PAB: IAR/72/11
4 April 1972

CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

TECHNICAL ADVISORY COMMITTEE

Third Meeting, Rome, 10-13 April 1972

THE COLLECTION, EVALUATION AND CONSERVATION OF PLANT GENETIC RESOURCES

Report of TAC Ad Hoc Working Group held in

Beltsville, U.S.A. - 20-25 March 1972

(Item 7)

TAC SECRETARIAT
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ROME 1972

WM/C7535

The Collection, Evaluation and Conservation of Plant Genetic Resources

Summary

Agricultural progress has depended heavily on new plants or beneficial characters introduced from the world pool of germ plasm represented by primitive cultivars and wild or weed species. This irreplaceable resource is rapidly being eroded by the expansion of cultivated area, and by the spread of new and more sophisticated crop varieties - in some cases whole regions are moving towards the use of a few narrowly related varieties. Thus on the one hand, the threat of disaster from pests and diseases is being increased, while on the other the genetic diversity on which to draw for resistance is being seriously diminished.

At its second meeting in October 1971, the Technical Advisory Committee expressed concern at these trends, and decided to seek further advice on the possibility of establishing an action programme to collect, evaluate, and conserve genetic resources for future use; including the probable costs of such a programme.

This report presents the conclusions of a working meeting of leading scientists in this field, convened under the auspices of TAC at the USDA Research Centre, Beltsville, U.S.A., from 21 to 26 March 1972.1/

The meeting shares the concern of the TAC with the gravity and urgency of the problem. It believes this to be of critical importance to the future advancement of agriculture throughout the world, but particularly in the developing countries which have both the greatest need to adopt improved varieties and contain the largest reservoir of genetic diversity threatened by their adoption.

In order to conserve genetic resources against the needs of the future without retarding agricultural expansion it is recommended that a global network of genetic resources centres be established as rapidly as possible, involving both developed and developing countries. The main focus of this would be on ten regional genetic resources centres; plus a smaller number of crop-specific centres - including the existing and proposed "International Centres" being supported by members of the Consultative Group. All of the centres recommended in fact form part of organizations already in existence, thus maximising experience and minimizing capital costs.. The regional centres would in turn form the nucleii of a network of cooperating national stations in developing countries, support for which is also proposed according to agreed priorities as an integral part of the programme.

To guide the operations of this network and to facilitate collaboration with centres in developed countries it is proposed that a Coordinating Committee be established. This would control a central fund for exploration, collection, training, and information, which would be allocated in response to requests from regional and other cooperating centres according to need. The Committee would be composed of not more than ten leading scientists in the field of genetic resources, to be selected by the TAC. It would be supported by a small central staff of three specialists and it is recommended that this be located in FAO Headquarters under a Trust Fund providing appropriate safeguards for its independence. It would complement and cooperate with the existing FAO Crop Ecology and Genetic Resources Unit, and its size has been determined accordingly.

A strong training effort is proposed mainly to strengthen national capacity to participate in the network (shortage of trained personnel at regional centres is not expected to be a major constraint). Approximately 40 graduate students would be trained to M.Sc. level at specialised institutions, in addition to shorter training courses at regional centres, etc.

1/ Terms of reference and a list of those attending are attached as Annexes 1 and 2.

The proposed programme would cost approximately $5.4 million spread over five years, with the bulk of the limited capital expenditure in the first two years. The report identifies priority crops and regions for emergency action in the first year, but it is anticipated that the full network of regional and crop-specific centres could be operative by the third year. (See Tables 1 and 2)

Genetic resources, if preserved, will never be exhausted like minerals, and can always be utilized in plant improvement. It is essential that the genetic variation which still exists can be drawn upon and that the natural evolution of species can continue; on this not only immediate progress in agriculture but man's future food supplies depend. The proposal presented here offers a very cheap means of ensuring this, and one with which it is hoped that the TAC and the Consultative Group members will be able to identify and associate themselves.

1. Introduction

1. Recent developments in agriculture have done much to increase production and to relieve shortages of food, but at the same time they have generated enormous dangers and hazards that are not generally understood nor appreciated.

2. First, the genetic diversity on which all plant breeding programmes depend is being wiped out as old landrace populations are being replaced by new varieties. Second, whole regions are moving toward one or a few genetically related varieties and the narrower gene bases are invitations to epidemics of diseases and pests. The classic example is the diffusion of the Mexican wheats and their derivatives from an estimated 10 hectares in India and Pakistan in 1964-65 to around 10 million hectares in 1971. In addition, there is a progressive erosion of the germ plasm base in both wild species and cultivated crops (some of which are of great importance to human nutrition) as a result of a complex of other technical, social and economic factors, including the pressure of population on land resources (both in cultivated areas and in natural grazings and forests), the spread of mechanized agriculture and herbicide use, changes in land use consequent on the expansion of irrigation, as well as in response to changes in factor and product prices and consumer requirements.

3. A few specific examples will serve to illustrate the gravity of the problem and the urgent need for action to collect, evaluate, and conserve such species, both for utilization in current agricultural and horticultural development programmes and as an insurance for future generations:

Wheat in Turkey: Turkey occupies part of the region in which wheat was first domesticated and at one time was enormously rich in wheat diversity. Wild and weed races are still to be found, and the wheat fields of Turkey were once planted to mixed, adapted landrace populations of great variability. Today, it is estimated that about 80 percent of the spring wheat acreage is planted to Mexican improved wheats and over 95 percent of the rest of the wheat acreage in the country is established to improved varieties selected by Turkish research workers. Not only this, but the wheat acreage has expanded, reducing the area planted to barley, oats, rye, and grain legumes which were also domesticated in the region and were once enormously variable in Turkey.

Rice in Ceylon: In the 1971-2 crop it was estimated that the new dwarf rice varieties were established on 60 percent of the land suitable for them and that 90 percent of the remaining acreage (the bulk of the total rice area) was planted to locally released improved cultivars. The figures will be higher in 1972-3. This leaves little room for the traditional landrace populations which will soon vanish altogether if they are not collected and preserved. In South and South-East Asia as a whole the spread of the new rice varieties, if not quite as dramatic as for wheat, has also been very rapid: from no more than 5,000 ha in 1965-66 to an estimated 7 million ha in 1969-70.

The Grain Legumes: The grain legumes are the main source of high quality protein throughout much of the Indo-Pakistani sub-continent, the Near East, and North Africa. There has been a sharp decline in the area under these crops throughout these countries from 28.5 mill.ha in 1963 to 26.3m.ha in 1970. This is partly as a result of their low yields (particularly under irrigated conditions), but mainly due to the great expansion of wheat acreage consequent on the striking success of the Mexican varieties and in some countries also on high support prices for wheat. Not only are the nutritional implications serious, but the loss of germ plasm resulting from the disappearance of these cultivars from large areas will impede the progress of selection and breeding programmes to develop improved varieties.

Tropical Fruits in South-East Asia: The traditional mixed plantings and wild forms, the commercial possibilities of which have barely been explored, are being replaced by a rapid increase in plantings of oil palm and rubber and by ruthless expansion of mechanical logging and strip-mining. A number of other tropical fruits of great commercial importance in Asia, in particular bananas, rests on a dangerously narrow genetic base.

Maize in U.S.A.: The serious outbreak of southern corn leaf blight in 1970 served notice that genetic variability is not always enough if the cytoplasm is all of one kind. Hybrid sorghum also uses only one cytoplasm. Such hazards are global.

4. This trend goes on all over the world and at an increasing tempo. As a result our stores of irreplaceable genetic variability are eroding at an alarming rate and the genetic bases of the crops we produce are being narrowed to a point where it will be increasingly difficult to avoid or prevent disastrous epidemics of diseases and pests.

5. The catastrophic outbreak of coffee rust in Brazil in 1970 is an example of advanced thinking and practice which is all too rare at present, but which ought increasingly to become standard procedure. The variety Geisha found in Ethiopia had already been introduced to Latin America through the USDA, evaluated for resistance to disease in Portugal, and for adaptation and yield in Central America. When rust appeared in Brazil, this resistant material was available for increase and evaluation from Turrialba and elsewhere so that propagating stock could be supplied to Brazilian farmers immediately.

6. The main sources of resistance to plant pests and diseases, as well as of other beneficial characters such as winter hardiness, drought tolerance, and nutritional value, have always been the traditional mixed landrace populations or the wild and weedy relatives of our crops. We thus need desperately to maintain as much genetic variability as possible for our breeding programmes - but at the same time the greatest genetic variability occurs in the developing countries where it is necessary to replace the old cultivars with others of higher quality or yield. This is a challenging paradox to which a solution is urgently required.

7. Fortunately, there is now a much greater awareness that the availability of broadly based gene pools is a pre-requisite of adaptation to environmental change, hence of species efficiency and survival. What has not yet been done, and urgently needs to be done, is to prepare an international programme of action that will provide the necessary conditions for the establishment of such a base.

8. Recognizing the importance of this problem, the TAC, at its second meeting in October 1971, emphasized the urgency for the collection and conservation of plant genetic resources, not only to ensure that certain existing cultivars of great genetic importance were not lost, but also to provide a continued and enhanced supply of genetic materials for research purposes. This it considered essential in order to maintain the impetus already established in international plant breeding work and to keep up with the constantly increasing demands for higher yielding, higher quality, widely adaptable varieties.

9. Stressing the need to develop a coordinated international programme in this field of activity as soon as possible, the Committee nevertheless recognized the need for further information before a firm recommendation for international action could be made. An important reason for this was that there were some differences of substance both in connection with the approaches proposed to the strengthening and coordination of the existing network of genetic resources centres, and in relation to the probable costs of new ones and the time horizons envisaged.

10. The purpose of this report is to provide the TAC, and through it the Consultative Group, with carefully worked out proposals for an action programme which will indicate the main needs, define the priorities, identify the approaches most likely to be effective (with due regard both to the needs and the financial resources likely to be available), and attempt to quantify the probable costs over a five-year time horizon.

11. In our recommendations for this programme we have envisaged a network of cooperating centres in both developing and developed countries making use of institutions already in existence. Some of these are adequately staffed and equipped already, but others require strengthening for this purpose. We have tried to indicate the role of the various units within this network, and to show how its creation and coordination would achieve complementarity and economy of effort.

12. The objectives of the proposed network are:

1. To salvage disappearing and threatened germ plasm as rapidly as possible.

2. To collect genetic resources on a systematic basis for future plant breeding programmes or for direct use.

3. To distribute material from the collections to plant breeders and other scientists.

4. To conserve on a permanent basis as much genetic material as is practicable.

5. To provide for rejuvenation of stocks as needed.

6. To provide information about material held in centres and its characteristics.

7. To assist in training of personnel.

8. To stimulate a worldwide awareness of the problem.

13. The developed countries have a major role to play, not only in the global effort of exploration, but in particular in collaborating with the proposed regional centres in the evaluation and conservation of newly collected materials, as well as in the training of workers and the exchange of information on genetic resources. **Association between institutes in developed and developing countries in these activities might attract support from members of the Consultative Group in whose countries the former were located.**

2. The Potential Benefits of the Collection, Evaluation, and Conservation of Plant Genetic Resources

14. The search for and use of new genetic materials either directly from introductions or in breeding programmes is essential not merely as a safeguard against losses from pests and diseases, but in order to provide greater flexibility to producers in diversifying their range of enterprises or responding to changes in factor availability and factor prices. Ruttan has argued, for example, that the key to success in long-term agricultural growth in Japan was the continuous evolution of higher yielding crop varieties in response to downward trends in fertilizer prices in a situation where land was the scarce factor in production.1/ Increasing demands are now being made on breeders to develop new varieties of crops such as cotton and jute tailored to specific end-uses in an attempt to meet competition from synthetics and to adapt to changes in consumer requirements. No country can today support an advanced and competitive agriculture based on indigenous plants alone.

15. A striking example of great benefits flowing directly from plant exploration, collection and introduction is the sheep and wool industry in Southern Australia which has been built entirely on leguminous fodder species introduced from the Mediterranean. Surprisingly few non-agriculturalists realise this. Similarly, the beef and cattle industry in Queensland and the northern territories developed originally around native grasses, but the more recent introduction of grasses and particularly of legumes, from tropical Latin America and Africa, has revolutionized its production potential. Improved cultivars derived from these introductions are now increasingly being utilized in the agriculture of developing countries. Comparable examples could be cited for other crops, for example certain drought resistant barleys from the Mediterranean.

1/ Ruttan, V.W.: Induced innovation in agricultural development. Economic Development Centre, University of Minnesota. Annual Report, 1971.

16. In the U.S.S.R. nearly all the most valuable varieties of crops in production on over 60 million ha, including wilt-resistant cottons, corn hybrids, barley and wheat varieties (amongst them the Bezostaya winter wheat now showing high promise in Turkey) utilized the collections of the Vavilov Research Institute in their creation.1/

17. A number of instances of large benefits flowing from plant introduction and collection are quoted in the recent report "The (U.S.) National Program for Conservation of Crop Germ Plasm".2/ These cover the whole spectrum of range, farm, and garden species, and are too numerous to describe in detail. However, by way of example, a selection from a peanut, introduced from the Argentine is estimated to have increased producers' incomes by over $9 million annually; the incorporation of wilt-resistance to tobacco from an introduction from Colombia to be worth $6 million annually or over $100 million over the last 25 years, and the introduction of wilt resistance to tomatoes from a primitive species in Peru has been worth an even larger sum.

18. The collection and evaluation of primitive lines of corn, barley, oats, and wheat for protein and amino-acid content also holds out considerable promise for improved nutrition in the less developed countries, which depend heavily on cereals for both calories and proteins. However, the opportunities may be even wider. Screening of 4,000 wild or little cultivated species of other plant families has revealed 379 with high protein and better amino acid values in their seed than those of many conventional food plants. The potential importance of these is incalculable.3/

19. In order to increase production, it is necessary to replace primitive cultivars and landrace populations with more nutritious or more adaptable higher yielding strains. The materials replaced should be preserved, but most developing countries cannot afford to maintain large collections. This is expensive, inefficient, and unnecessary if collections can be consolidated and maintained regionally or in world collections of international institutes. The chief value of the proposed regional collections is to provide a broad materials base for use in the region, but they would also be available to other regions through the network. It is common experience that workers in developing countries repeatedly request material they once had and lost, even when this may have had its origin in their own country.

20. The proposed network of centres and international institutes can render great service to the developing world by:

(1) Mobilizing world collections and providing materials the developing countries cannot afford to maintain.

(2) Providing information and stocks from extensive screening and evaluation programmes, e.g. IRRI screened over 7,000 cultivars of rice and 200 wild accessions including over 70 populations of *Oryza nivara* in order to find a source of virus resistance that turned up in only one accession of *O. nivara*. Over 14,000 accessions have been screened for blast resistance and protein quality.

(3) Assisting in the training of personnel.

(4) Cooperating in breeding programmes in which local workers want to incorporate special traits into locally adapted materials; often the traits are in non-adapted materials which must be grown elsewhere in order to make initial crosses.

1/ Information on the activities of the N.I. Vavilov All-Union Research Institute of Plant Industry.

2/ A progress report on Federal/State cooperation sponsored by Regional State Experimental Station Directors and the Agricultural Research Service, USDA. 1971.

3/ Imprint on Living. USDA Agricultural Information Bulletin no. 333, 1971.

(5) Identifying useful materials related to nutritional value in the more sophisticated screening programmes as in amino acid analysis, oil quality evaluation, etc.

(6) Stimulation of interest in workers in developing countries in evaluation and utilization of indigenous materials.

(7) Providing information on results of the more sophisticated types of research that developing countries can seldom afford, e.g. genetic and cytogenetic studies, seed physiology and storage, techniques for evaluation for diseases and pests, resistance, analysis of photosynthetic efficiency, etc.

(8) Assisting in upgrading badly needed facilities.

(9) Providing exploration experts and other specialists not available in some regions.

(10) Facilitating the restructuring of crop plants and other major improvements to agriculture in developing countries as a result of plant breeding programmes. This will be possible only if broad genetic resources are available.

3. Priorities Within the Network

21. In order to meet the needs and achieve the goals outlined above, we recommend the creation of an international network of genetic resources centres. This network would be based on regional centres in areas of great crop genetic diversity, and on international crop-specific institutions as shown in Table 1. In addition, several national institutions in developing countries have already extensive international activities and would be expected to participate in the network. The main support is proposed to be given to the regional centres, but support also needs to be given to some national institutions for specific tasks.

22. Within the network these centres and institutions would collaborate with organizations in the developed countries such as the N.I. Vavilov Institute of Plant Industry, Leningrad, U.S.S.R.; the USDA Agricultural Research Service, Beltsville, Maryland; C.S.I.R.O., Canberra, Australia; the Institute of Crop Science and Seed Research, Braunschweig-Volkenrode, Germany; Germplasm Laboratory, Bari, Italy; National Institute of Agricultural Sciences, Hiratsuka, Japan; Royal Botanic Gardens, Kew, England: National Agricultural Research Institute, Versailles, France; etc.

(i) The choice of regions

23. After discussion of possible systems of classification it was decided to base the choice of regions within which to undertake the programme and locate genetic resources centres on an adaptation of the classification of the world centres of genetic diversity proposed originally by N.I. Vavilov. This is as shown in Table 1 below:

Table 1: Proposed Regions, Regional and Crop Specific Centres, and Priority Ratings for Action*

Region	Proposed Regional Centre	Priority	Crop Specific Centre	Priority
1. China	None identified	-	None identified	-
2. South Asia	IARI (New Delhi)	A	ICRISAT (India)	A
3. South-East Asia and Pacific	Bogor (Indonesia)	B1 (non-rice)	IRRI (Philippines)	A - rice only
4. Mediterranean/Near East	Izmir	A	Bari (Italy)	A
5. Ethiopia	HSIU, Debra Zeit (Ethiopia)	A	None identified	-
6. Tropical Africa	IITA, Ibadan (Nigeria)	B1	None identified	-
7. Mesoamerica	INIA, Chapingo(Mexico)	B2	CIMMYT (Mexico)	B2
8. Meso and lowland tropical S. America	IICA, Turrialba (Costa Rica)	A	CIAT (Colombia)	A
9. Andean Highlands	La Molina (Peru)	B1	IPC (Peru)	B1 - potatoes only
10. Sub-tropical South America	Campinas (Brazil)	B2	None identified	-

* See Table 2 for crop priorities allocated to centres.
A = Emergency. Immediate action once funds available.
B1 and B2 also urgent, but action to be phased over 3 years according to resources.

(ii) The priorities for action by crop and region

24. The disappearance of genetic resources varies by crop and by region. There is hardly any part of the world where agriculture is practised that does not suffer from genetic erosion, but the urgency for salvaging vanishing material does vary and it is possible to establish some relative priorities according to threat and importance of the crops to human welfare.

25. According to TAC policy first consideration has been given to the major food plants. Of these, the ones most threatened are wheat and rice. It is, therefore, recommended that the highest priority for action be given to regions four and five for wheat and regions two, three and six for rice. These must be considered emergency situations. Of the latter group, region three is the largest and most critical. Genetic resources of African rice are rapidly disappearing in region six, but the region contains less material and fewer collection problems.

26. While wheat and rice are the crops most in need of immediate attention, there are whole regions in which most of the genetic resources are threatened. Genetic erosion is most advanced in region four. Region five is rather special. The Ethiopian materials are unique and systematic collection is urgently needed not only because of threat of loss but because of immediate need in plant breeding programmes. Multiple disease and insect resistance and useful quality characteristics in wheat, barley, and coffee, as well as the economic importance of these crops to many countries, render these materials especially vital. For these reasons it is recommended that the highest regional priority be given to regions four and five.

Table 2(a): Crop Priorities for Proposed Regional Centres [1]

Centre	Countries Included in Region	Highest Priority	Other Important Crops	Secondary Importance [2]
1. China - No centre	China.	Soya beans Rice Sub-tropical fruit	Vegetables Millets Sorghum	Ornamentals Tea
2. India - IARI	India. Bangladesh, Bhutan, Ceylon, Nepal, Sikkim.	Grain legumes	Rice, millets	Wheat, barley, sorghum, sesame, cotton, guar, tropical fruits
3. S.E. Asia - (a) IRRI (rice only) (b) Bogor (others)	Indonesia. Philippines. Burma, Cambodia, Laos, Malaysia, Melanesia, New Guinea, Polynesia, Thailand, Vietnam	Rice Banana Coconut	Sugar cane Other tropical fruits Spices	Grain legumes
4. Mediterranean and Near East - Izmir and Bari	Turkey. Afghanistan, Algeria, Cyprus, Egypt, France, Greece, Iran, Iraq, Italy, Israel, Jordan, Lebanon, Libya, Morocco, Pakistan, Portugal, Spain, Yugoslavia, USSR.	Wheat Grain legumes Temperate fruits	Barley Forage legumes Safflower	Oats Rye Flax Brassicae Forage grasses
5. Ethiopia - HSIU	Ethiopia. Kenya, Saudi Arabia, Somalia, Sudan, Tanzania, Uganda, Yemen, Zambia	Wheat Barley Sorghum Coffee	Finger millet Brassicae Safflower Pasture grasses Sesame	Teff Flax Ensette Cotton Noog
6. Tropical Africa - IITA	Nigeria. C.A.R., Chad, Congo, Dahomey, Ghana, Guinea, Ivory Coast, Liberia, Mali, Niger, Senegal, Sierra Leone, Zaïre	Pearl millet Sorghum Cowpea Oil palm Yams Forage grasses	Rice	Finger millet Bambarra nut Cotton Coffee Fonio
7. Mesoamerica - Chapingo	Mexico. Guatemala	Beans	Corn Cotton Cucurbits	Vegetables Fruits
8. Mesoamerica and lowland S. America - IICA	Costa Rica. Brazilian and Colombian tropics; Caribbean Islands, Ecuador, El Salvador, Honduras, Nicaragua, Panama, Peru, Venezuela	Beans (Phaseolus) Cassava Cacao Rubber Tropical fruits	Tropical forage legumes	
9. Andean Highlands - La Molina	Peru. Bolivia, Chile, Colombia, Ecuador, Venezuela	Cotton Potato	Sweet potato Quinoa	Andean tubers
10. Sub-Tropical South America - Campinas	Brazil. Argentina, Paraguay, Uruguay	Peanut Cassava	Sub-tropical fruits Sub-tropical forage legumes	Cotton

1/ Country where centre is located underlined.
2/ Either because only of local importance (e.g. teff in Ethiopia) lower economic priority, or because the the region is not a main centre of diversity for those crops.

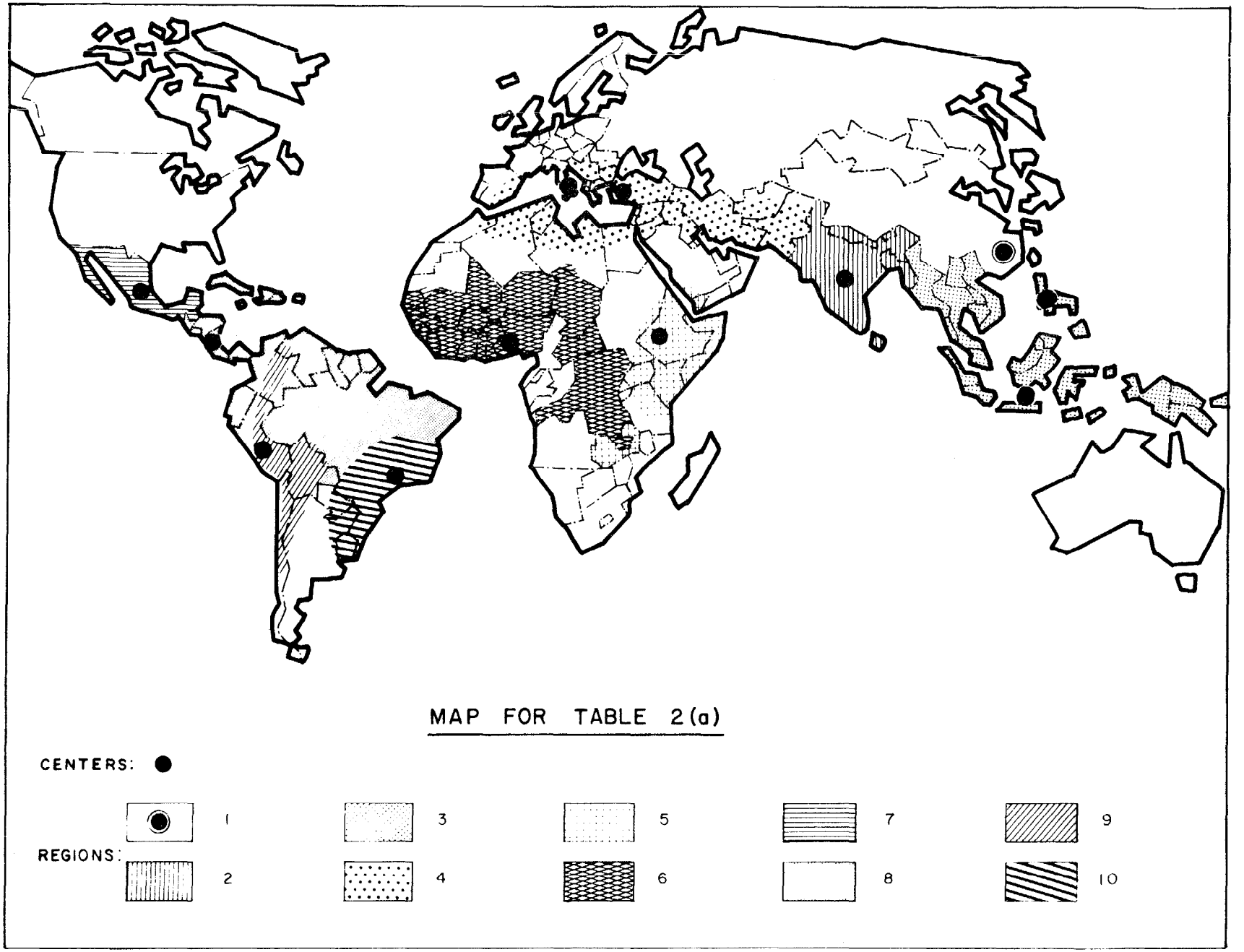
MAP FOR TABLE 2(a)
CENTERS:
REGIONS:
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Table 2(b): Priorities for Crop Specific Institutes[1/]

International Rice Research Institute, Los Banos, Philippines - RICE

Centro Internacional de Mejoramiento de Maiz y Trigo, Mexico, D.F. - MAIZE and WHEAT

International Crops Research Institute for the Semi-Arid Tropics, India - SORGHUM, MILLETS, CHICKPEA, PIGEONPEA

Centro Internacional de Papas, Peru - POTATO

Asian Regional Vegetable Research and Development Centre, Taiwan - VEGETABLES

1/ Assuming their Director's agreement to cooperate in the programme.

27. Of the other regions, there is less basis for choice of emphasis. In each case, one to several crops are seriously threatened, and in each case systematic collections are needed for current breeding programmes. It is evident that the entire network should be in operation as soon as possible.

28. The priority ratings for regions shown in Table 1 above were arrived at after careful consideration of a number of criteria, of which the most important were the nature of the emergency in the region, and the potential contribution to world agricultural development of the genetic resources available there. However, in one or two cases doubts also existed as to whether the capacity of the proposed station could be built up rapidly enough to participate effectively in the network in the first phase - for example because of lack of storage space or constraints on trained staff. Thus IRRI, which specialises in rice and which is well e equipped to handle the needs of that crop, has an A priority for South-East Asis, and Bogor, which is less adequately staffed and equipped at the moment and which would be handling mainly tropical fruits, the immediate threat to which is less than rice, is rated B1. Chapingo and Campinas have been given somewhat less urgent rating because some of the work which needs to be done in their regions of Latin America can be undertaken by CIMMYT and Turrialba respectively. But in no region is there any room for complacency, and it is urged that support to the proposed programme be phased to enable it to be fully operative at all centres shown in Table 2 by the end of the third year.

(iii) The choice of stations for genetic resources centres

29. The main stations proposed as genetic resources centres are all in existence already, although in some cases the facilities they have available to play a key role in the network require considerable reinforcement, and both the type and the cost of this additional support varies from centre to centre. This is a major reason for the differences in budgetary and other support shown in Table 3, Item 2.

30. The selection of the centres proposed for this major role has been based on the following criteria: (a) their geographical location in relation to the areas of genetic diversity of the main crops in the region they have to cover; (b) their probable capacity to contribute effectively to the exploration, collection and evaluation of the material available in the region; (c) their likely reliability in respect of conservation - taking into account both existing facilities and the probable long-term security of the collections· (d) their willingness to participate and receptivity to the concepts proposed as far as could be judged from the assessment of those present at the meeting.1/

31. In budgeting for their support it was considered that the first essential must be to provide or upgrade facilities for storage, without which any collections would be put in jeopardy. This is why practically all the capital investment proposed is concentrated in the first two years. Emphasis has also been placed on training; but although this is of vital long-term importance, especially to enable national centres to participate more effectively in the network, it is not seen as an over-riding constraint on the operational activities of the proposed regional or crop-specific centres which would form the core of the network.

1/ It should be noted that certain of the proposed centres, i.e. Bogor, Ibadan, Chapingo, La Molina, and Campinas were not represented at the meeting.

4. The Proposed Structure of the Network

(i) The Coordinating Committee

32. It is proposed that the activities of the network would be coordinated by a Committee consisting of six scientists representative of the network, and three independent scientists designated by the Technical Advisory Committee, but not necessarily members of the TAC. These would be appointed for a minimum term of two years on a rotating basis.

33. The co-ordinating Committee would report and make recommendations to TAC. Its functions would be:

1. To identify relevent institutions and organizations in all parts of the world and to invite them to participate in, or to cooperate with, the international genetic resources network; and to designate regional, crop-specific or other genetic resources centres;

2. To provide overall guidance on policy and planning for the network so as to secure coverage, fill gaps and avoid unnecesaary duplication in the areas of explorations, evaluation and conservation of plant genetic resources;

3. To receive reports and recommendations from affiliated regional and other organizations, to plan, promote and review activities, and to provide an annual financial statement and a budget of requirements.

4. To examine the overall needs and to provide, as a rule at the request of regional centres and other affiliated organizations, financial support for exploration, germ plasm increase, introduction of new techniques, and any other developments required for the more efficient utilization and conservation of germ plasm and for expert consultants to assist in such projects;

5. To co-ordinate and if need be, to provide funds for technical meetings;

6. To co-ordinate funds for training;

7. To assist in the dissemination of information and material among centres and institutions, and to encourage, within existing resources, and possibilities, the establishment of inventories of collections;

8. To assist in establishing standards, methods and procedures in exploration and evaluation, and to determine minimum standards for conservation and rejuvenation of both seeds and vegetative material;

9. To arrange for replicate storage of seed and vegetative stocks;

10. To encourage the establishment of nature reserves for the safeguarding of valuable genetic resources, to provide draft regulations for such a purpose as required, and to cooperate with other organizations with similar interests where possible;

11. To examine proposals for computerized information storage and retrieval systems and their suitablility for an effective international genetic resources network, taking into account compatibility with existing systems in operation at some regional or national centres.

(ii) Structure, Function and Location of the Central Staff

34. The Central Staff will be the executive agent in implementing the policy of the Co-Ordinating Committee. It should consist of a small core of three scientists with broad experience in fields relevant to genetic resources. They should, in total, provide leadership in the areas of exploration, conservation, information and documentation, one

of them being designated as the leader. It is proposed that the Central Staff be located at FAO Headquarters in Rome.

35. The Staff will assist regional and other centres in the planning and execution of joint programmes and will supervise the use of funds allocated for their implementation. Staff members will be required to maintain personal contact with centres and to report to the Co-Ordinating Committee as requested on the operations of the network.

(iii) Relations of the Central Staff with the Crop Ecology and Genetic Resources Unit of FAO

36. The FAO Unit has responsibilities for meeting the needs of its member countries (in particular the developing countries), in the conservation, exploration and use of crop genetic resources. However, the scope of these responsibilities is far in excess of the resources available, or likely to be available to it because of the increasing demands generated by the needs indicated in the introductory section.

37. The proposed central staff has been planned with a view to complement and cooperate with the existing staff of the Unit, particularly with respect to exploration, conservation and publications. It will rely on the Unit for the central distribution of seed and other stocks. The size of the central staff for the Coordinating Committee has been determined accordingly.

38. The FAO Unit has been assisted by an international advisory panel of experts. This panel has repeatedly stressed the inadequacy of resources to enable the Unit to fulfil its mandate effectively, and this was one of the main reasons for submitting a proposal to TAC for independent support to complement its activities. We believe the organization we propose would assure more effective participation of non-governmental institutions and other international agencies (e.g. foundations, IBP, universities, etc.).

(iv) Association of the Network with FAO

39. Recognizing the need for associating the proposed network with an appropriate international organization to provide the essential administrative support, we recommend that FAO be invited to assume this responsibility. It is proposed that a trust fund be set up for this purpose. Its articles should safeguard the technical and administrative autonomy of the Co-Ordinating Committee and Central Staff compatible with the requirements of the Organization.

40. To ensure good liaison between the network and the Crop Ecology and Genetic Resources Unit, we recommend that the head of the Unit be an additional (non-voting) member of the Co-Ordinating Committee.

41. FAO is expected to present nominations for appointment to the Central Staff to the Co-Ordinating Committee.

(v) Organization and Functions of Genetic Resources Centres

42. Each genetics resources centre should be considered as a regional network consisting of:

1. A regional centre, in which the actual gene bank is situated, and

2. A series of collaborating national centres, concerned chiefly with exploration, short-term conservation and the rejuvenation of the genetic stocks stored in the regional centre.

43. The complete attainment of these objectives could vary according to circumstances; if, for example, international crop specific centres such as IRRI existed in the appropriate areas, then regional centre activities would not need to duplicate these, thus saving considerable expense.

44. It is important to emphasize that all countries linked into the regional network scheme would function as voluntary and equal partners in the management and planning of their work. Furthermore, they would be able to obtain additional advice and assistance through the coordinating body for their work programmes and related activities such as training and information.

a) The Regional Centre

45. Each regional centre should possess adequately trained scientific personnel as well as field assistants, secretarial help and other support staff.

46. The facilities should include field collecting equipment, a vehicle, storage facilities of an internationally acceptable standard, together with field and/or glasshouse space for multiplication of stocks, seed cleaning, drying and moisture equilibration facilities, and appropriate documentation equipment. The amount of funding needed for the various regional centres will depend on existing staff, buildings and equipment.

47. The responsibilities and activities of the regional centres are envisaged as follows:

1. Exploration and collection of material in the region, and collaboration with national centres.

2. Identification and preliminary evaluation of materials.

3. Initial planting of introduced material according to the quarantine laws of the country in which the centre is located.

4. Exchange and distribution of seed and vegetative stocks, including, where appropriate, the introduction of breeding lines and advance cultivars.

5. Maintenance and storage of seed and vegetative stocks for long-term preservatic

6. Documentation and exchange of information with other centres in the network in an internationally accepted form. Some centres will be able to take advantage of existing local facilities for computerized information storage and retrieval.

7. Organization of genetic stock rejuvenation by the national centres wherever possible, or otherwise by the regional centre.

8. Organization of training programmes for personnel in collaboration with national or international training schemes.

9. Identification of "genetic reserve areas" (see p.9 point 10) in consultation with national centres and the international coordinating body.

b) National Centres

48. The national centres should possess adequately trained scientific personnel, field assistants and other support staff. Where these are not available, it may be necessary for the regional centres to take over some of the functions of the national centres, either permanently or for a limited period.

49. Facilities should include seed drying and cleaning equipment, collecting materials, a vehicle, and some provision for short-term seed storage. Provision for the rejuvenation of genetic stocks should also be made.

50. The responsibilities and activities of the collaborating national centres are envisaged as follows:

1. Exploration, collection, processing and field identification of materials.

2. Preliminary evaluation and increase of material.

3. Initial planting of introduced material according to national quarantine laws.

4. Exchange and distribution of materials with the regional and other centres.

5. Provision of simple short-term storage for working collections.

6. Documentation in an internationally acceptable form and exchange of information with other centres in the network, in collaboration with the regional centre.

7. Rejuvenation of seed and vegetative stocks in collaboration with the regional centre.

8. Identification of personnel suitable for training.

9. Development of a body of expert information on genetic resources in their own countries.

10. Identification of "genetic reserve areas" and notification of these to national governments, the regional centre and the co-ordinating body.

(vi) Management of the Regional Network

51. The programmes and responsibilities of the regional network would be established in consultation with a regional committee. This committee would be composed of representatives of the collaborating regional and national institutes together with the international coordinating committee, and would meet at regular intervals. The regional committee should have a small panel of advisers for consultation on matters of scientific and technical importance. The panel members should be of international repute, chosen for their technical expertise, and should consult with the regional committee. Advice would also be sought when necessary from specialists in the crops and subject areas of interest to the regional network.

5. Training Requirements of the Network

52. The training requirements of the proposed network must cover both the needs of the regional centres and of national institutions in developing countries cooperating with those centres. It is envisaged that the specialised trainging to M Sc or equivalent level which is considered necessary for staff of the regional or larger national centres will be provided overseas; and there are a number of institutions, including for example the East-West Centre in Hawaii and the University of Birmingham in the United Kingdom, which offer special courses at this level, relevant to the needs of workers at genetic resources centres. Shorter courses for technicians, field staff, etc. should in most cases be conducted by the Regional Centres, and provision for this has been made in their duties listed in Section 4 (v) a).

53. It is not possible at this stage to define a precise programme for training professional staff of the genetic resources centres phased over five years since some of the proposed regional centres were not represented at the meeting. The requirements of those centres are unlikely to be heavy, since all have some trained staff, but a survey would have to be undertaken by each centre, once established, to determine the needs of cooperating national centres.

54. On the estimates given by those representatives of the proposed Regional and Crop-Specific Centres present at the meeting (IICA (Costa Rica), HSIU (Ethiopia), IARI (India), CIMMYT (Mexico), IRRI (Philippines), Izmir (Turkey)), with a pro-rata allowance for Bogor, Chapingo, Campinas, IITA and La Molina; at least 40 students would have to be trained in the the specialised techniques required over the 5 years of the programme now being proposed. This estimate might prove to be on the low side once the nature of national requirements is known - for example Izmir envisages sending 10 students for training from the Near East and Mediterranean region alone. On the other hand India, with a strong base of trained personnel, foresees a much smaller need for its region; while some of the large Crop-Specific Institutes might be able to train national cooperating staff themselves.

55. There are therefore considerable uncertainties; but assuming 40 students requiring specialised training at an average cost of $ 5,000 each, the figure budgeted of $ 40,000 per year for this purpose (see Budget item 4), is not considered excessive.

6. Budget Proposals (Table 3, Items 1 - 4)

56. The estimates of funds required for the implementation of the network proposed in section 4 above, have been prepared with care on the basis of personal knowledge of members of the group. While the estimates cannot be expected to be correct to the last detail, the general order of magnitude can be accepted as reliable. The conservative nature of the estimates presented is due to the availability of existing staff and facilities at the institutions selected.

57. The detailed projection of expenditures is restricted to the first three years; thereafter expenditure for exploration may be expected to drop. However, additional requirements for equipment may arise as a result of newly developed techniques which are not now foreseeable.

58. No major building projects have been proposed, and none are foreseen. Requirements included are mainly for exploration (vehicles), and for glasshouse and storage facilities.

59. Requirements for staff include a small number of expatriate staff; however, the majority are to be locally recruited, and some of these may profit from additional training or experience in another centre. This has been taken into account in the allowances provided for training in item 4.

60. The proposals are presented on the basis of full financial years. The actual requirement in the first year will depend on the time of approval of the project and on the recruitment of staff. It is expected that only the appointment of expatriate staff may present difficulties and cause some delays.

61. The budget is presented in four parts. Item 1 provides for meetings of the co-ordinating committee and for the central staff. Item 2 lists the estimated requirements of the eight regional centres and the International Rice Research Institutes Further details are available if required. These proposals have not been weighted according to priorities, but this can be readily done by referring to Section 3 of the report. Item 3 makes provision for requirements by national organizations (see Section 4 (v) b)), such as seed storage, quarantine facilities, equipment and supplies for exploration, including vehicles, and support staff for evaluation. It is anticipated that some support at the national level might become available under bilateral arrangements. It is proposed that funds for consultants, exploration, technical meetings, publications, and training be allocated centrally by the co-ordinating committee on the basis of priority, need and purpose (Item 4). Allocations may be made to any participating institutions, and not only to the centres named in Item 2.

Table 3 . BUDGET SUMMARY

		Year 1	Year 2	Year 3
1	Co-Ordinating Committee and Staff	$ 131,000	$ 122,000	$ 122,000
2	Regional Centres, Recurrent	587,000	587,000	587,000
	Regional Centres, Nonrecurrent	140,000	71,000	-
3	Support for National Institutions	100,000	100,000	100,000
4	Exploration, Training, Consultants, etc. (for allocation to regional and other institutions)	190,000	230,000	230,000
		$1,148,000	$1,110,000	$1,039,000
	Project Service Cost (to be decided)			

Table 3 - Item 1 . CO-ORDINATING COMMITTEE AND STAFF

Salaries (3 Professional)		$ 70,000
Salaries (2 Secretarial)		16,000
Meetings of Co-Ordinating Committee -	1st year $18,000	
	2nd year and later	9,000
Travel for Staff		20,000
Supplies, Materials and Committee Reports		5,000
Postage, etc.		2,000
	Later years	$122,000
	1st year	$131,000

Table 3 - Item 2(a) REGIONAL AND CROP-SPECIFIC CENTRES - SUMMARY

Regional Centres	Recurrent Expenses	Capital* Expenditures
Agricultural Research and Introduction Centre, Izmir, Turkey	77,000	-
Indian Agricultural Research Institute, New Delhi, India	31,000	32,000
Haile Selassie I University/College of Agriculture, Debra Zeit, Ethiopia	95,000	43,000
Inter-American Institute of Agricultural Science, Turrialba, Costa Rica	81,000	17,000
Instituto Nacional de Investigaciones Agricolas, Chapingo, Mexico	63,000	7,000
Estacion Experimental/Universidad Agraria, La Molina, Peru	66,000	24,000
Instituto Agronomico, Campinas, Brazil	75,000	14,000
Botanic Gardens, Bogor, Indonesia	75,000	34,000
Crop-specific international centres**		
International Rice Research Institute	24,000	40,000
	587,000	211,000

* Overall capital expenditure to be $140,000 in the first year and $71,000 in the second year.

** It is assumed that CIMMYT,IITA, CIAT, ICRISAT and the IPC (International potato centre) will also be willing to participate, but this decision has been left open.

Table 3 - Item 2(b): Regional and Crop-Specific Centres

1. CAPITAL EXPENDITURES	Izmir	IARI	Ethiopia	IICA	Chapingo	La Molina	Campinas	Bogor	IRRI
1.1 Long-term Storage	-		28,000			12,000	8,000	12,000	40,000
1.2 Vehicles	-	12,000	10,000	7,000	7,000	10,000	6,000	10,000	
1.3 Laboratory equipment, greenhouse, etc.	-	20,000	5,000	10,000		2,000		12,000	
Sub-Total	-	32,000	43,000	17,000	7,000	24,000	14,000	34,000	40,000
2. RECURRENT EXPENSES									
2.1 Staff	*(1)	(1)	(3)	(3)	(3)	(2)	(2)	(3)	(1)
Professional	22,000	5,000	45,000	45,000	24,000	24,000	28,000	38,000	10,000
Secretarial	4,000		6,000	4,000	4,000	3,000	5,000	3,000	
Other	19,000	6,000	6,000	9,000	3,000	20,000	25,000	8,000	
2.2 Travel	4,000	5,000	7,000	6,000	5,000	9,000	6,000	6,000	8,000
2.3 Publications and documents	3,000				10,000				2,000
2.4 Operating expenses	25,000	15,000	31,000	17,000	17,000	10,000	11,000	20,000	4,000
Sub-Total	77,000	31,000	95,000	81,000	63,000	66,000	75,000	75,000	24,000
TOTAL	77,000	63,000	138,000	98,000	70,000	90,000	89,000	109,000	64,000

* Numbers of professional staff shown in brackets.

Table 3 - Item 3: Support of National Activities

(Maintenance and storage of collections, evaluation, multiplication and distribution of genetic resources, documentation)

First three years	$100,000 p.a.

Table 3 - Item 4: Support of Exploration, Training, etc.

(To be allocated by coordinating committee to regional and national institutions)

	Year 1	Year 2	Year 3-5
Consultants	$35,000	$35,000	$35,000
Exploration	80,000	120,000	120,000
Technical meetings other than of Coordinating Committee	20,000	20,000	20,000
Publications	15,000	15,000	15,000
Training courses, in-service training, scholarships, etc.	40,000	40,000	40,000
	$190,000	$230,000	$230,000

ANNEX 1

TERMS OF REFERENCE FOR AN AD HOC WORKING GROUP TO PREPARE A PROJECT FOR THE "COLLECTION AND CONSERVATION OF PLANT GENETIC RESOURCES AND THE ESTABLISHMENT OF A GLOBAL NETWORK OF GENETIC RESOURCES CENTRES"

GUIDELINES

The broad objective of the ad hoc Working Group is to agree on and to prepare a concrete proposal for consideration by the TAC for the establishment of a global network of genetic resources centres in the main regions of crop diversity; including arrangements for the coordination of the activities of any new centres proposed with those already established within an overall working programme.

Since the ultimate goal is to enable the TAC to make recommendations to the Consultative Group on International Agricultural Research for possible financial support to such a programme, the proposals presented by the Working Group must be costed over a five year time horizon with a clear definition of priorities for international action, specifying both the capital and recurring expenditures envisaged. Moreover, while it is generally recognized that the genetic resources in the centres of genetic diversity are of immense value for present-day and for future crop improvement, the direct benefits which developing countries will derive from this programme should be clearly outlined.

SPECIFIC OBJECTIVES OF WORKING GROUP

Within the broad framework indicated above, the Working Group should:

1. Assess the needs for the establishment of "regions" of crop genetic diversity and define their number and geographical limits.

   As an initial basis for discussion such regions might be the "centres of origin" defined by Vavilov, i.e. (1) China; (2) India/Indo-Malaysia; (3) Central Asia; (4) Near East; (5) Mediterranean; (6) Ethiopia; (7) Mexico/Central America; (8) Andean region/Chile/Brazil/Paraguay; - with necessary modifications as decided by the Working Group.

2. Establish priorities by crops for collection and conservation for each region defined under 1. above, identifying emergency situations where immediate action is required.

3. Indicate an optimum location for a centre in each region.

   For this the following criteria might be adopted, e.g. richness in genetic resources; convenience of situation in respect of accessibility and transportation facilities; quarantine laws and regulations facilitating free exchanges of materials; political stability of the country and its relations with other countries in the region; research institutions to which it might be attached and their facilities, etc.

4. Recommend an appropriate organization for each genetic resource centre, according to priorities to be determined by the Working Group, specifying:

   (a) Activities: exploration and collection; conservation; quarantine; seed storage and maintenance of living collections; multiplication and regeneration of genetic stocks; preparation of proposals for use

and exchange of such stocks; training; storage and retrieval of information; publications.

(b) Staff: number and kind of specialists; supporting personnel - scientific, technical, field workers, clerical, etc.

(c) Budgetary requirements: staff; travel; installations; materials and supplies; instruments; publications; ect.

5. Determine the role of a coordinating centre in respect of:

(a) Planning, coordinating and promoting the activities of the network of centres in: conversation: exploration; data - standardization and documentation; exchange and distribution of materials; training surveys and information.

(b) Maintaining relations with governments, foundations and other supporting entities forming part of the network.

(c) Overall administration and budgeting of the network programme.

(d) Future development of the global network.

(e) Relations with national or regional gene banks outside the network.

6. Suggest an appropriate location and organization for the coordinating centre, defining its staff and budgetary requirements.

7. Make proposals and indicate priorities concerning any further support considered necessary to ensure the efficient functioning of the network, e.g. establishment of an expert panel for technical guidance; funding of scholarships at universities or centres other than those recommended under 4 (a) above, etc.

8. Consider possible relations with existing genetic resources centres or gene banks in developed countries (USA, USSR, Japan, Germany, etc.) and in established centres in developing countries (IRRI, CIMMYT, etc.).

(a) Inclusion of major institutions in the network of co-operating centres, for

(i) exchange of material for distribution and/or conservation;

(ii) exchange of information and compilation of global records;

(iii) standardization of methods and procedures.

(b) Association of smaller and/or specialist collections for specific purposes such as conservation and recording of valuable stocks.

PREPARATION OF REPORT

The ad hoc Working Group should establish a set of priorities, and, as a result of its discussion and analysis of the problem and of any specific proposals made by its members, prepare a report for TAC which would recommend how, when and where to start an action programme, if possible in 1972.

The report should, inter alia:

(1) Define the nature and urgency of the problem and its relevance to future progress in crop science.

(2) Indicate the nature, role and specific functions of the coordinating centre.

(3) Assign priorities to the establishment of genetic centres over the next five years in selected regions.

(4) Make proposals for expanding or strengthening existing centres as and when required.

(5) Define training needs related to the overall programme being proposed.

(6) Indicate in order of priority any other activities considered necessary under the programme.

(7) Show clearly on an itemized basis the capital and recurrent expenditures required to support the proposed programme over the next five years, specifying staff and equipment needed.

(8) Include a summary of its main conclusions and recommendations and their financial implications.

The report should be completed in time for submission to the third meeting of the TAC to be held in Rome commencing on 10th April 1972 and the broad lines proposed for action should be drafted and agreed at the meeting.

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