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REPORT OF THE TAC VEGETABLE RESEARCH PROJECT FORMULATION MISSION

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## I. INTRODUCTION

### (i) TAC's Priorities and Vegetable Research

1. Although initially priority has been given to research on the basic staple foods (cereals, food legumes, and starchy foods), the Technical Advisory Committee (TAC) to the Consultative Group on International Agricultural Research (CGIAR) has recently decided to pay particular attention to the priority needs of other commodities including tropical vegetables. This expansion of priorities has resulted partly from the fact that research on the staple foods is now adequately covered by the programmes of the existing International Agricultural Research Centres (IARCs), but more so from the findings of surveys carried out on behalf of TAC which have indicated that vegetables perhaps hold a more important place in the diet of the peoples of the developing tropical countries than generally believed.

### (ii) Earlier Proposals

2. Earlier TAC had considered a proposal submitted by the Rockefeller Foundation for the establishment of a tropical vegetable research centre in Asia (IVRIT), but in view of the need to explore more closely the case for research on vegetables and to determine the main species of importance and assess their specific research needs, it reached no conclusion with respect to recommending the proposal to the CGIAR. Following a study by the TAC Secretariat, it was decided to appoint a mission to appraise the need for additional internationally-supported research and if possible to provide TAC with a better base of information for decision-making on proposals and their possible recommendation to the CGIAR. This Vegetable Research Appraisal Mission, which reported to TAC at its 12th meeting in February 1976, recommended "the establishment of a new (international) centre for research on vegetables in the tropics in combination with a network approach".<sup>1/</sup> The mission concluded that because of the general weakness of national research efforts on vegetables in most countries of Asia and Africa and particularly the lack of trained personnel, only a single international centre could achieve the desired efficiency in activities of collection, evaluation and dissemination of germplasm, training, and communications, etc.

3. The mission also recommended that priority be given, at least in the initial research stages, to the following vegetables: tomatoes and related solanaceous species; leafy green vegetables, in particular the amaranths and Ipomoea aquatica; and the main leguminous vegetables, in particular Vigna spp. (cowpea, yardlong bean) and the mung bean.

4. However, despite the consensus of TAC members that there was a need for some form of internationally-supported effort to strengthen vegetable research, TAC was not yet prepared to endorse a particular institutional approach. Apart from this problem of determining the most appropriate organizational form there were other unresolved issues such as deciding the correct order of priorities among the many plant species used as vegetables in tropical countries, the dearth of information as to the real significance of vegetables in the diet and nutrition of both rural and urban populations, and the need for a thorough assessment of on-going research particularly on the 'native' species widely consumed in traditional diets. In addition there was a need to recognize the real constraints in increasing vegetable production in tropical developing countries particularly the relative importance of access to reliable germplasm, of pests and diseases, of transportation and storage, and other socio-economic factors.

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<sup>1/</sup> Para. 18, page 4: Report of the TAC Vegetable Research Appraisal Mission, DDDR:IAR/76/1, January 1976.

5. These conclusions of TAC led to the preparation by the Secretariat of the 'Background Paper on the Various Options for Additional Internationally-Supported Research on Tropical Vegetables' for discussion at the 13th TAC meeting in May 1976. This paper specifically related to the five different options, viz., the strengthening of the national institutions; the establishment of a network amongst national programmes; the use of existing IARCs; the setting up of a new IARC fully dedicated to vegetable research; and the establishment of an international research board for vegetables in the tropics. It was pointed out, however, that these were not actual alternatives since they were not mutually exclusive; in fact, some could be considered as necessary complements to the other.

(iii) The Present Mission

6. As a result of its further deliberations TAC decided to mount an expert mission to formulate an International Vegetable Research Pilot Project which it was agreed:

"should contain the following elements:

- (a) should be a plan for not more than 5 years;
- (b) the preliminary action should be organized as one coordinated effort although actual work could be conducted in two locations, one in Asia and another in Africa;
- (c) should be considered as an international project, financed by CG but possibly based in one or more existing institutions, either international, regional or national, able to provide the project with the necessary technical and logistic backstopping; and
- (d) in the period of the pilot project, work should be initiated on the genetic evaluation and utilization of the main species of vegetable crops chosen for priority attention. Also, appropriate training programmes should be organized. Another purpose of this research project would be the compilation of all available information on vegetable research." 1/

7. The desired aims of this project would be to provide a base of information that would permit later decisions for longer-term action on any additional international effort in vegetable research. However, in the interim it was expected that the project would achieve some useful experimental results from surveys, field trials and analyses and thus make an early contribution to the improvement of selected vegetable crops through application of these results at the national level and also through the distribution of valuable germplasm, training and other cooperative activities.

8. The primary purpose of the mission was, therefore, to select the most appropriate location together with suitable alternatives, in South/Southeast Asia and in Africa, as a central base for the operations of the project. To assist the mission in this task a common set of criteria was drawn up to serve as a basis for discussion with the government officials and institutions of the countries visited in each region.

9. The mission comprising two expert horticulturists engaged for a period of 2 months, assembled at the TAC Secretariat, FAO, Rome, on 18 October, 1976, and had 3 days briefing with the TAC Secretariat and officers of the Horticultural Crops Group, Plant Production and Protection Division, FAO, and Secretariat of the International Board for Plant Genetic Resources. They then set out on a months' field mission, one consultant visiting India, Sri Lanka, Malaysia, Indonesia, Philippines, Thailand and Bangladesh, and the other visiting Senegal, Ivory Coast, Ghana, Nigeria, Ethiopia and Sudan. The mission also visited the National Vegetable Research Station, Wellesborne, U.K.; the U.K. Ministry of Overseas Development, London; the Royal Tropical Institute, Amsterdam, where they also

1/ Para. 452, page 67: Summary and Conclusions and Recommendations - Report of the 13th Meeting of TAC, DD:IAR/76/14, 1976.

met officials of the Horticultural Plant Breeding Institute, and the Ministry of Agriculture, Wageningen; the Department of Overseas Cooperation and Development, Brussels; and GERDAT,<sup>1/</sup> Paris. The purpose of this visit to some European countries was to discuss technical aspects of the project with institutions involved in vegetable research and to explain the nature and objectives of the project proposals to departments concerned with development cooperation.

10. The Mission completed its work on 17 December. Details of the visits to the different countries are given in the individual Country Reports in Annex II, and the terms of reference, names of the mission members and their itineraries in Annex III (a), (b) and (c) respectively.

## II. FACTORS DETERMINING THE WORK OF THE PROJECT

### (i) Definition of Vegetables and Their Importance in Human Nutrition in the Tropics

11. Reference is made to the report of the first (appraisal) mission, in particular to paragraphs 23-25 on definitions and paragraphs 49-56 on nutritional values. While supporting all the statements of the first mission on these subjects, the present mission wishes to add a few comments.

12. It appears that the designation of a crop as a vegetable is a matter of opinion in some cases, and it is suggested that any crop classed as a vegetable in a particular country should be accepted as such.

13. On the comparative importance of vegetables, it seemed to the mission that two aspects must be considered: firstly, the nutritive content of the crop in terms of calories, proteins, vitamins and minerals; and secondly, local diet preferences and the quantities of the different vegetables actually consumed. Considerable differences in dietary habits exist between different communities and although these habits are subject to change, it is well known that they can rarely be dictated. However, some generalizations on Asian and African diets can be made despite these local and national variations.

14. Throughout tropical Asia a great variety of vegetables are used and there is a considerable similarity in the range of the most important species used in the different countries. Tropical Asian diets are frequently based on rice and often do not contain a high proportion of meat; many communities are in fact vegetarian or semi-vegetarian. Vegetables are used in a great variety of soups, salads, and boiled and fried preparations to eat with the rice. This is reflected in the choice of priority species (see para. 22).

15. In Africa the cuisine tends to be simpler and to include a higher proportion of meat. There tends to be a standard favourite 'dish' in each country and this usually consists of a main component prepared from grain or starchy roots plus a stew of meat and vegetables. The basic carbohydrate varies from the unleavened bread of Ethiopia ('injira') and Sudan ('kisra') and the maize meal of Kenya to the yam or plantain preparations of Nigeria and other countries of the Guinean region. Some sort of stew is a constant in African diets and onions, tomatoes and hot peppers are usually essential ingredients. Leafy vegetables are also popular where available (see para. 22).

### (ii) Geographic, Climatic and Demographic Considerations

16. Although the original conception of the project gave strong emphasis to humid lowland tropical regions, the mission took as its terms of reference 'research related to vegetable production within all tropical regions of Asia and Africa' i.e., including all climatic zones between the tropics of Cancer and Capricorn. Many of the countries include a wide range of climatic conditions within their own borders and there is frequently a commerce in vegetables between one climatic zone and another. The restriction or concentration of studies in one climatic zone is therefore inadvisable in the case of this group of crops.

<sup>1/</sup> GERDAT - Groupement d'études et de recherches pour le développement de l'agronomie tropicale.

17. Throughout the tropics there are some common climatic denominators such as short day length, little seasonal variation in day length and absence of frost (the latter at least in the inhabited regions). In tropical Asia there is also a certain homogeneity in that the rainfall tends to be high and seasonal variation less marked. In Africa, both contrasts between seasons and between the climates of the different countries are more marked. There is not much in common between the climates of, for example, the West African 'Sahel', the Guinea coast and the East African highlands.

18. Naturally, particular attention must be given to the needs of the greater number of people and higher concentration of population. These concentrations tend to be located in the humid lowlands and major river valleys both in South and Southeast Asia and West Africa, although this is not the case in many parts of the Eastern tropical countries of Africa. The large lowland cities, frequently situated on or near the coast throughout the tropics, obtain their vegetable supplies from a variety of sources. These usually include supplies from nearby lowland areas for some species such as Amaranthus and Celosia, which grow well there, as well as supplies from regions with a more marked dry season for species like onions and tomatoes, which latter prefer a less humid atmosphere. Similarly, highland regions are used for the production of species like carrots and potatoes which prefer a cooler climate.

19. The rapidly growing urban centres show strong market preferences, which are of course the main determining factor in what species are produced. There are many rural communities, sometimes quite remote geographically, which depend on the production and transport of vegetables to the towns. For instance it has been reported that the construction of new roads in Nigeria frequently results in the 'spontaneous' development of new production areas.

20. Unlike the urban populations, which purchase most of their supplies in the market, rural populations, living in villages and scattered hamlets, are often largely self-supporting in vegetables. In this case improvement of vegetable supplies depends primarily on education through schools and extension services, to encourage people to eat more vegetables and to teach them how to grow and prepare them. The development of community gardens and assistance in supplies of pumps and tools, seeds, fertilizers and insecticides is often desirable.

21. The above considerations have relevance to research planning. While investigations are frequently and necessarily directed to the problems encountered by commercial growers, the needs of rural peoples must also be borne in mind. In either case, attention should be concentrated on the principal species consumed.

### (iii) Priority Species

22. These differences in diet have led the mission to recommend different priorities for the Asian and African regions. (Species are listed in order of first, second or third priorities in Annex I(a)). This involves some revision of the priorities recommended by the previous TAC vegetable research appraisal mission which concentrated mainly on the Asian region. It will be noted that a greater variety of species is included for the Asian region, reflecting the greater variety of diet. The first priority includes the leafy vegetables (Amaranthus spp., Celosia spp., Ipomoea spp., Basella spp., Corchorus spp. and Brassica spp.), leguminous vegetables (Vigna spp., Phaseolus vulgaris, Psophocarpus tetragonolobus and Dolichos lablab) and solanaceous fruits (Lycopersicon esculentum, Solanum spp. and Capsicum spp.). African first priorities also include the leafy vegetables listed above but otherwise are limited to onions, tomatoes and hot peppers. This reflects the African preference for strong flavoured sauces and stews and the fact that leguminous species are mostly used for their seed rather than green leaves and pods are usually classified as 'grain legumes' rather than vegetables.

(iv) Priority Technical Problems

23. Technical problems throughout the tropics reflect the poor supplies of seed, both in quality and quantity, and the difficulty of controlling pests and diseases. The mission would place next in importance problems associated with seasonality of supply which involves seasons of sowing, variety, storage and preservation techniques, although not all of these aspects can be covered in the first phase of the project. In Chapter IV, a programme of work is recommended for the first three years which concentrates on germplasm collection and assessment, control of pests and diseases, creation of documentation and information services and development of a training programme. This recommendation is based on a conception of the more urgent needs for international coordination of research. The importance of production economics, production techniques and post harvest physiology and other aspects is recognized and should not be excluded from the documentation and training programmes.

(v) Linguistic Problems

24. In all of South and Southeast Asia the growth of English as a lingua franca (especially marked in the last thirty years) has reduced language problems and no difficulty on this score is expected in the Asian Base and region. The same applies in most tropical countries in the eastern part of Africa although Mozambique, Somalia, Rwanda, Burundi and Madagascar are exceptions.

25. In West Africa the language barrier between 'francophone' and 'anglophone' countries<sup>1/</sup> is believed by the mission to be very serious and to obstruct communication to a far greater extent than it does, for example, in Europe. This opinion is widely shared in Africa, despite the efforts being made to improve communications, and was confirmed by individuals with experience of West African conditions during the Mission's discussions in London, Amsterdam, Brussels and Paris. The possibilities of establishing a francophone sub-centre are discussed in Chapters 4 and 5.

III. THE PROJECT ORGANIZATION AND WORK PLAN

(i) General Organization

26. The primary objective of the International Vegetable Research Project would be to initiate activities which should lead to a more rapid improvement of vegetable production and consequently of the diets of the poorer sections of both rural and urban populations in the countries concerned. It is suggested that in the South/Southeast Asian region attention should be focussed on those humid areas where there are relatively well defined wet and dry seasons and where responses could be determined in both seasons. In the tropical African region, however, a wider range of climates would be covered.

27. The two bases for the Asian and African regions would be responsible for taking the lead in the research and development of a number of vegetable crops as decided on a priority basis in that region, and for promoting cooperation toward the establishment of a network of research and information incorporating national, regional and international research programmes. They should also develop a training programme for the vegetable research workers of each region. To facilitate information exchange and training in the French language, a francophone liaison centre should be established in Africa.

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<sup>1/</sup> Francophone countries may be defined as those in which French is the main language used for international communication, there are 18 such countries in Africa.

In Anglophone countries, English is used for international communication and there are 15 such countries in tropical Africa.

There are, in addition, 3 countries in which Portuguese is used as a lingua franca and one which uses Italian.

28. For the coordination of the work of the two regional bases and particularly for the approval of the annual programmes of work and budget before submission for financing, there will be need for a mechanism such as a Project Steering Committee. The composition of this committee should be determined during the establishment phase of the project.

29. The Project would concentrate on research on the genetical improvement and technical aspects of vegetable production of the priority vegetable species as indicated in Chapter II. Each base would therefore act as a centre of germplasm collection, evaluation, maintenance and exchange for the region. In the first three years factors of economics, marketing and nutritional quality would not be directly studied by the project. Wherever possible, however, national institutes would be asked to take up such work in consultation with the project.

(ii) Main Thrusts of Project Activities

(a) Germplasm evaluation, utilization, storage and maintenance

30. A primary activity of the project would be the organization of germplasm collection, evaluation, storage and maintenance. Each central base would establish a working collection of the germplasm of the priority vegetable species (as listed in para. 40) which are readily accessible in research stations and institutes and would include established varieties, new cultivars and wild related species. Part of this germplasm would be stored on a short term basis at each base and part stored under long-term conditions in either an IARC <sup>1/</sup> and/or other suitable institution, for example, the National Vegetable Research Station, Wellesborne, U.K. The project would rely to a large extent on CIAT for long term storage of French bean germplasm.

31. Since many of the collections are likely to be in the impure form it would be necessary to purify the genotypes before actual evaluation could be attempted. This work might take from 1 to 3 years depending on the species and particularly the mode of pollination and the number of generations which can be grown in one year. Following purification, samples of the germplasm would be distributed to selected national institutions to assist in evaluation.

32. During the evaluation and screening, particular attention would be given to identifying sources of resistance to the diseases, insect pests and nematodes common to the region (see para. 34). Attention would also be given to germplasm which is particularly adaptive to adverse ecological (soil or climatic) conditions. There may be problems, like fruitset in tomato and French bean in high night temperature conditions, common to the region which the project would keep in mind while screening. Other ecological problems may be specific for a production area and the base would try to help the national project in solving such problems. In addition, the project would arrange for promising material to be analyzed for nutrient quality at specialist institutions which are collaborating with the project.

(b) Selection and Breeding

33. Although it is not anticipated within the period of this pilot project that any major breeding programme could be attempted, the project bases would assist on-going selection and breeding activities in national programmes especially by means of injecting any promising germplasm which might solve problems common to the region. The base would endeavour to have any successful lines bred in national programmes distributed to other countries for further evaluation on a free-exchange system both within and between the South/Southeast Asian and African regions. Due attention would also be given to selection of existing cultivars from all sources which prove adapted to the various tropical regions.

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<sup>1/</sup> If selected as the African Base, IITA could provide both short- and long-term storage facilities.

(c) Investigation of pests and diseases and control methods

34. Since, in tropical regions, diseases, insect pests and nematodes are a major constraint to increased vegetable production, the project should give special attention to this problem, particularly when screening germplasm. An integrated approach to disease and pest control combining judicious use of chemicals, selection of resistant or tolerant cultivars and effective agronomic practices is advocated. Wherever possible national programmes would be encouraged to take up such work in collaboration with the project. The bases would, however, be responsible for compiling an inventory of the principal pests and diseases of the region.

(d) Documentation and information services

35. An essential activity of the project would be the development, at each regional base, of a comprehensive and efficient documentation and information service. Initially this would involve the collection of journals, abstracts, annual reports, reprints and other publications on research aspects of vegetable production, consumption and nutrition for tropical conditions. Since there is a dearth of information on the lesser-known 'native' vegetables, the project should give particular attention to gathering together as much as possible of the relevant unpublished material that is scattered throughout the countries in each region. A primary responsibility of each project base would be to compile the information in a suitable form for distribution to institutions in the cooperating countries and other interested bodies. Where information was not readily available in a form for redistribution the base could serve to direct enquiries to the sources where the specific reference material would be available. The extent to which each project base could become involved in the more complex cataloguing and processing of the information will depend on the choice of location; for example, if IITA is chosen to be the African base there is already established an international-standard documentation and information service.

36. The mission has noted the documentation and information facilities which already exist in national or international institutions such as the Commonwealth Agricultural Bureaux Abstracts, <sup>1/</sup> CARIS, AGRIS, and the AVRDC library. During the first three years, the project would rely on the indexing and abstracting services of the latter organizations while collecting current publications from institutions in the cooperating countries.

37. The mission suggests that each base should compile and distribute a quarterly newsletter for the benefit of cooperating institutions. <sup>2/</sup>

(e) Training and Seminars

38. In addition to the research, information and documentation activities the bases would initiate a resident training programme. <sup>3/</sup> The participants would mainly be scientists and technicians who are actually handling the vegetable research projects in the cooperating countries of each region. The training programme should be concentrated on breeding and selection, and on vegetable production techniques, including pest and disease control, and be aimed at providing the personnel connected with research with the opportunity to learn advanced research techniques and modern methods of vegetable production. Where possible some training to national personnel in information retrieval and exchange should be given, possibly utilizing expert staff of the IARCs and other advanced institutions.

<sup>1/</sup> The U.K. Ministry of Overseas Development has indicated that it might be in a position to assist the project through the Commonwealth Agricultural Bureaux.

<sup>2/</sup> Note has been taken of the existence of a newsletter on "Vegetables for the Hot, Humid Tropics" by the Mayaguez Institute of Tropical Agriculture, Puerto Rico. The Project should invite the active participation of this Institute in the information exchange which the project bases will develop.

<sup>3/</sup> It is assumed that the essential dormitory, canteen and other facilities would be made available by the host institution.

39. Since it is unlikely that the training programme as envisaged could be started before the third year of operation of the project, it is suggested that a short seminar should be held at an early date for the leading research workers in the cooperating countries to discuss their problems and the programme of work for the project.

(iii) Outline of Annual Work Programmes

(a) Research programmes

40. A division of the main work programme over the first three years of the project is suggested below:

Year One (first six months): - collect from different institutes and organizations germplasm of leafy green vegetables (Amaranthus spp., Celosia spp., Ipomoea spp., Basella spp., Corchorus spp. and Brassicca spp.), leguminous vegetables (Vigna spp., Phaseolus vulgaris, Psophocarpus tetragoneloba and Dolichos lablab) and solanaceous fruits (Lycopersicon esculentum, Solanum spp. and Capsicum spp. - only for African base) and:

- compile a checklist of diseases, insect pests and other related physiological and agronomic problems occurring in the above vegetable species in the different regions.

(next six months): - sow each collection and start preliminary assessment of purity and other qualities. Those which prove to be pure lines will be multiplied, taking care to avoid any contamination. Each germplasm is to be tagged for its specific quality.

Year Two: - continue the collection process as in the first year's programmes  
- start supplying pure germplasm to the participating countries;  
- materials which were not pure to be selfed for further purification.  
- initiate preliminary screening germplasm against the diseases and insect pests which are common in those regions. The list has to be finalized on the basis of information collected in the 1st year. Some diseases, insects and other related problems which are likely to be common are bacterial wilt of tomato and eggplant; Phomopsis wilt and little leaf disease of the eggplant; leaf curl and tobacco mosaic virus of tomato, Rhizoctonia and bacterial wilt in legumes, shoot and fruit borer in eggplant, failure of fruit set at high temperature conditions in tomato and french beans. However, the list of such problems on which work should start on priority will be decided with the initiation of the project.

Year Three: - continue the collection process;  
- further supply of germplasm to the participating countries;  
- collect information on the assessment of germplasm earlier supplied to the participating countries;  
- continue the activity started in the 2nd year;  
- start supply to participating countries of any germplasm showing promising resistance;  
- arrangements for studies of the nutritional quality of vegetables to be completed and work started.

(b) Programme for information services

Year One (first six months): - contact all relevant institutions in the cooperating countries and organizations such as the Commonwealth Agricultural Bureaux, Royal Tropical Institute, FAO, AVRDC, and the Mayaguez Institute for Tropical Agriculture to collect information on vegetable crops, and process documents received;

1/ Only for green pods.

2/ With no duplication of the work of AVRDC. For details see Country Report - Philippines and discussion with AVRDC authorities (Annex II).

(next six months): - prepare and issue first two quarterly Newsletters.

Years Two and Three: - continue processing documents and disseminating information to cooperating institutions;  
- maintain regular issues of the newsletter at 3-monthly intervals.

(c) Programme of training and seminars

Year One: - seminar with representatives of cooperating countries to discuss problems and the project programme;  
- finalize syllabus for the training course and arrange for training facilities with the collaboration of the National agricultural departments and the Universities of the host and cooperating countries;

Year Two: - selection of the first group of trainees from cooperating countries.

Year Three: - start of training courses.

(iv) Requirements for Staffing, Material Facilities and Supplies

(a) Project staff

41. The proposed staff requirements at the bases have been kept to the minimum considering that the activities of the bases and those of the national vegetable projects of the cooperating countries will be supplementary to one another. The proposed Project Directors (1 for each base) should be leading scientists in the field of tropical vegetable crops with administrative capabilities and good research leadership qualities. A Senior Research Officer, who is an active research worker in the field of tropical vegetables, should be appointed as deputy to the Project Director for each base. The Associate Research Officers (3 for the Asian base and 1 for the African base <sup>1/</sup>) should be graduates in agriculture/horticulture with post-graduate experience in Olericulture. Special experience in the fields of Plant Breeding and Genetics/Plant Pathology/Entomology would be valuable. The Training/Information/Liaison Officer (1 for each project base and 1 for the francophone liaison centre) should have a post-graduate degree in Agriculture with experience in training, documentation and information services. The mission suggests that appointment of the above staff should be phased starting with appointment of the two Project Directors and their Secretaries, and working up to full staffing within the second year of operation of the project.

(b) Material facilities and supplies

42. The mission was not authorized to make commitments or enter into negotiations and cannot therefore predict what facilities will be supplied by the host institutions and what will be purchased by the project. The notes given in Annex I (b) indicate the main requirements of capital equipment and recurring supplies for three years. Budget preparation will have to await further negotiations. The mission has noted that if the African base is located at IITA there are possibilities of using existing facilities like glasshouses and germplasm storage space. However, in the case of Sri Lanka being selected as the Asian base, glasshouse facilities would have to be built.

<sup>1/</sup> The number of staff required for the project will depend to some extent on the choice of location of each base. It is assumed that if IITA is selected as the African base some of the present staff working on vegetables will be able to cooperate with the project. It is anticipated that the countries where the project bases are located would permit their national research staff to work in close collaboration with the international project and provide technical backstopping where necessary in such fields as agronomy, plant physiology and pathology, entomology, biochemistry, soil science and statistics. The Mission recommends that one Associate Research Officer should be responsible for each group of vegetable crops viz. leafy greens, leguminous, and solanaceous.

(v) Other Related Activities

(a) Coordination with farming systems programmes of IARCs

43. Three existing International Agricultural Research Centres (IRRI, ICRISAT and IITA), have on-going farming systems programmes in the regions of the project. IRRI has already expressed its willingness to try under its rice-based multiple cropping system any of the vegetable cultivars evolved and recommended by the project. IRRI has 15 centres for trials on rice-based cropping systems in South/Southeast Asia. IITA's farming systems programme involves vegetables like cowpea, tomato, Celosia and sweet potato and will be glad to cooperate with the vegetable pilot project.

(b) Coordination with other International, Regional or National Organizations

44. It is anticipated that the project bases would build up understanding with any organization dealing with vegetable research principally in the two regions, but including other countries (e.g. Puerto Rico). The main objective of such understanding would, firstly, be to avoid unnecessary duplication of research projects and secondly, to supplement each others work by close collaboration. In particular, the mission took the opportunity of having discussions with the Associate Director and the Philippines Resident Horticulturist of AVRDC at Los Baños, Philippines. Initially, AVRDC would build up relations with the proposed international project through their outreach station in the Philippines, and then later with their two other outreach stations which they are planning to set up in Thailand and Bangladesh.

(c) Post-harvest technology

45. Vegetables being perishable commodities experience heavy losses in quality and quantity in the time between leaving the growers' fields and reaching the consumers' tables. The loss may be due to bad packaging, attack by diseases and insects or lack of adequate storage facilities. There are now techniques and treatments by which this loss both in quality and quantity can be minimized. The project bases would keep in touch with laboratories at, for example, the Central Food Technological Research Institute, Mysore, India, and the Centre pour le Developpement de l'Horticulture in Senegal, to benefit from their ongoing research projects in this aspect and also try to interest other laboratories with such facilities to take up work on indigenous vegetables where such information is lacking.

(d) Production and consumption surveys and studies of nutritional quality

46. Reliable statistical data for consumption and for the area and quantity of production of tropical vegetables in most of the tropical countries of South/Southeast Asia and Africa are lacking. It is often difficult to formulate future projections of production requirements. To alleviate this situation therefore, it is suggested that a survey be initiated to estimate the area, production and consumption of a limited number of vegetables. The resources of the project bases will be inadequate to undertake these surveys and attempts should be made to get such data collected through national institutions.

47. A large percentage of the population in the more densely populated areas depend mostly on cereals and tubers. The diet therefore remains unbalanced and both under-nutrition and malnutrition become common. Some estimates should be worked out as to the role that the selected priority vegetables in the project can play in solving the under-nutrition and malnutrition problems. The project bases should help the participating countries in formulating such estimates and targets.

(e) Economics of production, marketing and consumption

48. Initially the resources of the project bases will not allow them to take up any in-depth economic studies. Nevertheless, the economic aspects of vegetable production, marketing and consumption are interdependent and none can be ignored. Studies on the economics of production and the marketing system and the price fluctuations are important and should be related to the rate of consumption by people at different economic levels. For example, it has been noticed that even where vegetables are available the poorer sector of the population cannot afford to purchase them and in most of the tropical countries the marketing of fresh vegetables is not well organized. The project should therefore encourage cooperating countries to take up such studies.

(f) Coordination of seed production, and planning for multiplication of recommended cultivars at both pre-release and released stages

49. With the objective of the project being to provide the poorer sector of the population with nutritious vegetables, production has to be geared to make them cheaply available to the consumers. One of the major bottlenecks in the tropical countries is the lack of good quality seed. To have an immediate impact it is therefore necessary to link the project with some seed multiplying organization. The idea is that when any cultivar is recommended by the project for a region or any particular country or group of countries, enough high quality seed should be made available to adequately supply these areas as soon as possible.

50. In Asia the only country which has already formulated a seed multiplication programme is India. The National Seeds Corporation, a Government of India undertaking, is multiplying seeds of different vegetables. They have all facilities and produce properly certified seed, and have agreed to help the project. Once the initial screening of the germplasm is done there will be an essential need for pre-release multiplication of selected material to make sufficient quantities of seed available for large scale trials in a number of locations. NSC has also agreed to take up this responsibility. In Africa, for example, this responsibility could possibly be shared by IITA in collaboration with the National Horticultural Research Institute, Ibadan, Nigeria. The project bases, however, would endeavour in the meantime to help the cooperating countries to create proper organizations for multiplication of certified vegetable seeds.

IV. CONSIDERATION OF ALTERNATIVES FOR THE LOCATION AND IMPLEMENTATION OF THE PROJECT

(i) The Position of Existing International Research Institutes

51. In the case of ICRISAT, the mission considers that the limitation of the sphere of activities to the semi-arid tropics excludes the Centre as a possible Asian base and this is understood to be the opinion of the Director and his staff. Similarly, in the case of IRRI, the mission concurs with the directorate of the Centre that its concentration on rice would render it unsuitable as a base. Both the above institutes would be ready to cooperate with the project insofar as vegetables enter into cropping rotations in their respective fields of interest.

52. The position of IITA, however, is different since its terms of reference appear wide enough to include vegetables grown in the tropics and the directorate is favourable to the idea that the Centre could host the African base of the project.

53. With respect to the Asian Vegetable Research and Development Centre (AVRDC) the mission considers that special arrangements could be made with this Centre's station in the Philippines and those planned in Thailand and Bangladesh. It is considered most important that any overlap in research activities of the international vegetable project and the AVRDC should be avoided and for this purpose it is suggested the AVRDC should be invited to nominate a liaison officer to work with the project, or alternatively to propose any other arrangement to provide for close cooperation. Funds should be available within the project budget to cover travel and information exchange between the Asian project base and the AVRDC outreach stations (see Annex II - Country Reports).

(ii) Alternatives for the Asian Base

54. Countries visited were India, Sri Lanka, Malaysia, Indonesia, the Philippines, Thailand and Bangladesh, in that order. All these seven countries agreed to participate in the network of vegetable research which is being contemplated. The only country which can be excluded a priori as a possible location for the Asian Base is Indonesia where the authorities, while ready to participate, did not consider they were in a position to host the Base. The pros and cons for possible Bases in the other six countries are summarized in the following paragraphs. Background information on vegetable production and research in each country is included in Annex II in addition to the country notes in the report of the previous TAC mission on vegetable research.

55. (a) India is at present in the most advantageous position insofar as the availability of qualified research staff, ongoing vegetable research projects and experience are concerned. Nevertheless there are some difficulties in locating a suitable institution in an area having the required climatic conditions. In the first place, vegetable research is conducted nationally through the Indian Council of Agricultural Research at the Indian Agricultural Research Institute (IARI), New Delhi, and the Indian Institute of Horticultural Research (IIHR) at Bangalore. The national interest covers a wide range of tropical, sub-tropical and temperate vegetables. IARI, New Delhi, is situated in the sub-tropics. IIHR, Bangalore, though in the tropics is situated in the highlands and the climate is not typical for South/Southeast Asia.

56. Six years ago an All India Coordinated Vegetable Improvement Programme was established with seven main centres and thirteen sub-centres, and ten other participating organizations, and with its Coordinating Centre at IARI, New Delhi. This programme covers a wide range of tropical, sub-tropical and temperate vegetables. It is not considered that an international coordinating base for research in tropical vegetables would readily fit in with this decentralized organizational pattern and the Indian authorities are also of this opinion.

57. Only the state of Tamil Nadu was considered sufficiently representative of the major climatic regions of tropical Asia. Although a site at Kudumiamalai in Pudukottai district could be made available, it was not considered to be very well adapted for a quick take-off of the project. The research activities in the State are to be transferred to the Tamil Nadu Agricultural University. The research station at Kudumaimalai is still with the State Department of Agriculture. The dual control in the research activity may create organizational problems. Moreover, for a smooth take-off, a research station/institute run by the National Government is preferred.

58. In general it was considered that India could be better used as a source of information, staff and plant material, and training facilities, to assist the project than as the site for the Asian base. All possible assistance has been promised by the Indian authorities, who concur with this view.

59. The fact that India is already a host for one institute sponsored by the CGIAR, that is ICRISAT, which would not be able to accommodate the Asian base, may also be taken into consideration.

60. (b) The Philippines are also in a comparatively favourable position as regards trained research workers and experience in vegetable research. Moreover, considerable facilities are available in a compact form at Los Baños and the Director General of the Philippines Council for Agricultural and Resources Research (PCARR), responsible for the coordination of all agricultural research, showed a keen interest in the project.

61. However, the considerations against siting the Asian Base in the country are considered to outweigh the above advantages. Above all, considerable overlap would be involved as AVRDC already run an outreach station at the Vegetable Research Centre, Los Baños. Also the Southeast Asian Regional Centre for Graduate Study and Research in Agriculture (SEARCA), Filipino-German Project, Association of Colleges of Agriculture in the Philippines (ACAP), IRRI (farming systems), University of the Philippines, Los Baños, Bureau of Plant Industry and a few private enterprises, are already active in vegetable research. The mission considers that existing arrangements for vegetable research coordination in the Philippines are adequate for their own purposes and feels that it would not be easy to fit the Asian base in the present rather complex set-up at Los Baños, despite the facilities it can offer. It was concluded that the resources of the Philippines could be best used by the project in a similar way to those of India - as source of staff, information and plant material - and the authorities would be happy to cooperate in this way. Coordination with the Philippines would also provide a convenient means of cooperation with AVRDC through its sub-station in the country.

62. The fact that the Philippines are already a host for one institute sponsored by CGIAR, that is IRRI, which would not be able to accommodate the Asian Base, may also be taken into consideration.

63. (c) Malaysia is economically the best placed country in the region, moreover communications are good and its geographical position relatively central for South and Southeast Asia. However, there is not much variation in climate and soil types available in vegetable growing regions of the country and this would prove a disadvantage for testing different strains of vegetable species under different ecological conditions. There are also some administrative difficulties in that MARDI appears not yet well placed to receive new projects. This organization, founded in 1969, started functioning in 1971 with the responsibility for National Agricultural Research and Development and has not yet developed many horticultural research activities. The authorities though keen on cooperating with the project have not shown the same degree of interest in hosting the Asian Base.

64. (d) Bangladesh is only partly within the tropical zone, although much of the country has a climate typical of tropical Asia. A vegetable research and development centre has only recently been established. Bangladesh has not yet reached a stage at which it could provide suitable facilities for the Asian base. The soil type of the main centre is too heavy for normal production of vegetables and other research facilities are yet to be built up. As noted earlier, AVRDC is likely to establish an outreach station in this country in the near future.

65. (e) Sri Lanka. The mission found that Sri Lanka offers many advantages as a potential site for the Asian Base, as follows:

- the country lies between 6° and 10° N of the equator and has distinct wet and dry seasons. There are estimated to be 24 agro-ecological zones with 9 out of the 10 major soil types of the region in this relatively small island.
- the Sinhalese grow a large range of tropical and sub-tropical vegetables in the different provinces and have a long tradition of vegetable growing.

- Sri Lanka is well placed for communications with South/Southeast Asian countries and would also be well placed for communication with the African base and with ICRISAT and other research centres in India.

- the authorities are very keen that Sri Lanka should host the Asian base and would give every assistance and cooperation. They are preparing a seed certification scheme and would make provision for rapid procedures for exports and imports of seed samples. Furthermore, the administrative 'set-up' seems comparatively simple and promises well for a quick 'take-off' for project implementation.

- a suitable site for the base, with ample land and suitable buildings was offered by the authorities at the Ministry of Agriculture research station at Kundasale situated six miles from the Central Agricultural Research Institute at Gonnuruwa, Peradeniya, where laboratory and germplasm storage (to  $-15^{\circ}\text{C}$ ) facilities are available. There is land for field trials at Kundasale covering 160 ha of which 10-12 ha could be made available immediately. Land at a lowland sub-centre can also be made available for field trials at the Agricultural research station at Maha Illuppallama (120 m altitude)  $2\frac{1}{2}$  hours drive from Peradeniya. The seed multiplication farm with 800 ha of land located at Pelwehera, between Kundasale and Maha Illuppallama, can also be utilized as a large-scale seed multiplication base associated with the work of the project in its later stages. Other stations with varying soil and climatic conditions will also be available for screening the germplasm of the various vegetable crops. The research plots of the University's Faculty of Agriculture are located at Kundasale and facilities for nutritive quality analysis could be made available at the laboratories of the Medical Faculty. Lecture rooms and students dormitories are available at the Agricultural School at the site.

- suitable housing for international staff could be found at Kandy (adjoining Peradeniya) which has all necessary facilities such as schools, hospitals, and communications.

66. The main disadvantage of Sri Lanka as host for the base are the lack of highly qualified staff in vegetable production, the comparatively low level of research work and documentation so far attained, and the lack of some installations like glasshouses. It is felt that these weaknesses can be overcome, with the help of institutes in India and the Philippines and, if possible, some multilateral and bilateral assistance. <sup>1/</sup> The mission concluded that notwithstanding the disadvantages, the positive aspects of Sri Lanka, in general, and Kundasale, in particular, qualify this as the first choice for the Asian base for the project. Conditions would also be suitable for an expansion of activities in the second phase.

67. (f) Thailand also offers many advantages as a potential site. There is a good tradition of vegetable growing in the country and considerable enthusiasm exists for the development of vegetable research. There is a large group of well trained research workers with Masters' degrees and Doctorates and many others with post graduate training. A national vegetable research committee has been formed with representation from all four universities and the Department of Agriculture. The Rector of Kasetsart University (the oldest and largest of the four universities) is very keen for the project proposals and assured the Mission that land and other facilities could be made available with the completion of the second campus at Kamphoengsan 80 km from Bangkok (about 40 km after completion of a new road). The first phase of the construction and development of the new campus will be completed by 1977. Out of the four universities the vegetable research activity is the best at Kasetsart.

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<sup>1/</sup> The mission was informed that a UNDP/FAO project for 'Reorganization of National Research and Training Resources for Agriculture' would be implemented in January 1977. See Country Report - Sri Lanka in Annex I).

68. However, as against these positive factors, the mission noted certain disadvantages. In the first place the completion and development of the second campus mentioned may take some time and delay the 'take-off' of the project. Opinion is divided as to whether the University or the Department of Agriculture should host the project. Furthermore, a most important consideration is that, according to the Associate Director of AVRDC, its third 'outreach' station will be started early next year in Thailand. In this case there would be some danger of an overlap with the functions of the Asian base as a coordinating body and centre of research if the latter were to be established in the same country. Finally, it must be admitted that Thailand does not have the same advantages as Sri Lanka in offering a wide variety of soil types and climatic conditions within a short distance of the potential centre.

69. On balance, the mission considered that Thailand should be considered as a second choice for location of the base after Sri Lanka.

(iii) Alternatives for the African Base

70. Countries visited were Senegal, Ivory Coast, Ghana, Nigeria, Ethiopia and the Sudan - in that order. From the information available to the mission, it was concluded that vegetable research facilities in other tropical African countries have not yet reached a level which would make them eligible as a site for the African base. It seemed to the mission that the large number and great diversity of countries in tropical Africa called for a rather different approach to the problem than was applicable to tropical Asia. This diversity applies to climatic conditions and the francophone/anglophone language barrier (see Chapter II.). The circumstances in each country and the measures and alternatives proposed are discussed below.

71. (a) Senegal offers considerable interest to the project in that it hosts the best established and endowed vegetable research station in francophone Africa - the 'Centre pour le Developpement de l'Horticulture (CDH)' at Cambérène, Dakar, which is an FAO project run on a Belgian supported Trust Fund. A close and fruitful relationship has been built up between the project and Belgian institutes. Dakar provides a natural centre of communication for many West African francophone countries. As there is a group of French speaking experts capable of teaching and communicating in the French language at CDH, this would seem to be the best choice for a francophone training and documentation centre to help overcome the language barrier in West Africa.

72. The Senegalese authorities would welcome this idea and the Belgian sponsors would also be pleased to see such a development. Plans for expansion of the centre next year include improved accommodation for teaching and extension of the area devoted to field trials. Some assistance from the project would be expected in the provision of a liaison and training officer, office staff and documentation equipment. As the CDH is only 20 minutes drive from Dakar there would be no great difficulty over staff housing and facilities nor accommodation for students. A new sub-centre is to be established by CDH next year at Savoigne in the Senegal river valley, an hours drive from St. Louis, and this will offer opportunities of testing vegetable varieties and production methods under 'Sahelian' conditions.

73. However, the climate of Cap Vert, where the main centre is situated, is not typical for any other climatic zone of West Africa and this diminishes the suitability of CDH as a site for the main African base. Another consideration is that, although excellently placed for communications with Europe and America, Dakar is far from the main concentrations of population of West Africa.

74. (b) The Ivory Coast also offers great interest to the project because of the rapid development of vegetable production under the leadership of the para-statal organization 'SODAFEL' (Societe pour le developpement des fruits et legumes) and because of the enthusiasm of the authorities for improving vegetable research.

75. The central agricultural research station run by IRAT at Bouaké has a small but efficient vegetable trials sector attached to it, operating under the guidance of an FAO expert. The main occupations are field trials of varieties and production methods, for adoption in the new cooperative market garden production units, and the distribution of vegetable seed. It does not offer the same facilities as CDH in Senegal, and although the facilities could be expanded and improved, the government plans are for the creation of the main national vegetable research centre at Korokho in the north of the country. The Government is keen to host the African base and if this were agreed they would intend to locate it at Korokho. Korokho is typical of the South Savannah region and not of the humid lowland tropical areas, but this drawback could be overcome by the use of Bouaké as a sub-station for the medium high rainfall zone and stations near Abidjan for the coastal climate.

76. If Ivory Coast were to be asked to host the African base there is no doubt that the authorities would supply vigorous and effective collaboration. The main disadvantage is that the station at Korokho has not yet been established and the fact that control of the Agricultural Research Stations has recently been transferred from IRAT to the Ministry for Scientific and Technical Research might possibly involve delay in implementation of the plans. Until this question is resolved and the establishment of the new station put in hand, Korokho has to be relegated to a position of second or third choice for the main African base. The authorities do not seem to be interested in the option of a francophone sub-centre.

77. (c) Ghana includes some highly populated regions and provides a large market for vegetables. Vegetable research work, however, is largely confined to the Faculty of Agriculture of the University at Kumasi. The Dean of the Faculty of Agriculture and the Head of the Horticultural Department are keen to develop work on vegetables and have made considerable progress in their field trials. The Department is a fairly small one, however, and the mission considers that it could be difficult to build up to international status. Furthermore communications by post and telephone are extremely unreliable in Ghana at present and this could seriously hamper coordinating activities. The mission concluded that despite the central position of Ghana for West Africa and the climate, which is typical for a large part of the region, the country would not be able to provide a suitable site for the African base.

78. (d) Ethiopia is another example of a country where the authorities have recently placed a much increased emphasis on horticultural development and research. The newly created horticultural development authority in Addis Ababa will be receiving bilateral assistance from the Federal Republic of Germany. It will be responsible for the creation of a number of cooperative production units and will be active in the organization of fruit and vegetable marketing. The Institute of Agricultural Research (IAR) has established a flourishing National Horticultural Centre at Nazareth (alt. 1600 m), 1½ hours drive south of Addis Ababa, which would be suitable for more intensive development. Vegetable production trials are also carried out at IAR research stations at Holletta (2400 m), Melka Werer (500 m), Bako (1600 m), Jimma (1700 m), and Awassa (2000 m). The IAR are anxious to cooperate with the project in the improvement of vegetable research and could make good use of assistance in this field.

79. Research in Ethiopia could have considerable importance for vegetable production in the highlands of East Africa, where conditions are very different from those in the greater part of West Africa. Liaison within East Africa would be of interest, as cultivars successful at the relevant altitude in Ethiopia, might well be suitable for the highlands of Kenya, Uganda and Tanzania.

80. However, in view of the respective concentrations of population and related climatic conditions, the mission considers that the African base should be situated in West Africa and, if only for this reason, Ethiopia and the other East African countries would be excluded. In view of the importance of the highland zone for vegetable production, special provisions for liaison with the project seem to be desirable. It is suggested that the Government should be invited to appoint a special liaison officer to assist coordination with project activities.

81. (e) The Sudan both geographically and climatically is another special case in the general panorama of tropical Africa. Although itself constituting a sizeable proportion (about 1 million square miles) of this zone, the climate in the north and centre of the country is hotter and drier than most other tropical African countries - with the exception of some sparsely populated regions in north central Africa. This peculiarity seems to detract from the Sudan's suitability as a host for the African base.

82. Nevertheless, the importance of the development of vegetable production and research in the Sudan should not be under-estimated and cooperation with the project should be fruitful. The authorities place great importance on the establishment of close links with the project and special provision for liaison is desirable, especially considering the value of the Sudan as a testing ground in screening for resistance to high temperatures (see Country Report). It is suggested that the Government be asked to appoint a special liaison officer to assist coordination with project activities.

83. The Agricultural Research Council is responsible for the following research stations <sup>1/</sup> where field trials on vegetable crops are undertaken:

- Hudeiba Horticultural Research Station, Ed-Damer, Northern Province.
- Shendi Horticultural Research Station, Northern Province
- Shambat Horticultural Sub-Station, Khartoum Province.
- Wad Medani Agricultural Research Station, Blue Nile Province  
(Horticultural Research Unit).

84. (f) Nigeria. Of all the countries visited, the Mission considers that Nigeria has the strongest general claims to host the African base. The following considerations are important:

- its position in the centre of the most highly populated regions of tropical Africa, and its range of climates typical of many of these regions;
- the importance of vegetables in the diet of Nigerians and the enormous demand and problems of production for the markets of Nigerian cities; and
- the interest in vegetable research in several institutions and the achievements made in this field.

85. The mission considered the facilities available at the following institutions: International Institute of Tropical Agriculture (IITA), Ibadan; Institute of Agricultural Research and Training (IART), Moor Plantation; National Horticultural Research Institute (NHRI), Ibadan; the main campus of the University of Ife at Ile-Ife, and the Institute for Agricultural Research, Ahmedu Bello University, Zaria. NHRI has not yet started on the vegetable research programme planned, but a wide variety of projects is under way at the other institutes named (see Annex II).

86. The mission considers that by far the best facilities for the African base are to be found at IITA and that this is the only one of the institutes that would allow for an early 'take-off' of project implementation on an international scale. Among the many advantages offered by IITA are:

- An established international reputation and close contacts with all tropical African countries as well as with tropical agricultural research institutes throughout the world.
- A very well appointed campus with excellent facilities for seminars.
- An established system for reception and training of advanced students in research work.

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<sup>1/</sup> The mission was not able to visit these research stations - see Country Report in Annex II.

- An excellent background of scientific staff and laboratories in subjects allied to vegetable research - soil chemistry, plant nutrition and physiology, pathology, entomology, nematology, climatology, production economics, etc.
- Considerable facilities and equipment, a share of which might be made available to project work, namely, glasshouses and screenhouses, land and machinery.
- A good library and documentation service.
- A modern seed store which is shortly to be expanded and improved, where both short- and long-term storage could be provided.
- Good staff welfare services including arrangements for schooling.

The farming systems department is already engaged in investigations in tomato selection and leafy vegetables and there are commodity programmes dealing with (amongst other crops) yams, sweet potatoes, okra, melons, cowpeas and lima beans. The Director General and his staff are sympathetic to the idea of hosting the African base of the project, although the way it could be fitted into the organization of the Institute has yet to be discussed. It would have to be decided whether or not the project would be accepted on the same basis as the FAO-sponsored Rural Storage Project and how best work in vegetable research needed by the new project can be coordinated with existing work on vegetable crops at the institute.

87. The climate of Ibadan is warm and humid, typical of most of the Guinea coast. It is well adapted to the growth of Amaranthus and Celosia ('Spinach' type vegetables) and to sweet potatoes, yams and plantains. Tomatoes, onions and peppers grow better in the north of the country and in this connection it should be added that the Institute has established sub-stations at Gusau (N.W. Nigeria) as well as at Port Harcourt in the South East. Field trials could also be arranged in cooperation with the NHRI which is situated in Ibadan, not far from IITA.

## V. CONCLUSIONS AND RECOMMENDATIONS

### (i) General

88. The mission considers that the project as formulated in Chapter III is feasible and understands that it would be welcomed by the relevant authorities in all the tropical African and Asian countries visited. In addition, the authorities consulted in the United Kingdom, Netherlands, Belgium and France supported the concept of the project and were ready to recommend that full support should be offered by their respective governments.

89. The mission believes that in subsequent negotiations with the institutions recommended for the siting of the project there will be no serious difficulties and that all possible cooperation will be given. Further investigation of the facilities and equipment needs as well as a detailed specification of budgetary requirements will, however, be necessary.

### (ii) Choice of Location of the Main Bases

90. In both Asia and Africa the mission found that the choice of suitable institutes to host the two main bases of the project was in fact restricted and that no potential site was ideal in all respects. Recommendations are made for different solutions to the problem on the basis of what the mission considered practical.

91. In Asia the problems varied from the position in India - where the institutions and their functions are too widespread geographically - to the position in the Philippines where there are already many institutions concentrated at Los Baños dealing with vegetable research. In Thailand, where neither of these difficulties apply, there is a good potential site at Kamphoengsan for the base, but the relevant institute has not yet been established. If reassurances on the date of completion are confirmed, the mission would recommend the new campus of Kasetsart University as a second choice for the Asian base. The mission recommends as its first choice the Agricultural Research Station at Kundasale, Sri Lanka, where most of the necessary conditions for the project base can be found or created. At this location there are exceptionally good ecological conditions in that a wide variety of soils and climates are within easy reach of the suggested site for the project base.

92. In Africa, suitable institutes were found in only a few countries. The very wide variation in climates within the African tropics posed a particular problem. Good institutes exist at the extreme West and East of the zone, in Senegal and Ethiopia, but the climates in both cases are atypical for much of the rest of the Zone. The Mission also noted a serious problem of communication in Africa between the francophone and anglophone countries.

93. Taking all factors into consideration, the mission recommends that the main African base should be located at IITA, Ibadan, Nigeria, where many excellent facilities are available, and in addition, recommends that a francophone sub-centre for documentation and training should be established at the 'Centre pour le Developpement de l'Horticulture' (CDH) at Cambéréne, Senegal.

94. The second choice rests between (a) reversing the above arrangement with the main base at CDH, Senegal, and an anglophone sub-centre at Ibadan, and (b) situating the main base in the Ivory Coast - again with the anglophone sub-centre at Ibadan. If the latter option is chosen the main question to be resolved is the date of completion of the vegetable research station which the Government proposes to establish at Korokho in the north of the country.

(iii) Assistance to National Institutions

95. In its visits to the Ministry of Overseas Development, U.K., the Ministry of Development Cooperation in the Netherlands and the Administration Generale de la Cooperation et Developpement in Belgium, the mission was assured of the interest of these bodies in providing assistance on a bilateral basis to national vegetable research institutes cooperating with the project.

96. The mission identified various cases where such bilateral assistance would be welcome and effective. In Asia there has already been a good deal of assistance from developed countries in the field of horticulture, but help is urgently needed in Sri Lanka, to make up certain deficiencies to complement the proposals for an Asian base - notably the provision of fellowships and the construction of glasshouses, the improvement of equipment,

97. In Africa, where the development of vegetable research is more recent than in Asia, the need for assistance in institution building is more widespread. Indications are given (see Chapter IV) where the mission considers that help in improving equipment and providing training would be desirable. This applies particularly at present to the horticultural department in the University at Kumasi, Ghana, and the National Horticultural Centre at Nazareth, Ethiopia. As work in the field of vegetable research develops, many other tropical African countries are likely to need assistance in institution building. It should be noted that the Belgian authorities already have plans in hand for extending the facilities at CDH, Cambérène, through the FAO Trust Fund concerned.

(iv) Liaison Offices for Ethiopia and the Sudan

98. In view of the large area, special conditions and the potential for vegetable production in Ethiopia and the Sudan, the mission believes that special liaison arrangements are necessary to the project. The mission considers that liaison offices should be created in these countries to avoid the possibility of their isolation from the rest of the project. It would probably be most suitable if these liaison offices and their staff are organized and financed by the governments concerned. The liaison officers could be given specialized training in documentation and liaison procedures through the project and should make periodic visits to the African project base.

(v) Work Programme

99. (a) Priority Species. The formulation mission found it necessary to revise the priorities recommended by the earlier TAC mission on the grounds that this first appraisal mission concentrated mainly on the Asian region and that priorities for Africa and Asia differ. The recommended first priorities are:

For Asia: Leafy vegetables (Amaranthus spp., Celosia spp., Ipomoea spp. and Basella spp.)

Leguminous vegetables (Vigna spp., Phaseolus vulgaris, Psophocarpus tetragonoloba and Dolichos lablab) and solanaceous fruits (Lycopersicon esculentum and Solanum melongena)

For Africa: Leafy vegetables (Amaranthus spp., Celosia spp., Corchorus spp. and Brassica spp.)

Solanaceous fruits (Lycopersicon esculentum and Capsicum annuum and C. frutescens) and other vegetables (Allium cepa).

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1/ Only for green pods, in collaboration with CIAT

2/ In collaboration with AVRDC's research project on tomatoes in the Philippines.

100. (b) Priority lines of work. The mission has recommended a programme of work for the first three years (see para. 40) which concentrates on germplasm collection and assessment, control of pests and diseases, creation of documentation and information services, and development of a training programme.

(vi) Duration of Project

101. The terms of reference concerned a pilot project of 3-5 years. The mission recommends planning initially for three years, on the grounds that, if first choices for project location are adopted, the 'take-off' should be rapid and the project should be ready for revision and expansion by the end of the third year. In the process of annual review, with an overall review in the third year, it can be decided whether or not the first phase should be extended. In view of the long term nature of the work, subsequent phases will be necessary.

(vii) International Staff Required

102. With some variation according to the location of the bases, the requirements for international staff are estimated as follows:

- 2 Directors (one for each base)
- 3 Bilingual Secretaries (one for each base and one for the francophone centre)
- 2 Senior Research Officers (one for each base)
- 4-6 Associate Research Officers (3 for Asian base and 1-3 for African base according to the availability of existing staff at IITA cooperating in the project)
- 3 Training/Information/Liaison Officers (one for each base and one for the francophone centre)

The recruitment of this staff should be phased starting with the two Directors and their secretaries and working up to full staff during the second year of the project.

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ACKNOWLEDGEMENTS

The mission would like to express its sincere thanks to all the people in the countries visited who gave much of their time in supplying the required information and guiding the mission in its visits to projects.

The assistance of various UNDP and FAO officials in arranging for transport, accommodation and the necessary contacts with government officials and national institutions is also gratefully acknowledged.

The mission also records its appreciation of the assistance of the TAC Secretariat.

ANNEX I - ADDITIONAL INFORMATION ON PROJECT PROGRAMMES

(a) Important vegetable species listed in priority groups for project programmes.

(1) For Tropical Asian Region

First Priority Species

Leafy Vegetables

Celosia spp.  
Amaranthus spp.  
Ipomoea aquatica and reptans  
Basella alba and rubra

Leguminous Vegetables

Long bean and cowpea (Vigna spp.)  
Dolichos bean (Dolichos lablab or Lablab niger)  
Winged bean (Psophocarpus tetragonolobus)  
French bean (Phaseolus vulgaris)

Solanaceous Vegetables

Tomato (Lycopersicon esculentum) and eggplant  
(Solanum melongena)

Second Priority Species

Leafy Vegetables

Spinach (Spinacia oleracea)  
Leaf Kale (Brassica oleracea var. acephala)  
Jap. mustard (Brassica juncea)  
Cabbage (Brassica oleracea var. capitata)  
Chinese Cabbage (Brassica pekinensis and  
B. Chinensis)

Leguminous Vegetables

Sugar Podded or Edible podded peas (Pisum  
sativum var. macrocarpon)

Solanaceous Vegetables

Capsicum spp. (Capsicum annum)

Cucurbits

Pumpkin (Curcubita moschata and C. pepo)  
Luffa (Luffa acutangala)  
Cucumber (Cucumis sativus)

Root crops

Radish (Raphanus sativus)

Third Priority Species

Leafy Vegetables

Green onion (Allium spp.)  
Lettuce (Lactuca sativa)  
Leek (Allium porrum)

Cucurbits

Bottlegourd (Lagenaria siceraria)  
Snakegourd (Trichosanthes anguina)  
Bittergourd (Momordica charantia)  
Melons (Cucumis melo and Citrullus lanatus)

Other Vegetables

Onion (Allium cepa)  
Okra (Abelmoschus esculentus)  
Cauliflower (Brassica oleracea var. botrytis)

(2) For Tropical African Region

First Priority Species

Solanaceous Vegetables

Tomatoes (Lycopersicon esculentum)  
Red Peppers (Capsicum annuum and C. frutescens)

Leafy Vegetables

(Amaranthus spp. Celosia spp. Corchorus olit-  
orius, Brassica spp.)

Other Vegetables

Onion (Allium cepa)

Second Priority Species

Cowpea (Vigna spp.)  
Okra (Abelmoschus esculentus)  
Sweet Potato (Ipomoea batatas)  
African eggplant (Solanum aethiopicum)  
Yams (Dioscorea spp. and Colocasia spp.)

Third Priority Species

The following cucurbitaceous vegetables are not so general and widespread, but in some localities of great importance:

Ridge melon (Telfaria sp.)  
Pumpkin (Cucurbita moschata and C. pepo)  
Water melon (Citrullus lanatus)  
Cucumber (Cucumis sativus)

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- Note: (i) Urban populations in the larger cities have a growing taste for 'Irish' potatoes, carrots (Daucus carota) and cabbage (Brassica oleracea var. capitata)
- (ii) Cassava leaves and sweet potato leaves as well as the fruits of certain trees and shrubs (e.g. Parkia speciosa and Tamarindus indicus) are of considerable dietetic importance in some rural areas and some urban markets.

(b) Project requirements for land, capital equipment and recurring items

(1) Land and capital equipment

- Irrigated land complete with irrigation canals and water should be supplied by the host institution. A rough estimate of area per base would be 3 ha in the first year, 5 ha in the second and 8 ha in the third year of operation.
- A cooled glasshouse equivalent to 18 m x 6 m per base would be needed (it could probably be provided from existing glasshouse space at IITA and would have to be built in Sri Lanka).
- Two growth chambers where humidity and temperature can be controlled would also be needed - total dimension 6 x 4 m.
- Buildings including offices, stores, and laboratory buildings will probably be supplied by the host institutes. For germplasm storage the requirements for short-term storage need further investigation. Long-term storage (-15°C) exists both at IITA and at Gonnoruwa, Sri Lanka.
- Field machinery. At least one heavy four-wheeled tractor per base will be needed for project work in plowing and heavy cultivation operations. This tractor should be supplied with a trailer for carrying crops, manures, etc., and equipped with plows, cultivators and harrows.

For plowing small plots and for inter-row cultivations and seed-drilling at least two two-wheeled tractors will be needed complete with implements and seed drills for each base.

- Hand tools. A complete selection of spades, rakes, shovels, pick-axes, hoes, knives, sickles, wheel-barrows, and water cans.
- Sprayers and dusters. 3 power-operated knapsack sprayers per base plus 3 small handsprayers and 3 dusters - per base.
- Transportation. Two cars (1 saloon and 1 station wagon) will be needed for each base plus 1 station wagon for the francophone centre, to ensure mobility of senior staff.

One lorry each for Asian and African base for transport of manures, plant protection chemicals, implements, pots and crops.

- Office equipment and library furniture. Each base and the francophone centre will need office furniture including filing cabinets plus typewriters, rotary scanners, duplicating machines and photocopying machines.

Depending on the existing facilities at the host institute, some library furniture may be required.

- Scientific documents. Purchase of text books and subscription to journals, etc.
- Laboratory equipment. Depending on the existing facilities at the host institute, some supplementary laboratory equipment may be required, including microscopes, balances, seed germinator, incubator, refrigerator and air conditioner.

(2) Recurring expenditure

In general all items under ' consumable stores' should be purchased against the project budget. These should include:

- Seeds, manures, fertilizers, fungicides, insecticides, and other chemicals.
- Storage and packing materials. Bags for pollination control, labels, pots.
- Laboratory reagents, glassware and sundries.
- Office materials, including stationary and postage.
- Telephone and electricity charges, petrol and oil for machinery and vehicles.
  
- Contingencies. A generous allowance for contingencies will be needed to provide for unavoidable programme changes and emergencies.
  
- Daily paid labour. In addition to any regular labour supplied by the host institution, including watchmen, cleaners and laboratory attendance, some funds will be required for daily paid field labour.
  
- Travel expenses and per diem. Senior staff will need to undertake frequent travel. Funds should also be made available for trainees' expenses.

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## ANNEX II - COUNTRY REPORTS

As the report of the first TAC Vegetable Research (Appraisal) Mission included country reports on Senegal, Nigeria, India, Thailand and Indonesia, a certain amount of repetition is involved in the present country reports. For these countries this was considered unavoidable for the sake of rendering a complete account of the present mission. The following country reports, however, concentrate on an account of existing research on vegetables and institutions and exclude accounts of production and consumption given in the previous country reports. The countries are treated in the order: South/South East Asia (India, Sri Lanka, Malaysia, Indonesia, Philippines, Thailand, and Bangladesh); Africa (Senegal, Ivory Coast, Ghana, Nigeria, Ethiopia, and Sudan); Europe (United Kingdom, Netherlands, Belgium, and France).

## Country Report

### INDIA

The mission visited India from the 22nd October to the 27th October, 1976.

#### Geographical situation and climate

The Indian sub-continent lies between 8° and 37°N latitude and from 68° to 97°E longitude. With the Himalayan ranges in the north and Deccan Plateau in the south, India enjoys all types of climate from temperate, sub-tropical to tropical. There is a rainfall range from the arid, desert areas in Rajasthan to the heaviest rainfall area in the world in the northeastern part. The tropic of Cancer passes through Calcutta, Jabalpur and Rann of Kutch and the southern part, within the tropics, has wet as well as dry regions. The area around Tamil Nadu has climatic conditions typical of most of the southeast Asian countries.

#### Agricultural research and development

The research, development and extension work in agriculture is looked after by the federal Ministry of Agriculture and Irrigation as well as the State Departments of Agriculture. The Indian Council of Agricultural Research (ICAR), through the Department of Agricultural Research and Education (DARE), of the Ministry of Agriculture is responsible for national research and the Agricultural Universities for research in the states, although in some states the research has not yet been transferred fully to the Agricultural University. In such cases the Department shares the research activities with the state.

The ICAR is headed by a Director-General who is also Secretary to DARE in the Ministry of Agriculture and Irrigation. The State Departments are headed by Directors and the Universities by Vice-Chancellors. Most of the states have one or more agricultural universities.

#### Vegetable production and consumption

Though there is no authentic data available, the area under vegetables is about 1.8 m ha. with a production of nearly 12.5 m tonnes. However, because of the dense population of 600 million, the per capita consumption of vegetables is only about one-fourth of what is recommended for a balanced diet. India grows over 40 different species of vegetables and except for some recent exports of potatoes to Europe vegetables are not normally exported. Onion, in the fresh as well as the dehydrated form, is the most important crop in terms of production. There is a need for a three- to four-fold increase in vegetable production in India to meet the requirements for a balanced diet. The fact that the country has achieved self sufficiency in cereal production indicates that this is not an unrealistic task. As in the case of cereals, research will play an important role in achieving these aims.

#### Vegetable research

Vegetable research was initiated with several ad-hoc research grants sanctioned by ICAR in the 1940's. During the late forties and early fifties the Indian Agricultural Research Institute (IARI), New Delhi, started screening large numbers of germplasm of different vegetable species at IARI and its substation at Katrain in the Kulu Valley at 1500 m in the Himalayas. A good number of recommended cultivars were obtained either by straight selection or hybridization. Later with the development of agricultural universities in most of the states and creation of separate vegetable departments in some of them, vegetable research received further impetus. The Division of Horticulture, established at IARI in 1956, gave rise to a separate Division of Vegetable Crops and Floriculture in 1970. The

## Country Report - India (2)

ICAR established the Indian Institute of Horticultural Research (IIHR) at Bangalore, with a Division of Vegetable Crops, in 1967. An all India Coordinated Vegetable Improvement Project was started by the ICAR in 1970 with the coordination cell located in the Division of Vegetable Crops, IARI. The objectives are to coordinate research on some specific problems of about 14 vegetables and to give additional help to research centres by supply of trained staff, equipment and other facilities. There are seven main centres where projects on vegetable improvement, breeding for resistance against diseases, insects and root-knot nematodes, cultural trials, disease and insect control, and hormonal trials are in progress. A large number of varieties and hybrids of different vegetables have been released by the central, institutional or state variety release committees. Before release they are tested at a number of the main as well as the sub-centres. There are at present 13 sub-centres with ten other participating organisations. The research workers meet in different workshops to review the work done and formulate the future research projects. In addition to the coordinated programme each Institute and Agricultural University has its own independent research project. There are a large number of highly qualified research staff with Masters' and Doctorate degrees at the Institutes and Universities.

### Agricultural education

In India there have been agricultural education schemes since the early 1900s. Initially colleges were affiliated for giving Licentiate in agriculture which was followed by courses up to the graduate level. The post-graduate education particularly in Horticulture received an impetus soon after independence in 1947. The Indian Agricultural Research Institute started post-graduate education in Horticulture leading to Associateship in 1956. The post-graduate school was established in this Institute in 1958 providing for M.Sc (Ag) and Ph.D. degrees. Agricultural Universities now exist in almost every State with courses leading to graduate and post-graduate degrees. Out of the 22 Agricultural Universities, a number have already separate departments of vegetable crops with courses leading to the doctorate degree. There are a number of other colleges affiliated to other conventional universities which also offer post-graduate degrees in subjects related to vegetable crops.

### Consideration of possible locations for the project base

It was found that none of the existing main vegetable research centres in India fulfilled the climatic requirements which represented most of the areas in South/Southeast Asia. The agricultural research station at Kudumaimalai in Pudukottai district was suggested as a suitable site. It is about 48 km from Trichinapalli which is connected by road (4 1/2 hrs. drive) and air (45 minutes) with Madras. The station has 400 ha of land out of which 80 ha are irrigated. Some vegetables like eggplant, tomato, chili and clusterbeans are grown on the farm. The research activity is at present concentrated towards seed production. A Pulse Breeding Project with a seed processing plant is also running at this station. Sections of Chemistry, Entomology, Plant Pathology, Water Management and Economics are also available. No housing facility exists at the station except a small guest house. The station has no vegetable research base. The agricultural research activities in the State, in principle, are to be transferred to the Agricultural University from the Department. This may cause some confusion in the future. Moreover, agreements are to be drawn up with the Central Government before any settlement with the State authorities. Therefore, this location which best fulfills the climatic criterion is not considered very suitable for a quick 'take-off' of the project.

Unfortunately, of the two institutions run by ICAR, IARI is in the sub-tropics and IIHR though in the tropics enjoys a sub-tropical climate, being at a higher elevation. It is suggested therefore that India with its vast resources of qualified staff and long tradition of vegetable research and experience can help the project by participating as a cooperating member. The Indian research authorities also have expressed similar views.

## Country Report - India (3)

### Vegetable seed production and certification

India does not import any vegetable seeds and produces all her own requirements through a number of private seed nurseries and the National Seeds Corporation (NSC), a Government of India undertaking. NSC produces and sells certified seeds according to the Seed Act passed by the Parliament. The Breeders' Seeds of any recommended and released cultivar are supplied to NSC by the Institutes and Agricultural Universities. NSC multiplies the foundation seeds in their seed farms and also produces the certified seeds with the help of State farms and private contract growers. Some State farms also produce their own seeds. NSC covers a wide range of vegetables from tropical, sub-tropical to temperate, for which it has farms spread all over the country. NSC also takes the responsibility of pre-release multiplication. If approached, NSC would be agreeable to helping the proposed vegetable project by multiplying seeds both at pre- and post-release stages.

### Plant Quarantine

This work is looked after by the Plant Protection Department of the Ministry of Agriculture and Irrigation. The Division of Plant Introduction at IARI has recently been raised to the status of a Bureau of Plant Introduction and Exploration to cater for the needs of the whole country.

### International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

ICRISAT was established in 1972 with headquarters at Hyderabad, which is at an elevation of 530m and receives an annual average rainfall of 850 mm. The crop improvement programme is limited to sorghum, pearl millet, pigeon pea and chickpea.

The authorities informed the mission that it would not be possible for ICRISAT to extend its research activities to vegetables. In the farming systems research ICRISAT might be interested if pigeon pea were included as a vegetable in the proposed project. There are, in fact, some bold-seeded pigeon pea cultivars which are used as a vegetable in the green stage.

ICRISAT was willing to extend some short-term seed storage facilities and if the National Institute for Nutrition collaborated with the project for nutritional analyses of germplasm, ICRISAT could spare some land for growing some vegetable crops. However, for the latter work a scientist (Vegetable Breeder) and some extra recurring contingency would be needed. On a subsequent visit to ICRISAT on the 22nd January, 1977, the mission had the opportunity of further discussion with Dr. B.A. Krantz, the group leader of ICRISAT's Farming Systems Programme, who agreed to consider the inclusion of some vegetables in the cropping systems experiments.

### National Institute for Nutrition (NIN)

NIN is situated in Hyderabad and functions under the Indian Council of Medical Research (ICMR). This laboratory has a long experience of food nutritional analyses. Although it has other heavy commitments, NIN could initially help the project provided arrangements are made to raise the crop near the laboratory. One junior scientist with one or two laboratory technicians and some cold storage facilities would also be required.

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1/ In case such help for nutritional analyses be needed, the ICAR and ICMR can be approached for giving necessary help to ICRISAT and NIN. This would also help India's national vegetable research project.

Country Report - India (4)

The mission consulted the following officials in India:

Dr. M. S. Swaminathan, Director General, ICAR and Secretary to the Ministry of Agriculture and Irrigation

Sir John Crawford, Chairman TAC

Dr. A. B. Joshi, Director, IARI

Other colleagues in the Division of Vegetable Crops and Floriculture, IARI

Dr. D. P. Singh, Chairman, NSC and State Farm Corporation

Mr. N. S. Maini, Managing Director, NSC

Dr. J. S. Kanwar, Associate Director, ICRISAT

Dr. B. Belavady, Deputy Director, NIN

Mr. A. Venkataraman, Director of Agriculture, Tamil Nadu .

Institutes and Organisations visited:

Office of Director General, ICAR, New Delhi

Indian Agricultural Research Institute, New Delhi

National Seed Corporation, New Delhi

ICRISAT, Hyderabad

NIN, Hyderabad

Office of the Director of Agriculture, Tamil Nadu

## Country Report

### SRI LANKA

The mission visited Sri Lanka from the 27th October afternoon to the 31st October 1976, forenoon.

#### Geographical situation and climate

The island of Sri Lanka lies between 6°N and 10°N of the equator. The southeast monsoon 'Yala season' brings rain from May to September and the northeast 'Maha season' from October to January. The temperature varies according to the elevation; for example, Jaffna (sea level) has a mean annual temperature of 28°C and Nuwara Eliya (1900 m) 15° C. There are some 24 agro-ecological regions with 9 out of 10 world soil orders in this small island.

#### Agricultural research

The Department of Agriculture works under the Ministry of Agriculture and is headed by a Director assisted by Deputy Directors in charge of research, extension and training. There is one Central Agricultural Research Institute at Gonnoruwa, Peradeniya, with four Regional Research Stations at Sita Eliya (up-country, wet), Rahangela and Bandarwela (up-country, dry), Maha Illuppallama (North Central Province) and Thimelvelly (Jaffna Peninsula). Each station has a number of farms.

#### Vegetable research

The Deputy Director (Research) is in charge of research on crops including horticulture. A Senior Research Officer is the Head of the Division of Horticulture and is assisted by a number of Research Officers. Each Research Officer is given charge of a single crop or a group of horticultural crops covering both fruits and vegetables. At the Central Agricultural Research Institute there are three Research Officers each working on soybean, leafy vegetables and other vegetables, respectively. Specific vegetables, on which work is in progress, are: French bean-pole and bush, cowpea, long bean, winged bean, Dolichos bean, Amaranthus spp., Centenella spp. and Basella spp. A number of cultivars of different vegetables are being screened, initiated under a Sri Lanka-German Collaboration Project. Long term germplasm storage facilities (down to -15° C) have been built at this institute with Japanese assistance.

This major institute at Gonnoruwa is situated in the wet zone with an average rainfall of 2200 mm which is well distributed, although very little rain falls between January and the middle of March. It is at an altitude of 500 m and is on the bank of the river Mahaweli Ganga. The annual mean temperature is 24.5° C. A very wide range of vegetables can be grown at this location.

#### Agricultural research stations

The Agricultural Research Station at Kundasale, about 9 km from Gonnoruwa, has an agricultural complex including the experimental farms of the Faculty of Agriculture of the University of Sri Lanka, a seed drying centre, a poultry and a fruit and vegetable preservation centre, as well as an agriculture school offering a diploma in agriculture. There are about 160 ha of cultivated land and although at the same altitude as Peradeniya, it is comparatively drier with an average rainfall of about 1600 mm, occurring mostly during October to January.

The Agricultural Research Station at Maha Illuppallama is two and a half hours by road from Peradeniya and four hours from Colombo. There are also rail connections. The

## Country Report - Sri Lanka (2)

total area of the station is 1200 hectares, of which 40 ha are now under cultivation, 60 ha are irrigated and 40 ha are low lying paddy area. It is at an elevation of 120 m. The annual rainfall is 1400 mm with most rain falling between September to January and some scattered showers till May and the next three months are hot and dry. The average temperature is 27° C with night temperature between 20° and 24° C.

A training institute offering an Agriculture Diploma Course has been established and in addition to a Farm Research Centre, there is a new Seed Processing Unit. There are residential buildings, a hostel for trainees and a Rest House including caravans with accommodation for about 20 guests. A medical doctor is stationed at the centre. Every month an agriculture newsletter (cyclostyled) is produced and distributed.

This station is doing research work on beans, tomato, eggplant and capsicum, okra and the different cucurbits. Some recommended cultivars of eggplant, okra and cucurbits have been produced at this station. Besides varietal improvement some work is carried out on bacterial wilt of eggplant (S-164 is reported resistant) and tomato, viruses of tomato and cucurbits, borers of eggplant and beans.

Between the above research station at Maha Illuppallama and Peradeniya there is a seed production farm at Pelwehera of about 800 ha. Irrigation facilities are being developed from an irrigation project. This farm is near the township of Damballa which has modern amenities.

The Agricultural Research Station at Sita Eliya is about 80 km away from Peradeniya at an altitude of 1900 m. The main vegetables grown, and on which some research work is in progress, are potato, cabbage, leek, beet, carrot, kholchol, cauliflower and radish. Apart from some radish and cauliflower seeds which are produced in this area the vegetable seeds are imported from Japan, U.S.A., Europe and Australia. There are good facilities for seed processing, packing and packeting. Seeds are imported in bulk and machine packed in small packets. A growth chamber with three controlled units has been installed with German assistance and the Australian aid programme has built a modern potato seed store.

### Agricultural education

The Headquarters of the Agricultural Department at Peradeniya is in the same campus as the Sri Lanka University. This has facilitated the building up of a close liaison between the Faculty of Agriculture and the specialists in the Department of Agriculture. A degree as well as a diploma course in agriculture is offered. Post-graduate facilities are available in certain disciplines. The Medical Faculty of the University has a good biochemical laboratory which could be used for the analyses of the nutritive qualities of the genotypes of different vegetable species.

### Other related activities

Sri Lanka is at present formulating a seed certification programme with the help of FAO.

The Plant Quarantine functions under the Department of Agriculture.

The facilities for printing and documentation services are somewhat weak and need strengthening.

A UNDP/FAO project entitled "Re-organization of National Research, Extension and Training Resources for Agriculture" has recently been finalised with the Department of Agriculture, Sri Lanka. Among other things, the main objectives are to provide an integrated research, extension and training base, to develop improved farming systems and

Country Report - Sri Lanka (3)

and to improve the information system. An amount of about \$15,000 has been earmarked for audio-visual equipment, books and publications. It is possible that these inputs may also be used to solve some of the weak links in the training and information services envisaged under the proposed vegetable project. The UNDP/FAO project is scheduled to start in January 1977 with its headquarters at Peradeniya.

An INTSOY Project is helping the Sri Lanka Soybean Development Programme.

The following officials were consulted by the Mission in Sri Lanka:

Mr. A. F. Braid, Senior Agriculture Adviser, FAO  
Dr. Y. R. Mehta, Seed Expert, FAO  
Dr. E. Abeyratne, Director of Agriculture  
Dr. C. Panabokke, Deputy Director of Agriculture (Research)  
Mr. E. Herath, Head, Division of Horticulture  
Mr. C. Dhamasena (Breeder) - Soybean  
Mr. A. Nandhi (Breeder) - Other Vegetables  
Miss Anula Perera (Breeder) - Leafy Vegetables  
Dr. W. Fernando  
Mr. Raphael  
Dr. C. Hittle, INTSOY Project Leader

Institutes, Stations and Organisations visited:

FAO Office, Colombo  
Directorate of Agriculture, Peradeniya  
Central Agricultural Research Institute, Gonnoruwa  
Agricultural Research Station, Maha Illuppallama  
Pelwehera Farm, Dambulla  
Agricultural Research Station, Sita Eliya  
Agricultural Research Complex, Kundasale.

## Country Report

### MALAYSIA

The Mission visited Malaysia from 31 October to 4 November 1976.

#### Geographical situation and climate

Malaysia lies between 2°N to 7°5' N latitude and 97°E to 118°E longitude. Being near the equatorial zone there is not much variation in the mean monthly temperatures, except in the Cameron Highlands, which are cooler. Mean annual maximum and minimum temperatures are 30°C and 23°C respectively. In the humid areas the annual average rainfall is about 2500 mm with most of the rain falling from April to November.

#### Agricultural research and development

Agricultural research and production is operated by the Department of Agriculture and the Malaysian Agricultural Research and Development Institute (MARDI). On principle it has been decided that the Department of Agriculture will look after the production aspects whereas MARDI will be responsible for agricultural research.

The Ministry of Agriculture controls three Departments, one each in Peninsular Malaysia, Sabah and Sarawak. The Department in Peninsular Malaysia has a Director General assisted by a Deputy Director General, while the other two are headed by Directors. The Department of Peninsular Malaysia, the largest of the three, has the following branches — Soil and Analytical Services, Crop Production, Crop Protection, Extension, Education, Development and Training, and Replanting and Rehabilitating Coconut. Each of these branches is headed by a Director. In addition the Agricultural Department in each of the 11 States in Peninsular Malaysia is headed by a Director.

MARDI, located at Serdang, Selangor, about 25 km away from Kuala Lumpur, was founded by an Act of Parliament in 1969 as a statutory body and started functioning from 1971. A Director is in charge and is assisted by two Deputy Directors, one for research and the other for administration and development. There are six Divisions (Crop Production, Animal Production, Basic Research, Agricultural Produce Utilization, Research Services, and Special Functions), each under the charge of an Assistant Director. There are 27 stations covering about 6,000 hectares, out of which total the main campus has 800 hectares. The new campus of MARDI, which is being built under World Bank assistance, is nearly complete.

#### Agricultural education

The University of Malaya and the University of Sciences, Malaysia formerly trained and supplied agricultural graduates to the Department. Recently, however, the College of Agriculture under the University of Malaya has been raised to the status of an Agricultural University. The first batch of graduates is expected to be out in 1977. The universities have facilities up to Masters' degrees. Generally students go abroad for Doctorate degrees.

#### Vegetable production and research

Vegetables are produced on about 8,000 hectares in Malaysia (about 400 in the Cameron Highlands) providing for an average per capita consumption of about 120 gms per day. Vegetables are mostly grown on peat and 'tin tailing' soils in the low lying regions. These soils are generally acidic, the pH ranging from 4 to 5.5. Thus liming is a normal practice.

Country report - Malaysia (2)

So far as research on vegetable crops is concerned, the Assistant Director, Crop Production, MARDI, looks after the group of crops in addition to rice, oilpalm, fruits, field crops, cocoa and coconut. There are only four research officers working on vegetable crops at the MARDI headquarters, three at Jalan Kebun and two at the Cameron Highland station. Of these nine research officers, only two have Masters' degrees. They are doing selection work mainly on chili, yardlong bean, French bean, tomato, cucumber and cabbage. Other vegetables which are commonly grown are cowpea, cauliflower, okra, Chinese kale, Chinese mustard, amaranth, eggplant and shallot. In cabbage, the Japanese hybrids KK and KY crosses and variety, Eiyo are doing well. The main problems in tomato are bacterial wilt, TMV and leaf curl virus; in eggplant, fruit and shoot borer and spider mite; and in cabbage, black and soft rots.

At Pontian Kechil, an Integrated Plant Research Station (IPRS) is being established also with the help of a World Bank finance programme. At this locality pineapples and vegetables are generally grown on the peat soils.

The plant quarantine section is in the Department of Agriculture. Most of the vegetable seeds are imported from Japan, China and Thailand. A seed certification programme is under active consideration.

The following officials were consulted by the Mission in Malaysia:

Mr. Ahmed bin Yunus, Director, Development and Training, Dept. of Agriculture  
Mr. Nik Abdul Halim, Asst. Director, Dept. of Agriculture  
Dr. Ting Wen Poh, Asst. Director, MARDI  
Dr. Tee Thean Soo, Horticulturist, MARDI  
Dr. Loh Charn Lum, Horticulturist, Dept. of Agriculture  
Mr. Tan Sing Ming, Research Officer, Dept. of Agriculture  
Dr. Ahmed Zaharuddin Idrus, Asst. Director, MARDI  
Mr. Ding Ting Haung, Research Officer, MARDI  
Mr. Zainab Abidin, Research Officer, MARDI  
Mr. Lim Hem Jong, Research Officer, MARDI

Institutions, Stations and Organisations visited:

Office of the Director General, Dept. of Agriculture, Kuala Lumpur  
Malaysian Agricultural Research and Development Institute, Serdang  
Agricultural Experiment Station, Malacca  
Vegetable growing areas around Kuala Lumpur  
Vegetable growing areas around Solok, Johor  
Vegetable growing areas around Pontian Kechil  
Vegetable growing areas around Batu Pahat

## Country Report

### INDONESIA

The Mission visited Indonesia from 4 to 9 November 1976.

#### Geographical situation and climate

Indonesia, consisting of a large number of islands, lies between 6°N to 11°S latitude and between 95° to 141°E longitude. The climate is mainly tropical with mean annual maximum and minimum temperatures at Jakarta being 30°C and 23°C respectively. There are, however, highland areas with comparatively cooler temperatures. The average annual rainfall is 1600 mm which is well distributed with the maximum coming from August to November.

#### Agricultural and horticultural research and development

The Agency for Agricultural Research and Development (ARD), headed by a Director General, controls all the research institutes connected with agriculture including forestry, animal husbandry, rubber and tea. The Horticultural Research Institute, Pasar Minbbu, is one of the institutes under ARD. This institute has 12 stations in addition to one at the headquarters covering a total area of 204 ha. The stations are located in West and East Java and in Sumatra at altitudes ranging from 2 to 1280 m and cover Red Latosol, Brown Latosol, Andosol, Young Volcanic, Dark Grey and Podsollic types of soil. At the headquarters there are five divisions, viz., Breeding, Agronomy, Pests and Diseases, Post-harvest Technology and Socio-Economics. Unfortunately, the experimental area at Parasimingu is being reduced every year because of the expansion of the city of Jakarta and the Institute may have to shift in the near future.

#### Vegetable area and production

The total area under vegetables in Indonesia is about 620,000 ha, and the annual production over 2.5 million tons for a population of about 129 million. The emphasis in vegetable research is for highland areas which occupy about 140,500 ha with a production of some 930,000 tons per year. The World Bank has given assistance specifically for development of highland vegetables and the Netherlands government is also helping in this vegetable project. At present there are Dutch advisers in the disciplines of Entomology, Nematology, Virology and Mycology/Bacteriology.

#### Vegetable research

The main research activities in vegetable crops are aimed at introduction and assessment of varieties of potato, tomato, cabbage, Chinese cabbage, eggplant, carrot, beans and chili; breeding for resistance against Fusarium, bacterial wilt, late blight and viruses in potato and tomato, black rot (Xanthomonas campestris) and Alternaria spp. on cabbage, and Alternaria in onion; mutation breeding for higher protein content, achieving dwarfness in beans, and flower induction in potatoes, cabbage and Chinese cabbage. The activities also include production of foundation seeds. The research projects also cover different agronomical trials, studies on pest and diseases control, and post-harvest technology. There are listed 184 technical staff but the majority of these only have degrees up to graduate level. Hence there is a need for increased training programmes to acquaint them with a sound knowledge of scientific approaches to the problems. Many young research workers are quite enthusiastic and can prove a great potential strength if guided and trained properly.

The vegetables grown in lowland areas are long bean and French bean (pole types), amaranth, water convolvulus, eggplant, tomato, ridge gourd and bottlegourd. There is a lack of research activities for the improvement of vegetables for the low-

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lands. The Director-General, ARD, expressed his desire to get some assistance through the World Bank, Asian Development Bank or any bilateral assistance for improvement of this group of vegetable crops.

Recent achievements in vegetable research worth mentioning are the release of three cultivars of potato, namely Rapen, Thung (both resistant to late blight) and Katela (good tuber quality). Also the tropical cultivar of cabbage Yasin and the KK and KY crosses are promising, and some lines of tomato introduced from AVRDC are doing well.

Agricultural education

There is one Agricultural University at Bogor and 17 other universities with Faculties of Agriculture. The Agricultural University at Bogor gives training up to the post-graduate level, whereas other universities mostly reach only graduate level.

The following officials were consulted by the Mission in Indonesia:

Mr. Sebastian K. Zacharia, Asst. Resident Representative, UNDP, Indonesia  
Dr. Sadikin Sumilitawikarta, Director General, ARD  
Mr. Masman Bekti, Director, Horticultural Research Institute, Pasar Minbbu  
Mr. Soewit, Horticultural Research Station, Cipanas  
Mr. Hendro Sunarjono, Cipanas  
Mr. Anggoro Hadi, Cipanas  
Mr. Sudjoko Sahat, Cipanas  
Mr. Mohamed Bagga Kali, Horticulturist, HEI, Pasar Minbbu  
Miss Satsizati, Agronomist, Pasar Minbbu

Institutes, Stations and Organisations visited:

Horticultural Research Institute, Pasar Minbbu  
Horticultural Experimental Garden, Cipanas  
Horticultural Research Station, Sindanglaya  
Office of the Director General, ARD, Bogor  
Vegetable growing areas around Bakasi, Tamburn  
Wholesale vegetable and fruit market, Jakarta  
FAO/UNDP office, Jakarta.

## Country Report

### THE PHILIPPINES

The Mission visited the Philippines from the 10th to the 14th November 1976.

#### Geographical situation and climate

The Republic of the Philippines constitutes a number of islands and lies roughly between 50° N to 18° N latitude and 97° E to 118° E longitude. The mean annual maximum temperature at Los Baños is 32°C with the hottest months April and May having an average monthly temperature of 34°C. The mean annual minimum temperature is 23°C, the coldest months being January and February with average temperature of 21°C. The average rainfall is 2000 mm, most of the rain falling between July to October.

#### Agricultural research

The Headquarters of the Philippine Council for Agriculture and Resources Research (PCARR) is at Los Baños. To develop a National Agricultural Research System the Philippine Council of Agricultural Research (PCAR) was created by Presidential decree on November 10, 1972. To provide for greater organisational scope and flexibility of operation the decree was amended on December 29, 1975 to include mining and the Council was renamed the Philippine Council for Agricultural and Resources Research (PCARR). PCARR has a Governing Council of ten members. They are: (1-3) representatives of the Ministries of Agriculture, Natural Resources and Science, (4) National Economic Development Authority, (5) the Budget Commissioner, (6) Chancellor of the University of the Philippines, Los Baños, (7) President of ACAP, (8-9) two representatives from the Private Sector nominated by the President of the Republic of the Philippines and (10) the Director-General.

At present PCARR only monitors agricultural research. Any organisation wanting to conduct research in the agricultural field has to route the proposal through PCARR and it can only become operational after approval by the Council. In addition, PCARR has a network of 15 Agricultural Research Centres and cooperating stations. The Council has 8 Divisions (Crops Research, Livestock Research, Fisheries Research, Forestry Research, Mines Research, Soil and Water Resources Research, Socio-Economic Research, and Technical Services), each headed by a Director.

A Memorandum of Agreement has been developed between PCARR and the Association of Colleges of Agriculture in the Philippines (ACAP) to foster collaboration in research. The research stations of such institutions are included among 115 main agricultural research centres and experiment stations. Likewise, an agreement has been reached between PCARR and the Educational Development Projects (EDPITAF) for the development of Agricultural Schools that have a role to play in the national research network. In another agreement with the Department of Agriculture and Natural Resources (DANR), the research responsibility and operations are being transferred to PCARR on a phased basis. PCARR has also signed agreements with a number of Private Sector Research Organisations. Similar agreements have been signed with International, Regional and other National Research Centres and organisations like IRRI, CIAT, ICRISAT, CIMMYT, IITA, CIP, AVRDC, The Southeast Asian Fisheries Development Centre (SEAFDEC), The Rubber Research Institute of Malaysia (RRIM), The Southeast Asian Regional Centre for Graduate Study and Research in Agriculture (SEARCA), and the Indian Council of Agricultural Research (ICAR).

FAO has designated PCARR as the liaison office of the Current Agricultural Research Information System (CARIS) with responsibility for completing and updating the documentation of current research both at the national and international levels.

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### Vegetable research

The Second Congress of Research Workers of PCARR was being held during the week the Mission visited Los Baños. The National Vegetable Research Programmes are discussed at such congresses by the National Vegetable Research Group (NVRG). This group reviews the ongoing projects and then determines the priorities of different broad-based programmes of work. It also works out the approximate budget allocation of each priority programme. Once the fields of priorities as recommended by this group are accepted by PCARR, invitations for research projects under each priority programme are sent to different organisations including International, Regional, National and Private Sectors. In case the organisation which wants to handle any project is short of funds PCARR gives monetary help. The Vegetable Group has representatives from PCARR, ACAP, Bureau of Plant Breeding, AVRDC and a number of Private Sectors. When any organisation wants to initiate a research project the details are submitted to PCARR which, in turn, examines whether it lies within the list of priority programmes recommended by the NVRG. If so, necessary permission and other facilities are made available. Projects under agreement with international and regional organisations where PCARR is not financially involved can proceed but should be brought to the notice of NVRG and PCARR.

Vegetable research in the Philippines is mostly highland-area based. Areas around Baguio City which is about 1600 m in elevation grow most of the exotic type of vegetables to supply Manila. Research on vegetables is carried out at the Baguio City Experimental Station of the Bureau of Plant Industry and the Mountain State Agricultural College, Trinidad. The vegetables on which they are working are tomato, potato, sugar-podded pea, cabbage, Chinese cabbage, cucumber and bittergourd. Most of the vegetable seeds are still being imported although trials are in progress for production of seeds of different vegetable species.

The organisations which are cooperating with PCARR in vegetable research are SEARCA, AVRDC, UPLB, ACAP, Bureau of Plant Industry, IIRI (for rice-based farming systems), a German-assisted project, and a few private enterprises.

### International Rice Research Institute, Los Baños

The Mission visited the Multiple Cropping Section of IIRI and found that the centre has heavy commitments and cannot extend its research activities to vegetables per se. However, IIRI indicated its interest in testing any of the vegetable cultivars evolved and recommended by the vegetable project, under its rice-based multiple cropping system. IIRI has 15 centres for such trials in South and Southeast Asia and trials could be conducted at any of these centres.

### Asian Vegetable Research and Development Centre (AVRDC)

The Mission met and discussed the working of AVRDC in S/S.E. Asia and its relationship with the activities of the proposed vegetable project, with officials of AVRDC at Los Baños. AVRDC is currently working on six vegetables: tomato, potato, sweet potato, Chinese cabbage, mung bean and soybean. The Centre has planned to establish five outreach stations and two of these, one in South Korea and one in the Philippines, have already started. It is expected that the third outreach centre in Thailand will be established early in 1977, to be followed by another in Bangladesh. The Annual Budget of AVRDC is US\$ 1.8 million. It was agreed that AVRDC should collaborate with the proposed vegetable project through its outreach stations in the Philippines and Thailand (once the latter is established). Also it was agreed that there would not be any unnecessary duplication of research activities; rather, they would be complementary in nature.

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The Mission consulted the following officials in The Philippines:

Mr. C. R. MacCulloch, FAO Country Representative in the Philippines  
Dr. Helmut Grosskrentz, FAO Assistant Country Representative in the Philippines  
Dr. J.C. Madamba, Director-General, PCARR  
Dr. Ramon V. Valmayer, Deputy Director-General, PCARR  
Dr. Empig, Leader, National Vegetable Research Group  
Dr. Elmo Sano, Mountain State Agricultural College, Trinidad, Benguet  
Mr. Crispino Ancheta, Experimental Research Station, Baguio City  
Mrs. Florida Ancheta, Experimental Research Station, Baguio City  
Dr. V.R. Carangal, Cropping System Network Coordinator, IRRI  
Dr. J.J. Riley, Associate Director, AVRDC  
Dr. John N. Hubbell, Resident Scientist, AVRDC  
Dr. Peter H. Calkins, AVRDC  
Dr. Romeo Opena, AVRDC  
Mr. Gualberto Bantoc Jr., Head, Quality Control Division, Makati Commercial Centre

Institutes, Stations and Organisations visited:

The Philippines Council for Agriculture and Resources Research  
Outreach Station of Asian Vegetable Research and Development Centre  
International Rice Research Institute  
Baguio City Experimental Station  
Mountain State Agricultural College, Trinidad Valley  
FAO/UNDP Office, Manila

## Country Report

### THAILAND

The Mission visited Thailand on the 14th and 15th of November 1976

#### Geographical situation and climate

Thailand is situated roughly between 5°4'N to 20°30'N latitude and 97°30'E to 105°5'E longitude. The average annual rainfall is about 1400 mm, with about 1900 mm in the south, most of the rain falling between May and November. The months of December to March are comparatively dry.

#### Agricultural research and development

Agricultural research is conducted by the Department of Agriculture, Ministry of Agriculture and Cooperatives and by the Faculty of Agriculture of the four universities, Kasetsart, Khonkaen, Chaingmai and Songkla. The Kasetsart University is the largest and oldest, being established in 1943, and is housed at Bangkhen, 14 km from Bangkok city, which is also the Headquarters of the Department of Agriculture. This university campus is known as the Central Agricultural Station and occupies an area of about 112 ha of lowland rice fields.

The Department of Agriculture, headed by a Director-General, has 15 research stations spread over the country.

The Kasetsart University is headed by the Rector. With the expansion of the university activities and the growth of Bangkok city, availability of land is becoming a limiting factor. The university is therefore developing a second campus at Kamphaengsaen in the Nakhon Pathom province about 80 km from Bangkok, although another road link when completed will reduce this distance to half. The new campus (plans are ready) has an area of 1200 ha. The land development, assisted by the World Bank, is in progress. The authorities expect to complete the first phase of development and construction before the end of 1977 when complete facilities for 1500 agricultural students and 130 faculty members and other operational staff will be available. It will, however, need a Herculean effort to complete all developments and construction work by the target date. The irrigation facilities are yet to be developed. A National Swine Research and Training Programme has already started with FAO aid at this campus.

#### Vegetable research and production

The population of Thailand is 40 million. The average annual consumption of vegetables is about 41 kg per head, which is only about 35 to 40 percent of the recommended daily requirement level. Only about one percent of the total area of 51.4 million ha is under vegetables.

Research projects on vegetables are handled both by the Department of Agriculture and the Horticulture Departments of the universities. To avoid duplication and to have coordination, all the vegetable workers have recently united to form a National Vegetable Research Workers' Committee (NVRWC). The members represent scientists from the universities, the Department of Agriculture, Department of Agricultural Extension, and the College of Agriculture under the Ministry of Agriculture and Cooperation. Scientists of various disciplines like breeding, agronomy, soil science, entomology, mycology and pathology, economics and extension are represented on the committee. Each organization has its own vegetable research workers subcommittee and broad-based research programmes are discussed in the NVRWC. From this a list of priority research is determined and budget requirements for each programme are worked out. Once the programmes

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are approved and the responsibility divided, the detailed projects are drawn up by the respective subcommittees. In principle, the universities handle basic research activities and the Department the applied ones. The research work of Kasetsart University is carried out at Pakchong and Chiangmai.

As in most countries of South/Southeast Asia research on vegetable crops is more concentrated on highland vegetables. The main vegetables on which work is in progress are cabbage, Chinese cabbage, tomato, capsicum, eggplant, onion, Japanese mustard, lettuce, water convulvulus, French bean, long bean, sugar podded pea, sweet potato, potato, cucurbits, sweet corn and baby corn. The main research activities in progress are: variety improvement, control of diseases and insects, cultural trials and seed production trials. For a country with such an enthusiastic young group of research workers vegetable research needs more support.

### Agricultural education

There are four universities with Faculties of Agriculture. These have courses up to Bachelor's degrees although Kasetsart University caters also for Master's degrees including Horticulture. The Agricultural College under the Ministry of Agriculture and Cooperation offers diploma courses in agriculture.

The Mission member delivered a talk on 'Vegetable Research in the Tropics with Special Reference to India' at the Khonkaen University. This was attended by the faculty members and members of the National Vegetable Research Workers' Committee.

### Vegetable seeds

Some vegetable seeds are produced within the country but most are imported, amounting to about 260 to 300 tons annually. There is no existing seed law or seed act, although attempts are being made to draft a seed certification scheme. There is a small seed testing laboratory in the Division of Horticulture at Kasetsart University.

### Organisational discussion

The Mission discussed the organisational aspect with Mr. S. H. Prakoso, Deputy Regional Representative, FAO, and Dr. Bhakdi Lusanandana, Regional Plant Production and Protection Officer, FAO, former Director General of the Department of Agriculture. The Rector of Kasetsart University was keen to host the project, whereas such negotiations are normally done by the Department of Agriculture. The FAO representatives suggested that the Ministry of Agriculture and Cooperation should be requested to host the project or to participate in the coordination network. The Ministry would make the necessary arrangements with the universities and the Department. The work could be managed under the auspices of the National Vegetable Research Workers' Committee.

### The Mission consulted the following officials in Thailand:

Mr. Soesilo H. Prakoso, Deputy Regional Representative, FAO.  
Dr. Bhakdi Lusanandana, Regional Plant Production and Protection Officer, FAO  
Mr. R. Billingley, Deputy Director, ESCAP/FAO  
Mr. S. Oglesley, Asst. Regional Representative, UNDP  
Dr. Rapee Sagarik, Rector, Kasetsart University  
Dr. Prakob Karjanasoon, Director General, Dept. of Agriculture  
Dr. Kauri Chutikil, Dean, Faculty of Agriculture, Khon Kaen University  
Dr. Chamien Boonma  
Dr. M.L. Anothai Choomsai  
Dr. Niranth Singhaputra  
Mr. Bunchong Sikkamondhol

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Dr. Thaworn Kowithayakorn  
Mrs. Suteusee Sukprakara  
Mrs. Sonporn Drabyasara

Institutions, Stations and Organisations visited:

FAO/UNDP Office, Bangkok  
Kasetsart University, Bangkok  
Department of Agriculture, Bangkok  
Second Campus of Kasetsart University at Kamphaengsaen  
Agricultural Experiment Station, Rangsit  
Vegetable growing areas around Ratchaburi  
Khon Kaen University  
Vegetable growing areas around Khon Kaen

## Country Report

### BANGLADESH

The Mission visited Bangladesh from the 18th to 20th November 1976.

#### Geographical situation and climate

The Republic of Bangladesh lies between 21°N and 26°N latitude and 88° and 93°E longitude. The land area falling in the tropical zone is the delta region of the rivers Ganges and Brahmaputra. However, since the country being more or less flat, most of Bangladesh has a hot and humid tropical climate. The monsoon rains usually start during May and continue until August-September. The remaining months are dry although some infrequent winter rains fall in December and January.

#### Agricultural research and development

The Ministry of Agriculture has two Divisions: Agriculture and Forestry, and Fisheries and Livestock. The Agriculture and Forestry Division contains an Agricultural Research Council (BARC), Directorate of Agricultural Research and Management (BARI), Directorate of Agricultural Extension and Management, Agricultural Development Corporation (BADC), and Horticultural Development Board (BHDB).

Realizing the urgent need for an organized agricultural research system, the Government of Bangladesh established BARC, by a Presidential order in 1973, to undertake, assist, promote and coordinate agricultural research throughout the country. BARC has recently initiated 16 coordinated research projects. Crop research is still with the Director of Agricultural Research. To achieve good coordination the Director of Agricultural Research is also the Executive Vice-Chairman of BARC.

BADC is responsible for management and supply of inputs like seeds, fertilizers, insecticides, fungicides, etc. The corporation has 30 farms and also multiplies seeds of different crops including some tropical vegetables. There is, however, no seed act or seed certification scheme functioning in the country.

BHDB is responsible for developmental activities of all horticultural crops. It also multiplies some propagating materials including vegetable seeds. It stores seeds under ordinary room conditions as no proper storage facilities are available. Most of the vegetable seeds are at present being imported and BADC is responsible for procuring the requirements as determined by BHDB.

#### Vegetable Research

The Division of Horticulture under BARI started initial screening of some vegetable crops in 1951. The research efforts, however, were to be reoriented after the formation of the Republic of Bangladesh. The present area under vegetable crops is over 3 million ha with an annual production of more than 27 million tons. This quantity meets only 25 to 30 per cent of the overall requirement of the country.

The crops on which some varietal screening has been done are: potato, sweet potato, onion, tomato, eggplant, carrot, radish, squash, cucumber and Basella.

The Bangladesh Vegetable Research and Development Centre is one of the 16 coordinated projects initiated by BARC. The main centre is at Jaydevpur, Dacca, with four sub-centres at the Bangladesh Agricultural University, Mymensingh, Comilla, Rajshahi, and Jessore. At Jaydevpur varietal trials were being conducted on tomato, amaranth, bottlegourd, mung bean, winged bean, long bean and Dolichos bean. The number of collections being tried was very limited and the crops were not healthy because of heavy texture and low pH of the soil.

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There is a separate coordinated soybean research project with four centres at Mymensingh, and at BARI, ICRISAT, and IARI in Dacca.

Agricultural education

The Bangladesh Agricultural University has been established at Mymensingh and functions under the Ministry of Education.

The Mission consulted the following officials in Bangladesh:

Mr. Gary Gabriel, Asst. Resident Representative, UNDP, Dacca  
Dr. Kazi M. Badruddoza, Executive Vice Chairman, BARC  
Dr. M.A. Mannan, Director, BARC  
Mr. M. S. Samad, Chairman, BADC  
Mr. A. Z. M. Ubayadulla, Secretary, Ministry of Agriculture  
Dr. M. Ishaque, Executive Director, BHDB  
Mr. K. Ahmad, Head, Director of Horticulture, BARI

Institutes, Stations and Organisations visited:

FAO/UNDP Office, Dacca  
Office of Bangladesh Agricultural Research Council  
Office of Bangladesh Agricultural Research Institute  
Office of the Chairman, Bangladesh Agricultural Development Corporation  
Office of the Executive Director, Bangladesh Horticultural Development Board  
Division of Horticulture, BARI  
Agricultural College, Dacca  
Vegetable Research Station, BARI, Jaydevpur, Dacca  
Bangladesh Rice Research Institute, Jaydevpur, Dacca

## Country Report

### SENEGAL

The mission visited Senegal from 21 - 28 October, 1976.

#### Geographical situation and climate

Senegal is situated on the west coast of Africa between latitudes 12°30' and 17° North and longitudes 11°30' and 17° West, approximately.

The climate is characterised by one long dry season (7 months in the south to 10 months in the north) and a short rainy season (5 to 2 months respectively). Average yearly precipitation decreases from 1500 mm in the south to 400 mm in the north. Rainfall distribution varies from year to year, and within the season, making rainfed agriculture an uncertain business. Sunshine in the dry season is abundant and even in the rainy season sunny periods are not uncommon.

Temperatures in the Cap Vert and northern coastal region are moderate to cool during the dry season although high inland throughout the year. During the rainy season temperature and humidity are high in all parts of the country.

#### Agricultural research organization

The "Institute Sénégalaise Recherches Agricoles" (ISRA) controls all research programmes. The French "Institute Recherches Agricoles Tropicales" (IRAT) no longer controls research programmes, although its experts continue to work for ISRA on a secondment basis.

The central agricultural research station is at Bambey in the main groundnut producing area. Until recently some selection work was done at Bambey on onions, tomatoes, eggplants and some African vegetables, but this has been discontinued. The station specialises in research on rain grown groundnuts and millet.

The main station for agricultural research in the River Sénégal Valley ("Fleuve") is at Richard Toll where field trials are mainly restricted to rice and sugar cane. Sub-stations started under the FAO sponsored project "Organization pour la Mise en Valeur du Fleuve Senegal" (OMVS) are situated at Kaedi, Gede, and the Delta and specialize in work on sorghum, maize and wheat. Another sub-station situated at Fanaille (60 Km. east of Richard Toll) concentrates on rice and vegetable crops. A documentation centre run by OMVS at St. Louis covers all publications on agriculture in the River Senegal Valley, including those on vegetable crops.

#### Vegetable Research

The "Centre pour le Développement de l'Horticulture" (CDH) founded under an FAO/UNDP project in 1971, now has sole responsibility for research on vegetables in Senegal. In practice all work on fruit crops is left to the mission from the French "Institut Recherches Fruits et Agrumes" (IRFA). Since 1975 the CDH has been financed through an FAO trust fund supported from Belgian bilateral funds. A third phase of the project (second under the Trust Fund) is now under negotiation and will provide for a considerable expansion of facilities and activities. The project is supervised by a committee of four including representatives of the Government, FAO and the Belgian commission, plus an 'external' consultant. On the national side CDH has hitherto come under the authority of the 'Ministere du Développement Rurale et Hydraulique', but it is proposed to transfer authority to the "Delegation Generale à la Recherche Scientifique et Technique" through ISRA (see above.)

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At present the project covers 8 ha. As from 1976 an extra 32 ha. will be made available, offices and laboratories will be extended, and staff and budget increased. Irrigation of various types is provided for all trial grounds.

CDH is organized in the following sections:

- i. Direction: (1 project manager + 1 co-director)
- ii. Phyto-technical section: (1 section chief + 1 counterpart + 1 associate expert)
- iii. Plant protection section: (1 section chief + 1 counterpart + 2 associate experts)
- iv. Extension liaison section: (1 section chief + 1 counterpart + 1 associate expert)
- v. Marketing and Economics section: (1 section chief + 1 counterpart).

In 1977 a new section will be established on "Plant Breeding and Applied Physiology" (1 section chief + 1 counterpart and 1 associate expert). Other sections will be strengthened with the recruitment of experts in production economics, irrigation and mechanical engineering.

In addition, a sub-station at Savoigne in the River Senegal Valley will be established and staffed with 1 vegetable production expert and 1 counterpart plus 2 associate experts in vegetable production and protection respectively. A series of demonstration and trial plots ("Centres d'Appui") at provincial centres is in the course of establishment.

The research programme at CDH from 1972 - 1976 has centred on selection of cultivars, production techniques - especially irrigation and fertilization, and crop protection. Investigations on nematode infestations and control have been carried out in collaboration with ORSTOM (Organisation Recherches Scientifiques et Technique Outre-Mer).

Future programmes will continue on the same lines plus new investigations in production costs, plant breeding and storage. The species of vegetables studied in previous seasons include tomatoes, onions, green "French" beans, capsicums, squashes, eggplants, potatoes and strawberries. Present and future trials also include cabbage, cauliflower, lettuce, asparagus and African vegetables (Okra, Covchorus, Amaranthus and African eggplant).

Officials consulted by the mission in Senegal

Mr. Van den Aemele, SAA/FAO representative

Mr. H. Van der Veken (and professional staff CDH), Project Manager, CDH

Mr. Ibrahim Paye            Chef, Div. Cultures Maraichères et Fruitières  
Min. Dév. Rurale et Hydraulique and National Director, CDH

Mr. Sakho                    Chef, Div. Cooperation Regional et Internationale  
Delegation Gen. Recherches Scientifique et Techniques (DGRST)

Mr. Inleyman N'Diaye Directeur des relations exterieures, DGRST

Mr. Abdel Kader Diallo    Directeur Lab. Veterinaire et Directeur Interim ISRA

Mr. Hayaux du Telly      Service Hydraulique  
Centre Nationale Recherches Agricoles, Bambey (CNRA)



## Country Report

### IVORY COAST

The mission visited the Ivory Coast from 28 to 31 October, 1976.

#### Geographical Situation and Climate

The Ivory Coast is situated on the Guinea coast of Africa approximately between 4° and 11° latitude north and from 8° to 2°30' western longitude.

The climate varies from humid equatorial at Abidjan and most of the southern half of the country to tropical continental savannah in the north. In the south there are considered to be two 'wet' seasons and two 'dry' seasons, but these terms are only relative where annual average rainfall goes up to 2000 mm. There are up to 4 fairly dry months in one dry season in the north and rainfall descends to below 800 mm (Bouaké about 910 mm.) Relative humidity is high over most of the country - commonly 80-90% in the south.

Mean maximum temperatures vary from about 25-34° C.

#### Agricultural research organization

Agricultural research has been guided in the past by the group of French institutes attached to GERDAT (Groupement d'Etudes et de Recherches pour le Développement de l'Agronomie Tropicale) such as IRAT for general tropical agronomy, IRCT for cotton and textile crops, IRHO for oil bearing crops, IRFA (formerly IFAC) for fruit crops, and IPCC for coffee, cocoa and tea crops.

As from 1977, however, authority will be transferred to the Ministère Recherches Scientifiques which was established in 1971. It is understood that French scientists will continue to work in the national research stations on a secondment basis from their 'parent' institute. The Government, however, is undertaking an intensive programme of education to train their own Ivorian agronomists and scientists via the 'Ecole Nationale Supérieure d'Agriculture' and numerous fellowships to universities in the USA.

Great progress has been made in the science and the production of agricultural crops. In the past this has concentrated on export crops but the present policy also emphasises self sufficiency in foodstuffs. Close liaison is maintained with IITA in Ibadan and missions are exchanged once or twice a year.

The main centre built up by IRAT is the 'Institute Savanne' at Bouaké, roughly in the centre of the country. This institute concentrates on agronomic studies on rice and maize. Other IRAT stations are: Ferkessedougou in the savannah land in the extreme north which deals with rice and soya trials, Gagnoa in the forest zone for rice and soya trials and soil studies, and Man in the humid zone and near the western border, also for rice and soya trials.

The Government has included provision in the current 5 year plan (1975-80) for the creation of a new research station at Korhogo in the north, primarily devoted to food production with emphasis on millet, sorghum and vegetable crops.

#### Vegetable production and research

Since 1970, great impetus has been given to the production of fruits and vegetables through the action of the "Societe d'Etat pour la Développement de la Production de Fruits et Legumes" (SODEFEL). The objective for vegetable production is the satisfaction of all local markets and the development of new export crops. This is expected by 1980 to amount to 20,000 tons/annum of fresh vegetables and 9000 tons/annum of tomato paste for the internal markets, and 3500 tons/annum of exported fresh vegetables.

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Most of this production will be located in four market garden zones which are being developed at Ferkessedougou, Touba, Kossou and Bondoukou. These will be supplemented by urban 'périmètres' for all the towns over 10,000 inhabitants, where vegetables will be grown on small holdings for the local market.

Plans for further expansion to 1985 are also in hand.

To provide the technical backing for this production, SODEFEL has created 3 horticultural centres for field trials and training as follows: Gagnoa for the forest zone, Bouaké for the humid savannah, Ferkessedougou for the dry savannah. These centres are run separately from the IRAT stations, but receive help from their specialists on pest and disease control, soil analysis, etc. Field trials concentrate on practical problems in the selection of cultivars, crop protection and production techniques. Seeds are imported in bulk and distributed from the centres and seed production is also undertaken for okra, aubergines (eggplants) and hot peppers.

First priority crops are tomato, African aubergine, okra, Basella, spinach, onion and potato. Second priority crops are lettuce, cabbage, leek and sweet peppers.

The technique usually followed is to start the trials as "micro assays" in replicated plots of about 1000 square yards each. The best cultivars and techniques are repeated on a larger scale on démonstration plots and then if satisfactory, transferred to the commercial production areas. SODEFEL's trials are therefore all on a short term ad hoc basis, but are very well adapted for their purpose.

The Government proposes that breeding and other long term research work on vegetables will be centred at the new research station to be established in the dry savannah zone at Korhogo (see above).

Officials consulted by the mission in the Ivory Coast

- M. Vial, Ministère du Plan
- M. Ravau, SODEFEL
- M. Mandjoba, Direction Générale du Dév. Agricole (DGDA)
- M. Bosso, Direction Générale du Dév. Agricole (DGDA)
- M. Viricelle, Min. Recherches Scientifiques
- M. Leroux, Directeur du Cabinet, Min. Recherches Scientifiques
- M. Rollin, FAO Horticulturist attached to SODEFEL.

Institutions and stations visited

- Direction Générale du Dév. Agricole, Abidjan
- Ministère Recherches Scientifiques, Abidjan
- Institute Savanne, Bouaké
- Zone Maraichère, Niambrun.

## Country Report

### GHANA

The mission visited Ghana from 31 October to 3 November, 1976.

#### Geographical position and climate

Ghana is situated on the Guinean coast of Africa and extends from 11° to 5° latitude north and from longitude 3° West to 1° east, approximately.

The climate varies from tropical coastal savannah with a dry season of 4-5 months at Accra and humid equatorial in the S. West with only 1-3 dry months to tropical continental savannah in the northern two thirds of the country, where there is a well marked dry season of more than 5 months.

Annual rainfall averages from over 1200 mm in the south to under 700 mm in the north. Coast temperatures are fairly moderate but with high humidity. Mean maximum temperatures in the dry season in the north are high — over 34°C.

#### Agricultural research organization

Research is organized under the Council for Scientific and Industrial Research - CISR (Ghana), and controlled by the Crops Research Institute of Ghana. There are six main institutes concerned with crops: the Crops Research Institute of Ghana and the Kwadoso Agricultural Experiment Station, both at Kumasi; the Cocoa Research Institute at Tafo in the south; the Agricultural Experiment Station at Ohawu; the Irrigation Station at Kpong (in the drier upland area to the East of the country), and the Agricultural Experiment Station at Aiyinasi on the coast. In addition crops research is undertaken by the University Facilities of Agriculture at Kumasi, Nungua (near Accra) and Kpong.

Specialities include: Insect pests and nematode studies; tobacco, kenaf, sugar cane, yam and maize production trials at Kwadoso Agricultural Experiment Station; coconuts and rubber at Aiyinasi; kenaf and jute production at Ohawu Agricultural Experiment Station; and sugar cane trials at the Kpong Irrigation Station.

#### Vegetable Research

Although some work in tomato breeding has been undertaken at Kwadoso Agricultural Experiment Station, the mission was informed that the only station with any substantial programme of research on a variety of vegetables was at the Faculty of Agriculture at Kumasi.

The professional staff of the Horticultural Department is small (one experienced horticulturist as Head of Department and 3 assistants, all of whom also have teaching duties), but considerable progress has been made. Field trials are conducted on selection and production techniques for tomato, eggplant, cabbage, cauliflower, sweet pepper, ginger and lima beans. About three ha of land are available and a good new plant propagation house has been constructed. In the mission's view, this station could make profitable use of further strengthening of equipment and professional staff.

It is worth noting that a successful international seminar in tropical horticulture was hosted by the Faculty under the aegis of the International Society for Horticultural Science (ISHS) in 1976.

Country Report - Ghana (2)

Officials consulted by the mission in Ghana

Mr. I. F. Moreithi, SAA/FAO Country Representative, Accra

Professor Asame, Dean, Faculty of Agriculture, Kumasi

Dr. J. C. Norman, Chief Horticultural Section, Faculty of Agriculture, Kumasi

Institutions visited

United Nations Development Programme, Accra

University, Faculty of Agriculture, Kumasi.

## Country Report

### NIGERIA

The mission visited Nigeria from 4 to 13 November, 1976.

#### Geographical situation and climate

Nigeria is situated on the Guinea coast of West Africa and extends from 4°25' to almost 14° latitude north and approximately from 2°30' to 14°40' longitude east.

The climate shows considerable variation, from the typical equatorial humid climate near the coast to a semi-arid tropical savannah climate in the north.

Rainfall in the lowland coastal zone averages over 1200 mm per annum and is distributed throughout the whole year. Towards the north precipitation progressively declines to under 500 mm where the dry season is 9 months long. Average maximum temperatures in the coastal zone range between 26 and 30°C but in the north they are higher often over 33°C. Relative humidities are generally high in the south but in the north the dry harmattan winds from October to March bring the humidity down to 25 per cent and even 15 per cent.

#### Agricultural research organization

Agricultural research in Nigeria is mainly carried out at university faculties and the research institutes that they control, as well as at some specialized research institutes such as the National Horticulturist Research Institute (NIHORT) at Ibadan. Coordination is arranged through the Agricultural Research Council of Nigeria (ARCN) with a secretariat at Moor Plantation.

The main universities concerned are:

- University of Ife, Oyo State, which also controls the Institute of Agricultural Research and Training (IART) at Moor Plantation.
- University Ahmadu Bello, Zaria, Kaduna State which controls the Institute of Agricultural Research at Samaru.
- University of Nigeria Anambra State Department of Crop Science, at Nsukka.

There is also the International Institute of Tropical Agriculture (IITA) at Ibadan which has international responsibilities but which, of course, carries out research of direct relevance to Nigerian agriculture. In addition to the Ibadan campus, the IITA has out-stations at Gusau (N.W. Nigeria) and Port Harcourt (S.E. Nigeria).

#### Vegetable research

All of the above institutions have research programmes in vegetables. However, the vegetable expert has only recently arrived at NIHORT and at the time of the mission's visit they had not yet started field trials on these crops. Plans are in hand at NIHORT to start work on vegetables in 1977 both at the main Ibadan station and at a sub-station at Baguda near Kanu.

Particular interest is taken at the Faculty of Agriculture, Ile Ife, on the collection of germ plasm of African vegetables, such as Amaranthus, Celosia and Corchorus which grow particularly well in the local climate.

At the IART Moor Plantation, in the programme of research in vegetables, special attention has been given to tomatoes (selection and production and protection techniques) and "leafy" vegetables (selection.)

At the IAR of the Ahmadu Bello University, Zaria, investigations have been mostly confined to tomatoes, onions and hot peppers, all of which are of great local importance. Field trials have been carried out for the last 10 years and considerable progress has been made in selection and production techniques for these 3 crops.

At IITA special emphasis is placed on the study of farming systems and a horticulturist works on vegetable crops within the Farming Systems Programme. Investigations on tomatoes, Celosia and plantain have been included. In the crop improvement programme trials have been made on yams, sweet potatoes, lima beans, melons and okra.

Much of the work undertaken at IITA primarily for the sake of other crops is also relevant to vegetable production, such as investigations on soils, irrigation, weed control, plant protection, intercropping, production economics, etc.

Officials consulted by the mission in Nigeria

Mr. W. V. Rose	SAA/FAO Representative
Mr. K. McClean	Acting Project Manager NIHORT (Dr. Town, the project manager, was consulted during his recent visit to FAO, Rome).
Mr. D. E. Iyamabo	Secretary Agricultural Research Council of Nigeria (ARCN)
Dr. W. K. Gamble	Director General, IITA
Dr. J. C. Plinn	Director of Research, IITA
Dr. B. N. Okigbo	Assistant Director, Farming Systems, IITA
Dr. R. J. Treharne	Plant physiologist, IITA
Professor Ajibola Taylor	Director, Institute of Agricultural Research & Training, Moor Plantation
Mr. J. H. Simons	Pathologist, IART (and other professional staff concerned with vegetable trials at IART)
Mr. J. C. Quinn	Horticulturist, Institute of Agricultural Research, Zaria
Dr. L. K. Opeke	Plant Breeder
Dr. I. C. Onwueme	Crop Physiologist, Faculty of Agriculture, Ile Ife (and other professional staff concerned with vegetable trials at the Faculty of Agriculture, Ile Ife).

Institutions and Stations Visited

United Nations Development Programme, Lagos  
National Horticultural Research Institute (NIHORT)  
International Institute for Tropical Agriculture (IITA), Ibadan  
Agricultural Research Council Secretariat, Moor Plantation  
Institute of Agricultural Research and Training, University of Ife, Moor Plantation  
Faculty of Agriculture, University of Ife, Ile Ife  
Institute of Agricultural Research, Ahmadu Bello University, Samaru, Zaria.

Country Report

ETHIOPIA

The mission visited Ethiopia from 15 to 19 November, 1976.

Geographical position and climate

Ethiopia is situated in East Africa and adjoins the Red Sea. It extends from about 3°30' to 18° latitude north and from 33° to 48° longitude east.

Altitude varies from below sea level in the Danakil depression to over 4000 m in the central mountain chain. A large part of the central highlands lies between 1500 and 3000 m.

The rainfall, like the topography of the country, is very variable -- from an average of less than 300 mm per annum in the extreme S. East to over 2000 mm per annum in the S. West. The distribution of the rainfall during the year also varies but most of the precipitation occurs from May to September.

Sunshine throughout the dry season is abundant and even during the rains there are many sunny intervals.

Agricultural research organization

All agricultural research in Ethiopia is controlled by the Institute of Agricultural Research (IAR) founded in 1966 and developed with the help of a UNDP/FAO project. The IAR now has 27 stations and 13 sub-stations throughout the country covering all the main crops and ecological zones.

Horticultural research

The National Horticultural Centre was established by IAR at Nazareth (alt. 1600 m) some 1½ hours drive south of Addis Ababa. Present research projects at Nazareth include production trials on tomatoes, onions, sweet potato, cassava, pumpkins, melons, kale, Ethiopian brassicas, carrots, "Irish" potatoes, asparagus and okra. Investigations on seed production and sun-drying of vegetables are also undertaken.

Vegetable trials are also in course at Melka Werer (800 m) in the Awash Valley for lower altitude conditions and at Holletta (2400 m) for typical highland conditions. Pepper and potato production trials are also located at Bako (1600 m). High rainfall conditions are exemplified at Jimma (1700 m) where investigations continue on ginger, tumeric, black pepper, coriander, colocasia and sweet potato. The station at Awassa (alt. 2000 m), on land adjoining the lake of that name, includes chili and tomato production in its programme of research.

During discussions the mission was informed that the Government was giving increased emphasis to horticultural production and research both for the purposes of home markets and exports. An energetic start has been made on horticultural development during recent years and further strengthening of professional staff and training is now required. The General Manager and staff of IAR are keen to collaborate with the proposed international vegetable project and special arrangements for liaison seem to be required

Officials consulted by the mission in Ethiopia

Mr. C. N. Coombes  
Mr. A. Hammersley  
Mr. T. Jackson

SAA/FAO Country Representative  
Project Manager, ETH 74/002  
Horticulturist to FAO Project ETH 74/002

Country Report - Ethiopia (2)

Officials consulted by the mission in Ethiopia (cont.)

Dr. Semu Negus Haile Mariam	Head, Horticultural Development Agency
Ato Yohannes Negassa	Officer-in-charge, National Horticultural Centre, Nazareth
Dr. Zemadu Worku	General Manager, Institute of Agricultural Research
Ato Taye Gurma	Director, Extension and Project Implementation Division, Ministry of Agriculture
Mr. N. Warner	UNDP/FAO Project ("Potential Contribution of Aviation to African Economies").

Organizations and Institutions visited

United Nations Development Programme, Addis Ababa  
Horticultural Development Agency, Addis Ababa  
Institute for Agricultural Research (Headquarters), Addis Ababa  
National Horticultural Centre, Nazareth.

## Country Report

### SUDAN 1/

#### Geographical position and climate

The Sudan is situated entirely in the tropics of East Africa, being between 23° and 3°28' latitude N and between 22° and 38° longitude E.

Although the country has a coast on the Red Sea, most of the inhabited areas have a continental climate. In the south the conditions are typical of the more humid savannah regions of Africa. At Wau (alt. 435 m), for example, the average annual rainfall is 1170 mm, a large proportion of which is distributed fairly evenly through May to October. Mean monthly temperatures vary from 27 - 30°C and maximum from 31-38°C.

In the central Sudan the mean annual rainfall decreases progressively northwards down to 160 mm at Khartoum.

In the northern Sudan rainfall is reduced to occasional showers of no value to agriculture; most daylight hours are sunny and atmospheric humidity very low. Temperatures are high during the day - maxima from 31 - 43°C., but nights are relatively cool - minima from 15 - 28°C.

These conditions are typical of the desert and semi-desert areas of north central Africa including, besides northern Sudan, much of Chad, Niger and Mali and parts of Nigeria, Senegal and Mauritania.

Population densities in this enormous area are low except where sources of irrigation are found, for example, along the Nile.

#### Agricultural research organization

Agricultural research in the Sudan is controlled by the Agricultural Research Corporation (ARC) directly responsible to the Minister of Agriculture, Food and Natural Resources.

The ARC has five main regional research stations and 12 sub-stations. Its headquarters is located at the Gezira Research Station, Wad Medani. The other regional stations are at Yambio (Equatoria), Hudeiba (nr. Ed Damer in the Northern Province), Kenana (originally the Central Rainlands Station), and Kadugli (Nuba Mts.)

Cotton and grain crops, both irrigated and rain-fed, have been the main subjects of an intensive system of research for many years. The full range of priority crops is now as follows: cotton, wheat, barley, dura, millet, maize, groundnuts, sesame, sugar cane, pasture and forage, vegetables and fruits.

#### Vegetable production and research

Although vegetable production was a comparatively minor branch of agriculture until the 1950's, recently much higher priority has been given to development of these crops by the Government firstly to satisfy the demand from the rapidly growing urban population both for fresh and preserved vegetables, and secondly, to provide for a winter season export trade especially to Arab countries in the Persian Gulf and the Mediterranean areas.

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1/ Due to flight cancellations the mission did not arrive in Khartoum until 19 November (Friday) and departed on 21 November, thus having only one working day in Sudan (Saturday 20/11). There was unfortunately no opportunity to visit the research institutions mentioned in this report.

Country Report - Sudan (2)

Land and water are available (for all practical purposes) for virtually unlimited production during the winter season, especially along the main Nile. When the cool north wind comes down the Nile valley in November, conditions are excellent for sowing most temperate vegetables such as onions, carrots, cabbages, tomatoes, cauliflower, leeks, radishes, beetroot, spinach beet, etc. All these grow well during the winter period December to March when night temperatures are cool (minima of 16° - 22°C. in the Northern Province). The problem comes with the hot weather from April to October when temperate vegetables cannot be grown and can only be stored under refrigeration. Traditional solutions include the use of dried vegetables such as dried okra and dried tomatoes, and the growing of heat resistant species like Brassica juncea and Corchorus olitorius.

Research at the chief horticultural research station at Hudeiba on the main Nile (Northern Province) established in 1965, aims at improving the production techniques and selection of cultivars for the main winter season and also at the extension of this season as far as possible.

A horticultural sub-station was established at Shambat in 1966 to cater for the needs of Khartoum Province, which serves the main urban market.

The horticultural research unit at Wad Medani was established in 1967 to test varieties and techniques of vegetable production adopted to the Gezira conditions to serve local markets in the cotton growing area. Horticultural field stations to cater for local needs were also established at Sennar (Blue Nile) and Shendi (Northern Province) in 1971.

Particular interest has been taken at the Food Research Station at Khartoum in methods of preservation, especially sun drying.

Further research is needed on the production of vegetables for processing especially tomatoes for paste and in storage of onions and fresh vegetables.

Horticultural research was transferred to the control of the ARC in 1971.

From the discussions held, the mission had the impression that collaboration with the proposed international vegetable research project would be both welcome and useful. Further investigation is necessary on the type of liaison to be established and the main areas of research to be developed.

Officials consulted by the mission in Sudan

Dr. Hussein Mohammed Hassan	Under Secretary, Ministry of Agriculture, Khartoum
Dr. Mahmoud Salih Hassan	Head, Horticultural Research Section Agricultural Research Corporation, Khartoum
Mr. K. M. Abed	SAA/FAO Country Representative, UNDP, Khartoum.

Report on Visit to the National Vegetable Research Station (NVRS)  
Wellesborne, Warwick, U. K.

The Mission visited the station on November 29, 1976.

Organisation

The NVRS and its substation at Paglesham, Essex, were established on the 28th September, 1949. The station is partly financed by the Agricultural Research Council (ARC) and partly from funds made available to ARC by the Ministry of Agriculture, Fisheries and Food on the basis of research projects which the Ministry commissions.

The station has nine divisions: Plant Breeding, Chemistry, Plant Physiology, Entomology, Biochemistry, Plant Pathology, Nematology, Weeds, and Statistics. In addition, the station has sections of Farms, Technical and Maintenance Services and Library. Professor D. W. Wright is the Director and Dr. J.K.A. Bleasdale is the Deputy Director. There are about 80 scientific staff working at the station.

Special facilities available

- Controlled environment facilities (for basic physiological studies) with a number of chambers in which the temperature, humidity, photoperiod and intensity of light can be controlled.

- A series of glasshouses built especially for virus and studies on other diseases.

Brief Report on working of a few divisions:

Plant Breeding Division - Dr. N. L. Innes explained the working of the Division. The main breeding work is being carried out on the following vegetable crops:

Brussel Sprouts - Work continuing on related problems of F<sub>1</sub> hybrid seed production and the S-allele system. A study to know the comparative merits of single cross, double cross and synthetics.

Cauliflower - Work is in progress for both winter and autumn maturing group. Synthetics are also being tried.

Onion - Work on both spring and autumn sown crops is in progress. Some Japanese lines have done well in U.K. as autumn sown crop. The comparative merits of synthetics, hybrids, and open-pollinated lines are being established. Search is also being made for lines with bolting-resistant characters.

Carrot - Studies are in progress on the genotype and environment reaction. There is another project on carrot fly resistance.

Tomato - Genotypes are being screened for lines which can be harvested in mature green stage in September, stored till December and then ripened.

French bean - Resistant breeding projects against bean mosaic, bean yellow and halo blight are in progress. There is also a search for cold tolerance.

Lettuce - Breeding lettuce resistant against mosaic, downy mildew, tipburn and aphids.

## Research Station - Wellesbourne (2)

### Plant Physiology Division

Dr. Peter Slater explained the working of the Division. This is the largest division of the station with about 30 scientists. There are three main sections:

(1) Plant and crop studies. The plant studies are carried out under controlled environment to study the factors influencing various plant characteristics, including limiting factors for plant production. For example, the storage characteristics of onion both at high and low temperatures are being studied.

The crop studies are carried out under field conditions. Another example is the study being conducted by the hormone physiologists on seed treatment for uniform germination in the field.

(2) Storage and post harvest physiology - on carrot, beet and cauliflower.

(3) Physiological disorders.

### Plant Pathology Division

Dr. R. T. Burchill explained the research work in progress. There are three sections in the Division.

(1) Virology. Work is in progress both on chemotherapy and meristem culture. Electron microscopy has developed a rapid method of identification of virus particles.

(2) Mycology. Some of the important diseases on which research is in progress are clubroot of cole crops, Sclerotium and Botrytis of onion, Alternaria of brassicas and downy mildew of lettuce. Botrytis on onion has been found to be seed-borne and Benlate seed treatment is quite effective.

(3) Bacteriology. Control of bacterial diseases like halo blight.

All scientists work in collaboration with the Plant Breeders in projects for disease resistance.

### Entomology Division

Mr. G. A. Wheatly discussed the working of the Division. Studies are in progress on: the pest behaviour and host plant resistance; evaluation of new pesticides; and biological and ecological studies on insects. The scientists also collaborate with Plant Breeders in the insect resistance breeding projects.

### The fields in which NVRS could possibly help the Vegetable Project

- (1) By sending experts for short term consultancies;
- (2) By sending experts to deliver lectures in training programmes;
- (3) By carrying out basic research with the special facilities available at NVRS which may solve some fundamental problems in growing and storing particular species of vegetables in the tropical regions.

Meeting with Officials of the Ministry of Overseas Development (MOD)

London

The Mission visited the MOD on 30 November 1976, and explained the background of the proposed vegetable project to Dr. Roger Smith of the Agricultural Research Department and Mr. Whiteleg, Chief of the Department of Natural Resources. They appreciated the CGIAR's policy of 'consolidation' but thought that this should not be stretched to the point of 'stagnation'. Such projects as in the present proposal should be acceptable as an aspect of gradual development and consolidation.

The Mission also gave an account of the tours of Africa and South/Southeast Asia and the officials understood and agreed with the views of the mission regarding the pros and cons of the situations related to vegetable research and production in the different countries visited.

The officials welcomed the project and informed the mission that MOD had 'very extensive' funding for research and would consider requests for bilateral assistance for building up any national or international research centre connected with the project. There would also be possibilities for funding some basic research project(s) in the U.K. in conjunction with the proposed project. They thought that it would be a good opportunity to use the National Vegetable Research Station, Wellesborne, for this purpose. The Tropical Products Institute could also be used for research on storage and post-harvest technology.

They showed keen interest in the training programme and said that MOD would be ready to entertain proposals for financing the trainees and U.K. experts participating in the programme.

In discussing documentation and information retrieval, the officials urged that proper use should be made of the Commonwealth Agricultural Bureaux (CAB). Plans are in hand for computerising the information available at the CAB and early contacts from project staff with a view to coordination of information would be welcomed.

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Meeting at the Royal Tropical Institute, Amsterdam.

The Netherlands

On the 1st of December 1976 the mission visited the Royal Tropical Institute, Amsterdam, and attended a meeting with the following Dutch officials:

Dr. J. J. Hardon, Ministry of Agriculture, Wageningen  
Dr. Ir. G. J. H. Grubben, Department of Agricultural Research, RTI  
Ir. G. J. Koopman, Deputy Director, Dept. of Agricultural Research, RTI  
Ir. C. Dorsman, Director, Institute for Horticultural Plant Breeding  
Wageningen

The mission explained the background of the proposed vegetable project and also gave an account of the tours in Africa and South/Southeast Asia. All the Dutch officials showed keen interest in the project. Dr. Hardon promised to recommend support to the Dutch Government. He was in general agreement with the concepts of the vegetable project and agreed to help the project in any way possible through bilateral assistance as well as funding special research projects in Holland. The Dutch Government continued to have a special interest in Indonesia. Also it might consider a suitable request for bilateral help from Sri Lanka.

The Director of the Institute for Horticultural Plant Breeding, Wageningen, offered any help on basic research in conjunction with the project. This institute and the Royal Tropical Institute maintain between themselves a very good reference retrieval system on vegetable crops. They would be willing to give any help to the project in the documentation and information service. The Dutch Government also runs an international training course in vegetable crops. The authorities thought that the help and experience of this institute could be utilised in developing the training activities of the proposed project.

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Meeting with Officials of Administration Generale de la  
Cooperation et Developpement and Universities of Ghent  
and Gembloux

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The mission visited Brussels on the 2nd of December 1976 and had discussions with the following officials:

M. Ramboux, Councillor AGCD

M. de Smet, Secrétaire d'Administration, AGCD.

M. Doumont, Development of Agriculture Department, AGCD

Prof. de Langhe, State University Ghent, Adviser Agricultural Research, AGCD

Prof. Boenman, State University Ghent

Prof. Meyer, Université de Gembloux

The mission explained the background of the proposed vegetable project and gave an account of the tours in Africa and South/Southeast Asia. The officials recognised and appreciated the new principle of the project which is unlike any previous CGIAR venture. They agreed to render full cooperation to the project though at present the Belgian Government had little involvement in such projects outside of the one at CDH, Cambérène, Senegal. They also suggested the possibilities of cooperation with some Southeast Asian countries like Malaysia and Indonesia in subjects like Pedology, Computer Science, Horticulture and Mathematics. Some post-graduate students from Malaysia are already at the University of Ghent.

The general consensus was that bilateral efforts should be focused on separate individual countries and that donors should agree between themselves where to concentrate their efforts.

The officials in Brussels were primarily interested in the work of CDH, Dakar, and its future relationship to the project. They approved of the mission's suggestion to develop a francophone documentation and training centre attached to CDH.

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Meeting with the officials of GERDAT<sup>1/</sup> France

The mission visited the headquarters of GERDAT in Paris on 3rd December 1976.

The following officials participated in the discussion:

- Mr. Borget (specialist in vegetable production) of IRAT<sup>2/</sup>, Paris.
- Mr. Gaillard (specialist in fruit production) of IRFA<sup>3/</sup>, Paris.

The mission explained the background of the proposed project and gave an account of their tours in Africa and South/Southeast Asia.

The above representatives of GERDAT expressed keen interest in the project and, while not in a position to make any firm undertakings on the subject, promised to recommend full coopération from GERDAT, especially as regards vegetable research in the Ivory Coast.

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- 1/ GERDAT = Groupement d'Etudes et de Recherches pour le Développement de l'Agronomie Tropicale.
  - 2/ IRAT = Institut de Recherches Agronomiques Tropicales et des Cultures Vivrières.
  - 3/ IRFA = Institut Recherches Fruits et Agrumes.

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ANNEX IIIDETAILS OF THE MISSION(a) Terms of Reference

"The mission shall visit areas where a two-location pilot project might be established in South/Southeast Asia and Africa, and collect information that will permit a concrete recommendation and justification to TAC on:

- a) locations in both South/Southeast Asia and Africa where an internationally-based pilot research project can be established;
- b) institutions that might be considered as suitable for hosting the project in each region. Both existing national and international research institutions to be considered without making any commitments;
- c) the main geographical areas of action and the main species of vegetable crops where research should be concentrated taking into account the recommendations of the TAC Vegetable Research Appraisal Mission, 1975;
- d) a broad outline of the work for the duration of the project (3-5 years) with more explicit details of the first year's activities including the experimental work to be initiated, the surveys and analytical work to be conducted, and inauguration of research training for the project. Although the basic objective will be to collect information that will later permit decisions for longer-term actions, it is expected that the information and genetic material collected will enable the project to actually contribute to the improvement of the selected crops through the distribution of valuable germplasm, training and application of results of the research activities.

The draft report of the mission's findings, conclusions and recommendations should be submitted to the TAC Secretariat by 15 March, 1977, in time for consideration at the 15th meeting of TAC, May/June, 1977." <sup>1/</sup>

(b) Members of the Mission

Dr. B. Choudhury  
Head, Division of Vegetables and  
Floriculture  
Indian Agricultural Research Institute  
New Delhi  
India

Mr. B. Thrower  
Tropical Horticulturist  
Plant Production and Protection  
Division  
Food and Agriculture Organization  
Rome, Italy

(c) Itineraries

18.10.76 Mission assembled in Rome

21.10.76 Mission departed Rome

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<sup>1/</sup> Since these Terms of Reference were drawn up, the date of the 15th TAC meeting has been brought forward to January-February, 1977.

Visit to South/Southeast Asian Countries (Dr. B. Choudhury)

22.10.76 Arrived New Delhi, India  
 25.10.76 Departed New Delhi and arrived Hyderabad, India  
 26.10.76 Departed Hyderabad and arrived Madras, India  
 27.10.76 Departed Madras and arrived Colombo, Sri Lanka  
 31.10.76 Departed Colombo and arrived Kuala Lumpur, Malaysia  
 4.11.76 Departed Kuala Lumpur and arrived Djakarta, Indonesia  
 9.11.76 Departed Djakarta  
 10.11.76 Arrived Manila, The Philippines  
 14.11.76 Departed Manila and arrived Bangkok, Thailand  
 18.11.76 Departed Bangkok and arrived Dacca, Bangladesh  
 20.11.76 Departed Dacca  
 21.11.76 Arrived New Delhi  
 22.11.76 Returned to Rome.

Visit to African Countries (Mr. B. Thrower)

21.10.76 Arrived Dakar, Senegal  
 28.10.76 Departed Dakar and arrived Abidjan, Ivory Coast  
 31.10.76 Departed Abidjan and arrived Accra, Ghana  
 3.11.76 Departed Accra and arrived Lagos, Nigeria  
 14.11.76 Departed Lagos and arrived Addis Ababa, Ethiopia  
 19.11.76 Departed Addis Ababa and arrived Khartoum, Sudan  
 21.11.76 Departed Khartoum and returned to Rome.

Joint Visit to European Countries

26.11.76 Mission departed from Rome and arrived London  
 29.11.76 Mission visited National Vegetable Research Station, Wellesborne  
 30.11.76 Mission returned to London to visit Ministry of Overseas Development  
 1.12.76 Mission visited Royal Tropical Institute, Amsterdam, Netherlands  
 2.12.76 Mission visited the Office of the Administrator-General, Department for  
 Cooperation and Development, Brussels, Belgium  
 3.12.76 Mission visited the office of GERDAT, Paris, France  
 3.12.76 Mission returned to Rome.