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RESEARCH ON TROPICAL FRUITS
PROPOSAL FOR AN INTERNATIONAL TROPICAL FRUITS CENTRE IN ASIA (THAILAND)
(Item 8)

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RESEARCH ON TROPICAL FRUITS

PROPOSAL FOR THE ESTABLISHMENT OF AN INTERNATIONAL TROPICAL FRUITS CENTRE IN ASIA (THAILAND)

I. Background

1. At its fifth meeting the TAC had before it two papers concerning a proposal for the establishment of an International Tropical Fruits Centre in Thailand, one submitted by Dr. Siribongse Boon-Long of Thailand, Asian representative on the Consultative Group on International Agricultural Research, and the other a supplementary note by FAO. Since then Dr. Boon-Long has submitted a further note entitled "The Significance of Fruits and Vegetables in the Diet of people in developing countries and the priorities of Tropical Fruits for Research Investigation". This note attempts to synthesize these three papers for further consideration by the TAC.

2. Most other major food commodities, e.g., cereals, roots and tubers, grain legumes and vegetables are now being covered by the work of large, well supported international or regional institutes, with strong multi-disciplinary programmes. This is not the case with tropical fruits, which represents an important gap in internationally supported research on behalf of the peoples of developing countries, to whom fruit is not a luxury but an important item of subsistence. The main purpose of this paper is to draw this gap to the attention of the TAC and to present for its consideration the case for the establishment of an International Tropical Fruits Centre.

3. It is suggested that the initial focus of this Centre should be on Asia, with a location in Southeast Asia; because of the great importance of the tropical fruits to the poorer segments of the population there, the relative lack of large-scale export oriented commercial enterprises, the very large number of indigenous people who would benefit, and the wealth of wild genetic material and primitive cultivars which can be drawn on for improvement.

II. General justitication for the establishment of a Tropical Fruit Centre

(i) The significance of fruits and vegetables in the diets of people in developing countries.

4. The diet of the people in developing countries consists largely of grain products, roots and tubers. According to Lester Brown (1963), this type of food constitutes 71.7 per cent of the total calorie intake. The next important items are fruits, nuts and vegetables which represent 11.5 per cent. Unfortunately, the statistics do not usually differentiate between fruits and vegetables. The next three kinds of food rank close together at 5.8, 5.1, and 5.1 for fats and oils, sugar, and livestock products respectively. Fish comes last at 0.9 per cent. However, because fruits and vegetables are relatively low calorie foods, the amount of bulk they contribute to the diet is much greater than would appear from these percentage figures. Moreover they have a high 'protective' value as the richest sources of vitamins and minerals. Since fruit is generally a cheap commodity in the humid tropics the impact of any research programme leading to substantial improvement in yield or quality would benefit a large proportion of the population.

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On a regional basis, the breakdown of consumption is as follows:

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Asia</th>
<th>Africa</th>
<th>Latin America</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain and starchy roots</td>
<td>74.5</td>
<td>70.1</td>
<td>50.7</td>
</tr>
<tr>
<td>Fruits and vegetables</td>
<td>11.4</td>
<td>11.5</td>
<td>12.3</td>
</tr>
<tr>
<td>Fats and Oils</td>
<td>5.3</td>
<td>7.5</td>
<td>8.0</td>
</tr>
<tr>
<td>Sugar</td>
<td>4.1</td>
<td>4.1</td>
<td>14.0</td>
</tr>
<tr>
<td>Meat</td>
<td>3.8</td>
<td>6.3</td>
<td>14.7</td>
</tr>
<tr>
<td>Fish</td>
<td>0.9</td>
<td>0.5</td>
<td>0.3</td>
</tr>
</tbody>
</table>

It will be seen that the figures reflect uniformly high consumption of fruits and vegetables for developing countries, being 11.4 for Asia, 11.5 for Africa and 12.3 for Latin America. The figures also showed that in Asia, the most populous continent, the people eat the lowest amount of animal protein. Many millions of these are vegetarians who eat no meat at all.

Projected demand for fruits in low-income countries is also high. According to FAO's commodity projections the index for 1980 (1970 = 100) would be almost 148 for all fruits, as against 134.5 percent for cereals, 131.1 for starchy products, 146.8 for sugar, 137.6 for pulses, nuts and oilseeds, and 142.8 for vegetables. Only animal products and fats and oils show a more rapid growth of demand. Per capita indices of demand follow a similar pattern.

However, fruits are not widely traded among developing countries, and by their nature are more difficult and costly to store or transport long distances than some other important constituents of the diet such as grain. It is therefore particularly vital to try and expand domestic production as rapidly as possible, and to achieve the growth rate of 4.0 percent compound per annum over the decade, implied by the demand projections will be no mean task considering the widespread neglect of scientific fruit culture in most developing countries.

(ii) Other considerations

The income potential per unit area of land is higher for fruit crops than for most food crops, rubber trees, oil palm, etc., and for this reason fruit crops provide a good alternative in agricultural diversification schemes. In Thailand for example, the Government is anxious to encourage tropical fruit production as an alternative to small-holder rubber or as a supplementary source of income for rubber producers.

Commercial fruit crops require intensive labour, and therefore increased production will provide additional employment opportunities for rural people. This applies not merely to production per se , but to packing, processing and shipping activities.

The international market potential for some tropical fruits, both fresh and processed, is expanding and it is expected that in the next decade there will be a substantial increase in imports of fruits such as mango, mangosteens, passion fruit, papaya and guava from developing countries. Indeed to anyone sampling these delicious fruits for the first time it is amazing that they are not more widely known and commercially traded already.

A good indication of this potential is the increasing interest shown by UN agencies in the development of the tropical fruit industry. FAO has several processing and marketing

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1/ Data supplied by Dr. Boon-Long
projects where tropical fruits are of prime importance - for example, the Tropical Fruit Processing Centre in Brazil. Recently, FAO published Commodity Bulletin Series No. 51: Processed Tropical Fruit. In 1971, UNCTAD and GATT also published a survey on Exotic Fruit Products. The TAG Mission to Latin America has reported a great interest in tropical fruits there.

13. Despite strong local demand and apparent export potential, research on tropical fruits in Asia has never reached high standards; programmes lack objectives, personnel and equipment. As a result of this, fruit development programmes have not been successful as they suffered from lack of information and propagative planting material, for which they had to rely on the help of foreign institutions, with all the delays that this involved, i.e. long distances, plant quarantine regulations, etc.

III. Broad objectives of the proposed research centre

14. (i) To assemble and evaluate existing cultivars and strains of tropical fruits and to make propagative material available to other countries.

(ii) To conduct a research programme on various phases of the tropical fruit industry, covering: propagation, breeding and selection, pest and disease control, plant nutrition, irrigation, marketing and post-harvest physiology (for fresh fruit and processing).

(iii) To train junior scientists, teachers and extensionists in applied research related to the spread of advanced techniques in all phases of tropical fruit culture.

(iv) To collect and organize for dissemination all the readily available documentation and information on research and modern technology in tropical fruit production.

(v) To serve as a genetic resources centre for germ plasm of tropical fruit species.

IV. Specific problems requiring attention

15. Some specific problems of important tropical fruits species which it is suggested would benefit from solutions at the international level, instead of through piecemeal national research, and which might therefore form part of the programme of the proposed centre are the following:-

Banana

16. Though banana is an important fruit of commerce, research and development has been confined to the area of a few export varieties of narrow genetic base which are adapted to plantation type operation. It is difficult to duplicate such varieties and practices solely for domestic consumption in a developing country. It should also be emphasized that, in a few countries, banana and plantain are important as the major source of energy in the place of grains and starchy tubers. One traditional way of weaning a child is to feed him banana.

17. Most tropical countries have their own favourite varieties of banana which have one or more of the following characteristics:-

(i) Low yield and/or low quality.

(ii) Susceptibility to such diseases as Panama disease (Fusarium oxysporum) and Sigatoka (Cercospora).
(iii) A slow method of propagation by norma or young plants which makes large scale planting of new improved varieties a long drawn out process.

(iv) Not adaptable to rainfed farms.

(v) Susceptibility to wind damage.

(vi) Lack of knowledge on end-usages, preservation, and cheap storage of fruits.

Mango

18. Though mango has its origin in Southeast Asia, most tropical countries now have their own favourite mango. It is the most important seasonal fruit of the tropics, as apple is in the temperate region. In India alone, the production exceeds 5 million tons a year. It is a fruit enjoyed by all people, rich and poor. Mango also deserves to be better known as an export crop.

19. There are many still unsolved problems concerned with mango production and marketing. These include:

(i) Biennial nature of flower production.

(ii) Difficulty in obtaining a good fruit set.

(iii) A long period of immature stage of the mango tree before it starts to bear a commercial crop.

(iv) Many destructive diseases and insects e.g., malformation, anthracnose, mango leaf hopper.

(v) Poor production of high quality mango varieties in contrast to relatively high production of low quality mangoes.

(vi) The inheritance of important characters of mango is not definitely known.

(vii) The effects of wild mango and frequently used mango stocks on the scion are not known. The favoured dwarf stock is not proven.

(viii) The vegetative propagation of improved varieties as well as of uniform stock clones is not generally known and used by gardeners.

(ix) End-use development of the mango fruit is still in preliminary stages, and marketing is often primitive with heavy losses.

(x) The use of mango timber as a by-product of mango fruit production has not been tested, though the wild mango timber rates as high as teak in veneer wood production.

Citrus

20. Citrus might perhaps be classified as a subtropical fruit tree. However, orange, lime, pomelo and related species are consumed as fruit or food flavouring in tropical countries. Pomelo is the only fruit which sells at a high price while all others are truly the fruits for the poor. Citrus fruits are rich in Vitamin C. This gives an additional weight to its importance for health reasons. Citrus culture has many critical constraints which have made it similar to shifting cultivation in primitive culture; old orchards quickly die off and new ones in new areas have to be started up.

21. The numerous problems of citrus growing are:

(i) Citrus decline is the foremost problem in the tropics. The causal organism or factor is still not definitely known. However, *Fusarium* root rot, citrus greening virus or excessive application of
fertilizer, singly or collectively, can cause a total loss of a grove in 2–3 years. A search for resistant stocks to the foot rot and a practical method of making citrus clones free from important viruses are major efforts requiring the help of an international centre.

(ii) There are good citrus varieties suitable for the humid tropics but their merits and short-comings are not sufficiently known to warrant a general acceptance by growers in developing countries.

(iii) Sub-tropical citrus trees are known to produce high quality fruits only at high altitudes in the tropics. Pomelo of the highest quality is also location specific. Other citrus trees produce high yields but low quality fruit in certain areas.

(iv) No-one has successfully canned citrus juice and still retained its original fresh fruit flavour and aroma.

(v) There are no rootstocks suitable for water-logged soil or saline soils.

(vi) Other end-uses of the tropical citrus are not known, e.g. essential oils.

Date

22. It is regrettable that date palms cannot be more widely grown in tropical monsoon countries. The fruit is delicious and nutritious, the yield high and the tree lives and produces long.

23. Problems worthy of study by an international centre include:

   (i) Propagation methods. Propagation by offshoots is a slow process and by seeds is highly variable and sex differentiated.

   (ii) Spoilage by high humidity and rain limits the date palm to the arid tropics, and sub-tropics.

   (iii) No breeding programmes have been undertaken for physiological characters of date in search for better adaptation to agroclimatic conditions in Monsoon Asia.

   (iv) Fusarium disease. This is now a limiting factor in the Saharan countries; whether and to what extent it would affect the crop if it could be adapted to the monsoon areas of the tropics is not known.

Avocado

24. Though avocado is not strictly a tropical fruit, the races grown in the West Indies are adaptable to the tropical lowlands. The food value of avocado is high and its taste, to those initiated, delectable, but it is not widely consumed in developing countries. There is no reason why people should not learn to like it and use it more, given appropriate market promotion and nutritional education programmes.

25. The problems in avocado culture are:

   (i) The lack of improved varieties suitable for the tropical lowlands. Trees are grown from seed producing fruit of variable size and quality.

   (ii) Clonal selection of stock.

   (iii) Phytophthora root disease and anthracnose twig disease.
Coconut

26. Coconut is very widely grown throughout Asia and the Pacific, and practically all parts of the nut and the tree are utilised. Coconut oil is the most widely used cooking oil in this region and because of the slow growth of domestic production vis-à-vis demand, export earnings from copra in most countries are progressively declining. Moreover, coconuts are losing ground on export markets to competition from palm oil which, because of the more advanced levels of technology, can be produced much more cheaply.

27. The main constraints for coconut are:

(i) Low yield, low response to fertilizer, delayed effect of fertilizer application.

(ii) Breeding work will take a long time to obtain high oil lines, high protein lines or "scented milk" lines. The coconut tree takes 6 - 8 years to reach maturity.

(iii) There is still no cure for "Cadang Cadang" and similar diseases of coconut.

(iv) The rhinoceros beetle and the weevils cause serious damage in certain areas.

Papaya

28. Papaya is easily grown in rainfed agricultural systems so long as good drainage prevails. In a shredded form, the green fruit is often eaten as a salad and when ripe, the best quality fruit compares well with such fruits as mango in its refreshingly pleasing taste and distinct aroma. The milky sap yields the meat tenderizer papain which even in high income countries is increasingly being needed to make low priced meat palatable. Moreover, the tree matures in 6 - 8 months and may bear for 2 - 3 years. The fruit is cheap and within the purchasing power of the poorer people.

29. Constraints in papaya culture are:

(i) Papaya is dioecious. Surplus trees have to be grown so that a proportion of those which prove to be male can be removed at flowering time. Tissue culture or other methods should be tried to propagate female trees.

(ii) Low yield and low quality fruit are common in many countries. Improvement by breeding for use as ripe fruit, green fruit or papain production should be attempted and, at the same time genetic stocks assembled.

(iii) The tree bears no fruit in the dry season and is easily killed by poor drainage in the rainy season. An improved cultural system is needed for fruit production all the year round.

Pineapple

30. Commercial fruit production for canning has very exact requirements. This exquisite fruit should be made more freely available to low income people in the fresh form,
There are possibilities of growing pineapple as an intercrop among fruit trees to increase the farmer's income, but the system and the optimum methods for this type of cultivation are not widely known or practised.

31. The constraints are:

(i) Weed infestation. Cheap methods of weed control are badly needed.

(ii) The fruiting season is short even with the use of a retardant and a flowering hormone.

(iii) End-use products are not fully utilized in developing countries.

Mangosteen

32. Whoever eats the mangosteen, the queen of fruits, cannot fail to appreciate its refreshing and distinctive quality. The thick outer skin of the fruit is astringent and can be used for tanning. However, it is little known outside the humid tropics of Southeast Asia.

33. There are many constraints in mangosteen culture, e.g.

(i) With current cultural practices, the mangosteen takes about 7 - 8 years to reach maturity. Ways should be found to shorten this period.

(ii) Mangosteen is suitable only for the humid tropics and its water requirement is high. This prevents the extension of the growing area. However, many species of Garcinia have a habitat in a drier climate. By the use of stocks resistant to drought or by cross breeding, it should be possible to grow mangosteen elsewhere in the tropics.

(iii) All mangosteen trees are grown from seed. However, good varieties are known in many countries. If successful grafting or budding techniques could be developed high yielding clones could be used as propagating materials.

(iv) Harvesting, packaging and transporting needs to be studied to ensure highest quality fruits.

(v) The long period to maturity delays returns on investment. There is therefore a need to develop methods of inter-cropping between mangosteen trees.

Breadfruit

34. No serious research has been undertaken on this tree which is grown for its starchy fruit. It can be developed as a survival crop. It is valued as a shade tree because of the handsome large foliage in full canopy.

35. The main constraints in breadfruit culture are:

(i) Propagation is difficult and slow.

(ii) There is no traditional method to store the fruit for consumption. It is well known only as a candied dessert fruit.

(iii) There are no improved varieties. Records of production of varieties should be undertaken and improved clones selected.
(iv) Breadfruit tree culture has been left to nature. More information is required concerning cultural practices, especially on how to prevent fruit drop.

V. Feasibility of the proposal

36. Tropical fruit production in Asia is mainly carried out on small scale peasant farms with scattered fruit trees growing among other crops; this applies especially to crops such as mango, papaya, litchi, limes, pomelos and many other at present minor crops, although a few crops such as bananas and pineapples are grown on a commercial scale. There is an almost complete lack of information on many of these tropical fruits, some of which undoubtedly offer chances of commercial exploitation; and due to this lack of data it is impossible at present to evaluate their economic potential in monetary terms. Certainly the proposed Tropical Fruit Centre would provide the means of evaluating and exploiting the potential of these numerous and neglected fruit crops and could lead to the development of a tropical fruit industry which could be expected to have an important economic and social impact on the region.

37. It would however require very careful planning in view of the large number of potential species for study and the long term nature of the work. In order to keep the research programme within manageable proportions its development might therefore be phased along the following lines:

(i) No more than six species would be worked on at one time.

(ii) Trees with short life cycles would be studied in detail first, e.g. banana, papaya, pineapple, citrus.

(iii) Planting of trees with longer life cycles would be delayed until the second or third year to give priority to study of the genetic material and to planting of shorter maturing species.

(iv) Short and long life cycle species would be interplanted and studied concurrently. A specialist responsible for banana for example, might also be responsible for mangosteen. In fact, mangosteen can be intercropped in a banana plot for as long as 3 - 4 years. His primary concern would be banana for the first 6 years, leaving intervals of slack banana work to study mangosteen in the experimental plots and in private orchards. After 6 years, his associates should become proficient in banana research and he could move on to mangosteen.

Papaya and mango, pine-apple and coconut, and citrus and date are other possible pairings of species.

(v) A germ plasm pool of the trees in the above list as well as representative commercial varieties of rambutan, durian, santol etc. as appropriate would be started.

VI. Location of the Centre

The proposal to establish such a centre is strongly supported by the governments of three major countries of the region - and the Government of Thailand has expressed its willingness to act as host for the centre. As Thailand has suitable environmental conditions for the successful cultivation of a varied range of tropical fruit tree species and is centrally located in the region, FAO would support the setting up of the centre in that country. This is also in line with the Thai Development Plan which allocates high priority to tropical fruit culture as a means of diversification.
Thailand has accordingly made the following proposal for consideration by the Consultative Group, subject to support from the TAC:

(i) An invitation to negotiate for approximately 1000 hectares of forest land in the southern part of Thailand as a site for an International Tropical Fruits Centre to be supported by the Consultative Group. This site would be adjoining the newly developed research center for southern Thailand, which deals in other crops not covered by the proposed international centre.

(ii) The International Tropical Fruits Centre could be developed together with the national southern research centre sharing some common facilities or services in the first five years. After the first phase, the two centres could operate independently.

(iii) The Thai research officers would help as counterparts of the international experts to get the first phase of work initiated, while at the same time receiving technical training.

The area proposed is favourable for banana, cashew, cacao, coconut, durian, lanziana, mangosteen, oil palm, pineapple and rambutan. Other tree species e.g. citrus, date and mango could be studied at sub-centres in Thailand with a drier climate. (This could be a significant factor in developing 'upland' soils in Thailand and elsewhere in Asia which are not now widely or efficiently utilized for agriculture, or are subjected to types of shifting cultivation conducive to erosion).

We believe that this proposal is worthy of serious consideration by the Technical Advisory Committee in view of the importance of tropical fruit to the people of Asia, the export potential, the weakness of current research, the support expressed by other countries in the region, and the willingness of the Thai government to act as host for an internationally supported Centre.

We are of the opinion that a detailed field study, supported by the TAC, would be fully justified to clarify more concretely the benefits which could accrue from such a research centre to delineate the scope of its programmes, and to prepare a more fully worked out and costed proposal for further consideration by TAC as the basis for a recommendation to the Consultative Group in 1974.