribbean</th>
<th>West Africa</th>
<th>East Africa</th>
<th>Asia *</th>
<th>Oceania **</th>
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<tbody>
<tr>
<td>Production Problems</td>
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<tr>
<td>Nematodes</td>
<td>Sigatoka</td>
<td>Sigatoka</td>
<td>Agronomic characters</td>
<td>Sigatoka</td>
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<tr>
<td>Sigatoka</td>
<td>Nematodes</td>
<td>Nematodes</td>
<td>Sigatoka</td>
<td>Fusarium</td>
</tr>
<tr>
<td>Moko (bacterial wilt)</td>
<td>Agronomic characters</td>
<td>Bunchy-top</td>
<td>Bunchy-top</td>
<td>Nematodes</td>
</tr>
<tr>
<td>Fusarium</td>
<td>Weevil borer</td>
<td>Fusarium</td>
<td>Salt Tolerance</td>
<td>Nematodes</td>
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<tr>
<td></td>
<td>Bunchy-top</td>
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<td>Weevil borer</td>
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<td>Bunchy-top</td>
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<td>Market</td>
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<td>Export</td>
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<td>Domestic</td>
<td>Export</td>
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<tr>
<td>Fruit type</td>
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<tr>
<td>Dessert</td>
<td>Plantain</td>
<td>Cooking</td>
<td>Cooking</td>
<td>Dessert</td>
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<tr>
<td>Plantain</td>
<td>Dessert</td>
<td>Beer</td>
<td>Dessert</td>
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</table>

* Information from India and China not included.

** Australia, Pacific Islands.

So far the work has led to the identification of 10 resistant cooking banana and wild diploids, and 16 female fertile French and 7 female fertile False Horn plantain. Research has also led to the production of 370 plantain hybrids, two of which were found to be high yielding and resistant to Black Sigatoka. IITA has also developed a method for the rapid multiplication of Black Sigatoka resistant clean planting materials.

Research and related activities at IITA’s Onne Sub-station include germplasm exchange, germplasm evaluation, and plantain breeding. IITA has increased its applied and strategic research on Black Sigatoka and its causal agent Mycosphaerella fijiensis. IITA is also working on dwarfism, improved harvest index, resistance to nematodes, and prevention of yield decline in plantain.

3.2. IBPGR

The basic function of IBPGR is to promote and coordinate an international network of genetic resources centres to further the collection, conservation, documentation, evaluation and use of plant germplasm. Germplasm conservation and related research on banana and plantain have been assigned high priority by IBPGR. The main activities comprise germplasm collection, characterization, disease indexing, information and documentation.

IBPGR collaborates with IITA, INIDAP, the Centro Agronomico Tropical de Investigación y Enseñanza (CATIE) in Costa Rica, the Institut de Recherche Agronomique et Zootechnique (IRAZ) in Rwanda, and many national programmes in germplasm collection and conservation, and in research on wild and cultivated species of the genus Musa. IBPGR has developed a list of descriptors for banana and plantain. It organizes and executes its thematic research through contracts with advanced institutions in developed and developing countries.

3.3. Assessment of CGIAR activities relative to needs

The activities of IITA and IBPGR provide essential but still inadequate inputs into the global effort to alleviate the main constraints to increased production of banana and plantain, and to promote germplasm collection and conservation. The activities of IITA are confined to the humid West and Central Africa. This leaves East Africa, Asia and the Pacific, and Latin America and the Caribbean regions without CGIAR support for germplasm improvement in plantain. Furthermore, an international breeding programme for banana is also needed. Given the perennial habit of banana and plantain cultivars, and the fact that they can only be propagated vegetatively, research is needed to identify innovative breeding approaches, and techniques for the conservation of banana and plantain germplasm.

Until such time, as cryopreservation is possible, it will be necessary to have field gene banks. In this regard, IBPGR has promoted in situ conservation at Davao (Philippines), Bodles (Jamaica), and Ekona (Cameroon). A field gene bank is also needed for the East African highland banana.
3.4. Resource allocation for banana and plantain research

IITA has allocated 3 senior scientist-years to work on plantain for the period 1989-1993: one breeder, one agronomist, and one pathologist. The cost of a senior scientist-year at IITA (in 1987 dollars) was $183,390 (IITA, 1988). Research contracts by IBPGR for banana and plantain were approximately $100,000 per annum during 1988 and 1989. Unless the future for INIBAP can be assured outside the CGIAR, additional CGIAR support for these crops would be necessary.

4. Current and Planned NAC Activities

INIBAP works on banana and plantain germplasm improvement and pathology while ICIPE has some research activities dealing with banana weevils and nematodes. In this analysis the activities of ICIPE are only mentioned in passing.

4.1. INIBAP

INIBAP coordinates an international network on banana and plantain research in developing countries with the objective of increasing the productivity and sustainability of production for small-holders. Its specific objectives are to:

(a) initiate, promote, support, conduct, and coordinate research on banana and plantain;

(b) strengthen national and regional programmes and facilitate the interchange of improved and disease-free germplasm through assistance in the establishment and analysis of regional and global trials of new and improved banana and plantain genotypes;

(c) promote the collection and exchange of documentation and information on banana and plantain;

(d) support training of research scientists and technicians from developing countries.

INIBAP has selected two broad thematic activities for emphasis during its first quinquennium, namely germplasm improvement, and pathology. It has four research support services based at headquarters, and four regional networks.

4.1.1. Germplasm improvement

The germplasm improvement programme covers a wide range of activities. INIBAP expects to play an increasingly active role in the collection of Musa cultivars and wild germplasm (in collaboration with IBPGR). INIBAP will also evaluate new germplasm and conserve introduced wild germplasm in the form of seed. Medium-term storage of in-vitro material will be done in collaboration with advanced institutions. INIBAP maintains working collections at its regional bases. INIBAP supports work relating to the taxonomic analysis of Musa spp., both wild and cultivated; international transfer of disease-free clones of
banana and plantain; evaluation of potentially useful clones in cooperation with national programmes; and promotion of banana and plantain breeding activities. INIBAP promotes the use of new biotechnology techniques, such as somaclonal variation, cell and protoplast culture, and recombinant DNA methods, to backup the conventional breeding approach.

4.1.2. Plant pathology

The plant pathology programme will concentrate on two diseases: Black Sigatoka, and BBTV. While Black Sigatoka is now a major problem in virtually all developing regions where plantain is important, BBTV has a more restricted geographical distribution. It is aphid transmitted and can be very damaging. BBTV has not yet been found in Latin America.

4.1.3. Research support services

At the global level the network is supported by four services: (a) Musa Germplasm Exchange Service; (b) International Musa Testing Programme; (c) International Musa Pathogen Sampling Service; and (d) Information/Documentation Centre.

4.1.4. Regional networks

When fully operational INIBAP will have four regional networks: one is planned for the Southeast Asia and the Pacific region, with a Regional Coordinator at Davao on the island of Mindanao in the Philippines. Two have been established in sub-Saharan Africa, an East African network with a coordinator at IRAZ in Burundi, and another for Central and West Africa with a coordinator at IITA’s Onne sub-station in Nigeria; and one for Latin America and Caribbean with a coordinator at CATIE in Costa Rica. The West and Central Africa regional network had WARCORP as its predecessor. The Latin America and the Caribbean had an informal regional network on banana and plantain research for a number of years, before INIBAP was established.

A major objective of the regional networks is identification and introduction of improved germplasm with resistance to Black Sigatoka, BBTV, and where relevant to Panama disease, nematodes and banana weevils. The regional networks have established quarantine procedures to acquire germplasm from different parts of the world for trials in different countries. An essential component of each regional network is the organization of training courses.

4.1.5. Relations with other institutions

INIBAP has a collaborative agreement with IITA for plantain research. IITA has transferred the coordination of WARCORP/INIBAP. INIBAP depends on ICIPE for applied and strategic research on banana weevils and nematodes. IBPGR has taken the lead in the collection and storage of banana and plantain germplasm, including the development of a field technique for collecting and transferring genetic material to secondary quarantine centres. Further, IBPGR and INIBAP have a collaborative agreement for work on Musa taxonomy and data bank.
INIBAP cooperates with a number of regional centres, such as CATIE and IRAZ, and national institutions including the Fundación Hondurena de Investigación Agrícola (FHIA), Honduras; EMBRAPA, Brazil; the Institut de la Recherche sur les Fruits et Agrumes (IRFA), and CIRAD, France; Katholieke Universiteit Leuven (KUL); Philippines Council for Agriculture, Forestry and Resources Research and Development (PCARRD) and those in Nigeria, Jamaica and Taiwan; ACIAR, Australia; IDRC, and Canada.

4.1.6. Resource requirements

In its first full year of operation, INIBAP has estimated that it would require $3.1 million for essential activities. Funding estimates for 1989 were $1.43 million, with 11 senior staff positions. The estimates for 1990 are $2.43 million, with 12 senior staff positions. The estimated relative allocation to research and related activities for 1990 is shown in Appendix I. INIBAP plans to allocate 56% of its budget to essential activities at headquarters and 44% to the regions when it becomes fully operational. About 60% of the research support would be channelled through the regional networks.

4.2. Assessment of NAC activities relative to needs

INIBAP provides an innovative approach to international agricultural research. It is a collaborative venture with most of the research being done by national institutions. However, given the paucity of past research on these commodities, the fact that the network is not yet fully operational, and the weakness of many of the cooperating national programmes, it is difficult to determine whether the network mode could be the most cost-effective mechanism for banana and plantain improvement. It is arguable whether the proposed in-house research capacity at INIBAP headquarters will have the critical mass required to respond effectively to the varying demands from the regions. Further, it remains to be seen how the research at headquarters will relate to that being done through contracts with advanced institutions, and that in the regional networks. ICIPE's work with nematodes and weevils appear to be project and thesis related, and therefore short-term in nature.

5. Research Overlaps/Gaps in CGIAR and NAC Activities

IITA has a mandate for plantain. Its activities are confined to West and Central Africa. IBPGR has a global mandate, for both banana and plantain genetic resources. Therefore the CGIAR does not support productivity research on banana in developing countries, or on plantain in Asia, and Latin America and the Caribbean. Although INIBAP also has a global mandate for both banana and plantain, it has not yet been able to attract enough funds to become fully operational.

A collaborative agreement exists between IITA and INIBAP, but there are signs of tension in their working relationships. In view of the uncertainty about future funding for INIBAP and the economic importance of banana and plantain in Asia and the Pacific, sub-Saharan Africa, and Latin America and the Caribbean, there is an urgent need to
extend CGIAR support with respect to germplasm improvement, post-harvest technology, and socio-economic research, for both commodities beyond the humid West and Central Africa region.

With the exception of West and Central Africa, where both IITA and INIBAP are working with national programmes, there is little duplication between them. There is also no duplication between IITA, INIBAP, and ICIPE with respect to the latter's work on nematodes and weevils.

Notwithstanding the fact that Fusarium wilt, and bacterial wilt cause serious damage and yield reduction in some areas, there is no international support for work on these diseases. Currently agronomic research on banana and plantain is also not receiving much attention, particularly in sub-Saharan Africa. Further, banana and plantain are highly perishable and therefore need research on post-harvest technology including storage. If successful, such research would enhance the production and consumption of banana and plantain as well as local and international trade for these crops.

6. Research by Other Organizations

6.1. National institutions

There are two developing countries with fully established breeding programmes on banana and plantain. These are Honduras and Brazil. Guadeloupe, Jamaica, and Colombia also have substantial capacity for research on banana and plantain. In Central and West Africa, Cameroon, Côte d'Ivoire, Nigeria, and Ghana have a number of research projects on plantain. National research efforts in East Africa are sporadic, uncoordinated and poorly funded. In the Asia and Pacific region, there are modest research programmes on banana and plantain in Taiwan, Thailand, India and the Philippines (Appendix II).

Among the industrialized countries, France has the largest overall research programme on banana and plantain. Its activities, particularly those in Guadeloupe and francophone West Africa are highly relevant to developing countries. IRFA is the lead institute under the umbrella of CIRAD. Australia also has an active research programme for banana and plantain, which has great relevance for Asia and the Pacific region (Appendix II).

Scientists in the USA, Belgium, and Spain have embarked on new research programmes with banana, particularly in the field of biotechnology, pests and diseases. A number of private sector companies in developed countries are active in the fields of crop protection, agronomy, and post-harvest research on banana.

6.2. International institutions

CATIE and IRAZ have research programmes on banana and plantain. Both collaborate with IBPGR. The FAO/IAEA Joint Division in Vienna, Austria is doing some tissue culture work with banana.
Modes of Operation and Institutional Arrangements

7.1. Methods of operation

This section will address the modes of operation for IITA and INIBAP. These institutions overlap in their mandates and research activities with respect to plantain. IITA is a typical example of the international centre model with centralized research facilities and programmes. All of IITA's plantain research work is based at the Onne sub-station, Nigeria. Collaboration with national programmes is through WARCORP, bilateral arrangements, workshops, and training activities.

According to its strategy, INIBAP is a research-oriented network with in-house research capacity. Its small group of core staff at headquarters is expected to provide scientific leadership to the overall programme through its own research, and to coordinate the thematic activities. INIBAP seeks to establish links among institutions and scientists working on these commodities to generate knowledge and technologies that will increase the income and general welfare of small-holders and poor consumers in developing countries.

In its formative stages, INIBAR operated largely on a project-by-project basis. Emphasis was placed on workshops to define the state-of-the-art, and to identify research needs and priorities. INIBAP implements its programmes mainly through research contracts with advanced institutions, regional networks, and research support services based at headquarters (Appendix II).

INIBAP does little research itself, but encourages and helps others to do it, while coordinating the process. Research contracts are given to specialized institutes and laboratories. Each regional network coordinator ensures contacts with regional and national institutions including universities involved with banana and plantain research in the region. Where funds are provided to INIBAP to support national programmes, INIBAP draws upon the services of an advisory committee to allocate the resources.

7.2. Governance and structure

IITA is an autonomous institute with legal international status. It has a Board of Trustees which is the institute's highest policy making body. Members of the Board, with the exception of the host country representatives and the Director General, are appointed in a personal capacity.

The governance and structure of INIBAP is very similar to that of the CGIAR centres. However, the developing country members on the Board of Trustees only come from the banana and plantain growing countries. Further, the status of INIBAP as an international organization with legal identity has still to be confirmed. At least three of the countries that were signatories to the convention which established the network (Belgium, Canada, Colombia, France, Senegal and the Philippines) are required to ratify the convention before France agrees to grant legal status to INIBAP. If INIBAP were to be incorporated into the CGIAR, these issues would need to be pursued.
8. Overall Assessment and Preliminary Conclusions

8.1. Assessment

According to the 1985 TAC review of CGIAR priorities, banana and plantain fit most of the criteria for CGIAR support. The need for greater international support to these commodities is even strengthened by the revised CGIAR mission statement and goals. Some CGIAR support is already provided through IITA and IBPGR. Therefore the main issues to be considered by TAC would appear to be institutional options, resource implications, and adequacy of resources.

INIBAP provides an attractive operational mode for international support to banana and plantain research. The main areas of research are expected to be defined by scientists participating in the regional networks. Strategic research at headquarters will presumably seek solutions to major research problems identified in the regions. However, it is questionable whether the proposed small team of core staff at headquarters will have the critical mass required to ensure scientific quality, to provide leadership to the overall programme, and to coordinate the thematic activities. Further, if the senior staff at INIBAP headquarters are expected to be involved in research, the network would not differ substantially from a small centre operating in a decentralized fashion. The method of operation proposed by INIBAP is indeed very similar to IBPGR.

The INIBAP model would facilitate collaborative research with advanced institutions in developed countries, and some of the stronger national programmes in developing countries. The network would also have a research enabling, as well as a capacity building function for the weaker national programmes.

Of the three continents where banana and plantain are important, Africa has the weakest national research systems while Latin America and the Caribbean have the strongest national programmes. Asia is in between the two extremes. Networking could therefore be an appropriate mechanism for Latin America and the Caribbean, and might also be applicable to Asia and the Pacific as well. Africa does not yet have the research base, the capacity, or the infrastructure to make a collaborative research network meaningful. Therefore, a different strategy should be considered for sub-Saharan Africa.

8.2. Major issues

A number of issues have become apparent from this analysis. Three are considered to be significant:

(i) The importance of banana and plantain was stressed by TAC in the 1985 Review of CGIAR Priorities and Strategies. Banana and plantain were also ranked very highly in the TAC document, "A Possible Expansion of the CGIAR - Part I - Interim Report" with respect to value of production among the major agricultural commodities in developing countries. Should the CGIAR assume a greater role on banana and plantain research than previously considered necessary by TAC?
(ii) Should IITA assume a global role for banana and plantain? If not, what should be the best mode of operation and institutional options within an expanded CGIAR? It should be recalled that the 1984 EPR of IITA recommended a revision of the mandate to allow the centre to have global responsibility within the CGIAR System for these commodities, but TAC did not support such a move.

(iii) Lately, networks have become increasingly popular as a mode of operation in the CGIAR. Would this be realistic for commodities with a short research history like banana and plantain, particularly given the weakness of most NARS in the major producing regions?

This analysis also reveals some unsettled issues:

(a) The inclusion of banana, particularly dessert banana, in the CGIAR would raise the question of the role of the CGIAR in research on tropical and sub-tropical fruits. Should the CGIAR consider support for other important tropical fruits like avocado, mango, and pineapple?

(b) Banana is a major cash crop in Latin America and the Caribbean where they are mainly grown as a plantation crop by the private sector. The private sector is not supporting germplasm improvement work, due in part to the difficulties associated with plant breeders rights for clonally propagated crops. Should the CGIAR support work which might mainly benefit the private sector?

(c) Taking into account the current preoccupation in the CGIAR with sustainability issues, interest in income generation for smallholders, and the recent decision to include forestry in the mandate of the CGIAR, is it time to consider some tree crops like cocoa, oil palm, coffee, tea and coconut for CGIAR support? It should be noted that coconut was recommended in the 1985 TAC Review of CGIAR Priorities for CGIAR support.

8.3. Preliminary conclusions

Several modes of operation could be considered for banana and plantain research within an expanded CGIAR. In our judgement, four institutional options deserve serious consideration:

(i) IITA could assume global responsibility for banana and plantain. INIBAP would be given the option of becoming part of IITA. If INIBAP accepted the invitation, banana and plantain research would become a full-fledged programme at IITA with its own Director. In light of recent developments in the CGIAR, and the economic importance of banana and plantain, TAC may wish to review its 1985 position.

(ii) IITA could have primary responsibility for banana and plantain in the CGIAR, with particular emphasis to sub-Saharan Africa. IITA would have global responsibility for germplasm enhancement, and the conservation of base collections. CIAT and IRRI would be
invited to add banana and plantain to their mandates for Latin America and the Caribbean, and Asia and the Pacific regions respectively. The relationship between IITA, CIAT, and IRRI would be similar to that presently existing between IRRI, WARDA and CIAT for rice. In this model INIBAP would have no specific role to play within the CGIAR.

(iii) INIBAP could be asked to assume full responsibility for banana and plantain research within the CGIAR. IITA would be requested to drop plantain breeding activities from its operational mandate.

(iv) Maintain the present arrangements with IITA, IBPGR and INIBAP as the main actors. The CGIAR would support INIBAP through IITA and IBPGR to promote and coordinate network activities, and thematic research.

The panel may wish to review these options and give its views on the strengths and weaknesses of each. The panel is also invited to suggest/consider other options.

8.4. Resources implications

With respect to resources INIBAP plans to spend $3.1 million per annum on essential activities during its first full year of operation. The medium term plan of IITA envisages the allocation of 3 senior scientist-years per annum for plantain research through 1993 (at a cost of $183,390 per senior scientist-year in 1987 dollars). IBPGR will probably continue to allocate about $100,000 per annum for research contracts dealing with banana and plantain. Therefore, if INIBAP were to become fully operational by 1991, there would be more than $3.8 million allocated for international essential research and related activities on banana and plantain.
REFERENCES


<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACIAR</td>
<td>Australian Centre for International Agricultural Research</td>
</tr>
<tr>
<td>ACORBAT</td>
<td>Asociación para la Cooperación en Investigaciones Bananeras en el Caribe y América Latina</td>
</tr>
<tr>
<td>ASBANA</td>
<td>Asociación Bananera Nacional</td>
</tr>
<tr>
<td>BBTV</td>
<td>Banana Bunchy Top Virus</td>
</tr>
<tr>
<td>CATIE</td>
<td>Centro Agronómico Tropical de Investigación y Enseñanza</td>
</tr>
<tr>
<td>CGIAR</td>
<td>Consultative Group on International Agricultural Research</td>
</tr>
<tr>
<td>CIRAD</td>
<td>Centre de Coopération Internationale en Recherche Agronomique pour le Développement</td>
</tr>
<tr>
<td>EMBRAPA</td>
<td>Empresa Brasileira de Pesquisa Agropecuaria</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
</tr>
<tr>
<td>FHIA</td>
<td>Fundación Hondureña de Investigación Agrícola</td>
</tr>
<tr>
<td>IAEA</td>
<td>International Atomic Energy Agency</td>
</tr>
<tr>
<td>IBPGR</td>
<td>International Board for Plant Genetic Resources</td>
</tr>
<tr>
<td>ICA</td>
<td>Instituto Colombiano Agropecuario</td>
</tr>
<tr>
<td>ICIPE</td>
<td>International Centre on Insect Physiology and Ecology</td>
</tr>
<tr>
<td>IDRC</td>
<td>International Development Research Centre</td>
</tr>
<tr>
<td>IITA</td>
<td>International Institute of Tropical Agriculture</td>
</tr>
<tr>
<td>IMTP</td>
<td>International Musa Testing Programme</td>
</tr>
<tr>
<td>INIDAT</td>
<td>International Network for the Improvement of Banana and Plantain</td>
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<tr>
<td>IRAZ</td>
<td>Institut de Recherche Agronomique et Zootéchnique</td>
</tr>
<tr>
<td>IRFA</td>
<td>Institut de Recherche sur les Fruits et Agrumes</td>
</tr>
<tr>
<td>KUL</td>
<td>Katholieke Universiteit Leuven</td>
</tr>
<tr>
<td>PCAARD</td>
<td>Philippine Council for Agriculture, Forestry and Resources Research and Development</td>
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<td>TAC</td>
<td>Technical Advisory Committee</td>
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<tr>
<td>WARCORP</td>
<td>West African Regional Cooperative Research Network on Plantain</td>
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</table>
### APPENDIX I

#### INIBAP'S RESEARCH AND RELATED ACTIVITIES (1990)

<table>
<thead>
<tr>
<th>Proportion of budget allocated to research</th>
<th>49%</th>
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<tbody>
<tr>
<td>- strategic</td>
<td>10%</td>
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<tr>
<td>- applied</td>
<td>23%</td>
</tr>
<tr>
<td>- adaptive</td>
<td>16%</td>
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</table>

#### Development of research capacity | 27%

- training                                | 12%
- conferences & seminars                  | --
- technical assistance ++                 | 2%
- financial assistance ++                  | --
- information & communications             | 13%

#### Administration etc. | 24%

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

Also required: Breakdown to show proportions of budget allocated to:
- (i) research;
- (ii) related activities; and
- (iii) administration, etc.
## RELATIONSHIPS WITH NATIONAL PROGRAMMES

### A. Collaboration with Individual Countries (Developed or Developing)*

<table>
<thead>
<tr>
<th>Purpose of Collaboration</th>
<th>Country or Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>KUL/BELG. INDEX</td>
</tr>
<tr>
<td>X</td>
<td>LAC</td>
</tr>
<tr>
<td>X</td>
<td>WAC</td>
</tr>
<tr>
<td>X</td>
<td>EAC</td>
</tr>
<tr>
<td>X</td>
<td>ASP</td>
</tr>
</tbody>
</table>

#### Purpose of Collaboration
- Strategic research
- Applied research
- Adaptive research
- Extension
- Institution building

#### Types of Relationship
- Collaborative
- Contracting
- Enabling

#### Role(s) of centre in the collaboration
- Leader/controller
- Customer
- Partner/collaborator (no funding from centre)
- Donor
- Channel for funding

---

* Since many developing countries are participating in the network, they are included under B. Participation in Networks.

**Note:** The above analysis should be accompanied by a list of projects and their objectives (see following page).
KUL-Belgium

INIBAP’s transit centre is located at Katholic University of Leuven, where germplasm material is stored, and through where it transits to different countries requesting it. The laboratory also conducts research on Musa somaclonal variation, in-vitro research and rooting of Musa plantlets. This research is supported by INIBAP.

Indexing Centre – France

INIBAP supports the activities of the Virus Indexing Centre located in CIRAD, Montpellier, France. The research is for indexing plants for virus diseases and particularly for observations on Bunchy Top Virus.

Latin America and The Caribbean (LAC) Region

The INIBAP LAC Regional Coordinator supports small enabling research projects in various countries in the region: Musa collection at ICA, Colombia; exchange of Musa germplasm between EMBRAPA, Brazil, and CATIE, Costa Rica; training of pathologist in Black Sigatoka identification from Jamaica in Costa Rica; training of regional officers of plant protection in Honduras; FHIA, ASBANA and ICA participation in International Musa Testing Programme; etc.

West and Central Africa (WAC) Region

The WAC Regional Coordinator supports small research and training activities in his region including quarantine training course for regional plant protection officers; financial support to Musa in-vitro research at IITA; initiation of small Musa research projects in Congo, Cameroon and Western Zaire.

East Africa (EAC) Region

The EAC Regional Coordinator will support activities in training in Information/Documentation for researchers and documentalists from all the region through a workshop; a quarantine course for plant protection officers; International Musa Testing Programme (IMTP) project participation by IRAZ in testing of Musa varieties with resistant/tolerance to Black Sigatoka Disease.

Asia and The Pacific (ASP) Region

In the ASP region, programmes for the establishment of a Regional Coordinator’s office will be undertaken. In the process, research collaboration with a number of national programmes, Malaysia, Philippines, Indonesia, Australia and India will be coordinated, including the initiation of an IMTP project in Asia and Pacific countries.
B. Participation in Networks

<table>
<thead>
<tr>
<th>Main purpose of network</th>
<th>LAC</th>
<th>WAC</th>
<th>EAC</th>
<th>ASP</th>
<th>DOC</th>
<th>GMO</th>
<th>PAT</th>
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<tr>
<td>Strategic research</td>
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<td>Applied research</td>
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<td></td>
<td></td>
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<td>Adaptive research</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
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<td>Extension</td>
<td>X</td>
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<tr>
<td>Institution building</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<table>
<thead>
<tr>
<th>Type of network</th>
<th>LAC</th>
<th>WAC</th>
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<th>ASP</th>
<th>DOC</th>
<th>GMO</th>
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<tr>
<td>Collaborative</td>
<td>X</td>
<td>X</td>
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<table>
<thead>
<tr>
<th>Role(s) of centre in the network</th>
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<tbody>
<tr>
<td>Administrator/controller</td>
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<tr>
<td>Scientific coordinator</td>
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<tr>
<td>Partner/collaborator</td>
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<tr>
<td>(no funding from centre)</td>
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<tr>
<td>Scientific consultant/</td>
</tr>
<tr>
<td>provider of germplasm</td>
</tr>
<tr>
<td>Channel for funding</td>
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</tbody>
</table>

Note: The above analysis should be accompanied by a list giving the title of the network, its objectives and the participating countries (see following page).
Information/Documentation Network

The objective of the Information/Documentation Network is to provide global information on banana and plantain research. The global network is subdivided in the regional networks of LAC, WAC and EAC, and will organize, in 1990, a training course in info-documentation for regional researchers and documentalists.

Germplasm Movement Network (GMO)

The objective of the global network is to coordinate the movement of Musa germplasm material on a world-wide level, with exchange and collaboration between breeders and researchers in different institutions and national programmes. In 1990, a great deal of material will move from breeders, such as FHIA, via the transit centre at KUL.

Pathology (PAT) Network

The objective of the pathology and diseases control network is to monitor and coordinate research related to Musa diseases, in particular Black Sigatoka and Banana Bunchy Top Virus (BBTV).

This network will support research, both strategic, applied and adaptive that would allow for the development of control methods against these two diseases.