REPORT ON FRUIT CROP DIVERSIFICATION POSSIBILITIES IN COLOMBIA

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INTRODUCTION

This report summarizes observations and recommendations made as a result of a 20-day reconnaisance survey and consulting mission to Colombia in June 1967 at the request of USAID. Purpose of this mission was to make a preliminary report and on-the-spot assessment of prospects, resources, potentialities and problems expected to be encountered in developing a fruit crop diversification program in Colombia. Particular attention was given to newly developed INCORA projects and diversification possibilities in the coffee zone. The survey, made with the assistance of and in company with INCORA, AID and Rockefeller Foundation technicians, covered a wide spectrum of fruit crops but did not include bananas and coffee. These two crops are already well developed commercially in the country and at times in surplus supply. Citrus and pineapple were also excluded from the survey inasmuch as these fruit crops are already being given intensive attention by highly competent specialists.

An intensive travel schedule was arranged through representative areas of the Cauca and Magdalena river valleys, northern coastal lowlands and several representative sections of the coffee zone. The purpose of this itinerary was to observe fruit crops growing in different areas and obtain necessary background information concerning topography, soils, climatic conditions and growing conditions in general.

For purposes of orientation and discussion, fruit crop diversification in Colombia may be divided into two major geographical zones. These are: (1) the warm tropical zone located below 1000 meters elevation and (2) the coffee zone located between 1000 and 2000 meters.

These two areas present some basic differences in economy and development but many fruit crops are well adapted in both zones or in parts of both zones. The coffee zone is much more heavily populated and developed agriculturally because of the existing favorable temperature range. Many tropical fruit crops, however, grow well from near sea level up to about the middle of the coffee zone (Ca. 1500 M.). From 1500 meters to the upper part of the coffee zone, temperatures are somewhat cooler and subtropical fruits grow and produce better than those with strictly tropical requirements. In some instances, however, certain fruits such as citrus, avocados and various cooking and dessert bananas can be and are grown all the way from near sea level up to the upper part of the coffee zone.

FRUIT CROP DIVERSIFICATION POSSIBILITIES

Annonas (*Annona spp.*)

Annonaceous fruits with possibilities for expanded planting and marketing include the 'Guanabana,' *A. muricata*, the cherimoya, *A. cherimola*, and the Australian custard apple variety known as 'Pinks Mammoth,' which is a hybrid between *A. squamosa* and *A. cherimola*. Guanabanas and custard apples could be produced commercially from the lower half of the coffee zone down to near sea level. Guanabanas are probably the best of the Annonas for processing purposes, being particularly good as ice cream and sherbet flavor and for a fruit nectar base. The custard apple, on the other hand, is best utilized as a fresh fruit and is a good substitute for cherimoya at lower elevations where cherimoyas cannot be successfully grown.

Cherimoyas are well adapted to cooler areas in the upper section of the coffee zone and in frost-free locations above the coffee zone. It is one of the best subtropical dessert fruits but is probably not suitable for processing purposes. Any expansion in growing and marketing cherimoyas depends upon selection and standardization of improved clonal varieties, large scale

production in well managed orchards, consumer education and improved marketing and handling. With proper handling and refrigeration there is a possibility that fresh cherimoyas could be successfully exported to Europe and/or the U.S.

Avocado (Persea americana)

Avocados grow and produce well in Colombia and possibilities exist for export to Europe, although several major problems exist. The most serious problems are the widespread occurrence of: (1) trunk borers, (2) seed and fruit borers and (3) Phytophthora root rot. Poorly drained soils subject to flooding should be avoided and light, well drained soils are almost a necessity for successful avocado culture. Seedlings predominate among avocados grown in the country and West Indian types are by far the most common below the coffee zone. West Indian-Guatemalan hybrids also do well at low elevations and can extend the ripening season by several months. Guatemalan race types and Mexican race hybrids are better adapted than West Indian types to cooler areas at higher elevation and would grow well throughout the upper part of the coffee zone. Variety testing is of vital importance and small, high quality fruit averaging less than one pound is preferred for export purposes. These should preferably be green skinned and stringless with relatively high oil content.

Bananas and Platanos (Musa spp.)

Bananas and Platanos are well adapted to growing from near sea level up to the upper part of the coffee zone. Adaptation depends somewhat upon variety. Commercial production of dessert bananas is concentrated at lower elevations where the period required for ripening is relatively short. Platanos, especially the 'Harton' type, are widely adapted and could possibly be exported fresh to New York, the U.S. west coast and Florida in considerable

quantity. A demand for them already exists in those areas. The best variety for canned fruit salad packs is 'Manzana.' Banana figs, chips and canned pulp are in need of investigation as possible export items. Certain platano varieties of the Hawaiian 'Maoli' group do better at higher elevations than standard varieties such as 'Harton' and 'Cuatrofilos.' One of these varieties, 'Maia Maoli,' has already become established and was frequently seen in markets throughout the upper coffee zone.

Better sigatoka control would be beneficial to production of all banana varieties in the country.

Cashew (Anacardium occidentale)

Two nut crops of possible interest and potential value have been discussed and studied as possible economic crops for Colombia. They are Cashew nuts and Macadamia nuts. Rather large areas in Colombia, well adapted to Cashew nut growing, are available and sizeable pilot plantings already established. Since there seems to be comparatively little acreage that might possibly be suitable for Macadamias, it seems more logical to consider the possibilities of expanding Cashew production. Cashew trees grow well in many warm dry areas of Colombia, while the few Macadamia trees observed were in poor condition and did not seem productive or well adapted. Test plantings of well grown seedling Macadamia trees might, however, be attempted in the upper part of the coffee zone. If areas are found where they grow and produce good crops of marketable quality, trial commercial plantings could then be made. However, experience in growing Macadamias in the American tropics within 15° of the Equator has not been encouraging, in spite of the fact that many seedling trees have been planted over the past 15 or 20 years.

Considerable enthusiasm has nevertheless been generated in Colombia and elsewhere in Latin America, relative to Macadamia nut growing prospects. This, however, is based almost entirely on reports and research from Hawaii where

this crop has achieved its greatest development and such enthusiasm may not prove justified. In Central America, growth of Macadamia trees in test plantings has been slow, production per tree discouragingly low and quality of nuts produced, below minimum processing standards.

Cashew growing, on the other hand, seems well adapted to many warm dry areas of the country below about 1200 feet, especially those with a dry season from December to March. Cashew trees have the facility of growing and producing fairly well in warm dry locations on relatively poor soil, where other fruit trees often fail. A dry period during flowering season is, however, essential for good yields as a blossom blight, often referred to as "anthracnose," may destroy the flowers if rainy or humid weather occurs during the flowering period.

Hand processing of Cashews is a serious problem because of the tedious hand labor involved. Mechanical equipment developed in Mozambique and elsewhere has, however, demonstrated that Cashews can be successfully cracked and processed mechanically on a large scale. Such mechanization may well be closely linked with future development of more extensive Cashew production in Latin America.

Cashews are presently grown under somewhat primitive methods of culture in most parts of the world and this is true also in Colombia. No extensive orchards of selected clonal varieties exist in the world up to now, but if Cashews are to be cultivated on good land and/or under irrigation, improved planting material should be obtained or developed. These might be progenies from selected seed, but it is more likely that grafted trees of selected clones will have to be grown if really good yields are to be attained. If seedling trees are grown, the productivity of the trees as well as uniformity and quality of the nuts would be doubtful until trees are in production.

Cashew nuts have a high unit value, keep well in storage and can be

readily exported to Europe and North America where a good market exists for high quality exotic nuts. Cashews definitely merit attention in suitable areas of Colombia as a crop with good export possibilities.

Guava (Psidium guajava)

Guavas are easily grown and widely adapted to much of the coffee zone as well as lower elevations. They are more tolerant of heavy soils and poor drainage than almost any other tree fruit. The ordinary seedling guavas found in Colombia consist mainly of thin-fleshed, seedy, sweet types of inferior quality which are really not suitable either for dessert purposes or processing. Processed products observed were mostly jams of mediocre quality.

To have any hope of success new guava plantings for export production would have to be highly productive budded trees producing large, thick-fleshed, acid, processing type guavas.

Guavas offer good prospects for export if a market can be developed and steadily supplied with high quality products. There is at least one high quality, acid, processing variety in the collection at Palmira which could serve as foundation stock and budwood of several others has been imported.

Research and development of guavas as a processing crop is not highly developed in other countries and as a consequence, named varieties for processing are not always readily available. Most of the named guava varieties are sweet, white dessert types not suitable for processing. Guavas would seem to have excellent prospects as a possible new export crop for processed products including canned halves, nectar base and high quality jam and jelly.

Lulo (Solanum quitoense)

Juice and fruit nectar products made from Lulo are highly acceptable and could be a successful export item to the U.S. and possibly Europe if production and quality control problems could be solved. Lulos grow well in

cool situations in the upper half of the coffee zone provided rainfall is fairly well distributed throughout the year. A long dry period can, however, be disasterous. Nematodes are a serious pest of Lulo and failure of plantations often traced to heavy infestations of root-knot nematodes which can devastate Lulo plantings in a matter of a few months. Lulos can quite easily be grafted using other Solanum species as rootstocks, providing a satisfactory nematode resistant rootstock species can be found. S. macrophylla and S. hirtum from Central America, as well as several indigenous Colombian Solanums, are compatible with Lulo and easy to graft. This might solve the nematode problem.

The spiny-leaved "septentrionalis" form of Lulo is most common in Colombia and Costa Rica but is not as satisfactory or easy to harvest as the smooth-leaved form more common in Ecuador and Peru. There is considerable variation in spininess and productivity, as well as flavor and acidity of fruit. Variety trials would be advisable before extensive plantings are made for export. The processing and growing of Lulo are not very difficult aside from the nematode problem. Lulos would probably be most successful above 1500 meters because of their adaptation to relatively cool temperatures.

Mango (Mangifera indica)

Mangos are widely grown and well adapted to many lowland areas and as far up as about the middle of the coffee zone. Warm locations in which the dry season and the flowering period of mangos coincide are conducive to good fruit set. Because of the availability of considerable areas of good land well adapted to mango growing, this fruit obviously has promise as an export crop. Mangos also have considerable potential for improvement in keeping quality and flavor for domestic uses.

The processing of mango products and export of fresh mangos to Europe are good possibilities that should be explored. Mangos of the right type can

be processed and canned and also are an excellent ingredient in canned tropical fruit salad. Mango chutney is another export possibility. Fresh mangos picked mature green can withstand shipment in refrigeration for at least two weeks if properly handled. However, virtually no mangos of improved varieties suitable for export are being produced in the country at the present time.

Unfortunately, the usual seedling mango types which predominate, produce relatively poor quality fibrous fruits. Such mangos are definitely not suitable for export, either fresh or canned. They are really not even satisfactory for expanded use within the country because of their poor appearance, mediocre dessert quality and unsatisfactory keeping properties. Furthermore, they do not represent an acceptable sample of the superior types of mangos available in other parts of the world.

A variety improvement program is definitely indicated and would logically begin with importation and establishment of a fairly extensive collection representing outstanding varieties from other parts of the world. Much of this necessary material could be obtained as scions from Mexico, Florida, India and Hawaii. Both canning and dessert varieties should be obtained and particular attention focussed on dessert quality, keeping quality, productivity and suitability for canning purposes. The polyembryonic varieties 'Manila,' synonym 'Carabao,' from Mexico and 'Kensington,' from Australia, come true from seed in addition to being desirable varieties for dessert and canning. These should definitely be tested along with a selected group of the best monoembryonic varieties from Florida, Hawaii and India.

Mangos are a logical crop for expansion inasmuch as they grow and produce well in large areas in the northern part of the country including the lower Cauca and Magdalena valleys.

A research program with emphasis on variety testing and processing research is indicated and should begin at the earliest possible date.

Maracuja (Passiflora edulis f. flavicarpa) and other species

Passion fruit culture presents no major production problems, but marketing and processing need further investigation and development. Maracuja strains grown in the country are of excellent quality with relatively high juice yields. Trellises are in general too low and far too many plants per acre are planted, often up to 750 plants per acre. Because Maracuja is such a vigorous plant, 240 vines per acre would be adequate for maximum yields, and much easier to trellis, cultivate, harvest and prune. No major disease or insect pests were noted, but plants at "Valle" had some sort of disorder that could possibly be of virus origin. The best yellow-fruited Maracuja strain appeared to have good resistance to root diseases.

The thick fleshy pulp of the large Badea (P. macrocarpa) diced or in chunks should be a good ingredient in a processed fruit salad pack, while the juice would be a good flavor ingredient. The "Curubas," P. mollissima and P. mixta, are popular and well-accepted juice fruits in Colombia, but the juice is probably not as suitable for export as that of Maracuja.

Mora or Mora de Castillo (Rubus glaucus)

This crop is well adapted to cool locations in the upper part of the coffee zone. It grows and produces well above 1500 meters, yielding good crops of well-flavored berries suitable for processing into juice, jam, jelly, wine and ice-cream flavoring. Mora does not, however, find wide acceptance as a fresh fruit because of its tartness and acidity. It has much the same flavor characteristics as black raspberry and would probably be as well accepted if it could be produced and marketed competitively on the U.S. and European markets. While comparatively easy to grow, picking costs have been and continue to be a problem because of the thorniness of the plant. If the economics of growing, picking and handling permit, processed Mora products should find good acceptance on both local and export markets.

Papaya (Carica papaya)

Papayas, which are widely adapted, grow and produce well from near sea level on up to about the middle of the coffee zone. Virus diseases and insect pests present problems and effective control measures would have to be found and applied to assure success of any extensive papaya planting enterprise.

Papayas observed in Colombia were extremely variable in type and not outstanding in quality. Some good quality fruits were, however, occasionally encountered in local markets. The large, firm, pink-fleshed, criolla type of papaya common in the country could be readily utilized in a canned tropical fruit salad pack. On the other hand, new plantings should always be made from self-pollination seed derived from hermaphrodite plants producing desirable fruit. This is because of the excessive amount of genetic diversity evident in criolla papayas, almost invariably grown from open-pollination seed of doubtful parentage. Colombian dessert papayas observed in markets appeared in serious need of genetic improvement. A start should be made at the earliest possible date by selecting and inbreeding the most desirable criolla plants producing good quality fruits.

The flavor and quality of Hawaiian 'Solo' papayas are appreciated but the fruit size is too small and the hermaphrodite plants often develop excessively large numbers of malformed fruits. F_1 hybrid papayas for commercial use are distinctly feasible and could logically be produced using female 'Solo' plants with pink-fleshed fruits as female parents, crossing them with suitable male or hermaphrodite plants of pink-fleshed criolla types. The objective of such a program would be to produce round or oval, pink-fleshed fruits of good quality, weighing from 2 to 5 pounds. This size and type of papaya seems most acceptable in Colombia at present. F_1 seed so produced would have to be progeny tested for acceptability and production.

Parental plants or their equivalent should be maintained as long as possible in order to be able to repeat desirable crosses. The services of a professionally trained plant breeder would be needed to decide on crosses to be made and keep necessary records of desirable parental lines and combinations. The actual crossing techniques could, however, be readily mastered by field personnel with limited training, if adequately supervised.

Export of fresh papayas to Europe or North America is an exciting possibility, but fruit of the type and quality necessary for successful export is not presently grown in Colombia. The majority of papayas now grown for market would be culls by export standards. In fact they are hardly satisfactory for marketing as fresh fruit within the country because of the high degree of variation found in size, shape, color and flavor. However, even for domestic uses, the production, type and flavor of papayas could easily be greatly improved through application of modern plant breeding methods.

The export of fresh papayas would require an even more ambitious and intensive program to develop varieties of the size, texture, flavor and uniformity necessary for successful export marketing. Probably an intensive breeding program comparable in scope and duration to those carried out in Colombia with soybeans and potatoes, would be necessary to develop an acceptable papaya variety suitable for export. The objectives of such a program would be to produce small, high-quality papayas averaging less than 3 pounds with good handling and shipping characteristics. This would require the services of a well qualified plant breeder working at least half time on the project with necessary field and laboratory facilities. A lesser effort on a part-time basis by growers or practical horticulturists would be of doubtful value and not likely to succeed.

SOME EXPORT POSSIBILITIES

1. Fresh mandarins and canned or concentrated orange juice to Europe
2. Cashews to U.S. and Europe
3. Avocados to Europe
4. Mora juice to Europe
5. Lulo juice to U.S. and Europe
6. Maracuja juice to U.S. and Europe
7. Platanos and platano products to U.S.
8. Fruit salad with such ingredients as:
   a. Badea juice and pulp
   b. Papaya
   c. Zapote de carne*
   d. Pineapple (less than 50 percent)
   e. Pummelo sections**
   f. Mango
   g. Maracuja juice
   h. Guava juice***
   i. Banana (Manzana)
   j. Corozo juice****

*Calocarpum mammosum
**Citrus grandis
***Psidium guajava and P. araca
****Bactris minor

NEW FRUITS FOR TESTING

There are several good tropical and subtropical fruits which have probably never been introduced or at least not adequately tested in Colombia. Several are from similar climates in Southeast Asian countries where they have attained considerable economic and nutritional importance. A number of the most important of these fruits which should be investigated further in Colombia are listed in Table 1.

Table 1: Some promising tropical and subtropical fruits not well known and/or tested in Colombia

Common Name	Genus and Species	Area of Origin	Uses
1. Durian	Durio zibethinus	S.E. Asia	fresh fruit and in confections
2. Rambutan	Nephelium lappaceum	S.E. Asia	fresh and canned fruit
3. Pulusan	Nephelium mutabile	S.E. Asia	fresh and canned fruit
4. Jack Fruit	Artocarpus heterophyllus	S.E. Asia	canned fruit salad ingredient and fresh fruit
5. Lansone	Lansium domesticum	S.E. Asia	fresh fruit
6. Mangosteen	Garcinia mangostana	S.E. Asia	fresh fruit
7. Jaboticaba	Myrciaria cauliflora	Brazil	wine, jam, jelly and fresh fruit
8. 'Pinks Mammoth' custard apple	Annona squamosa Annona cherimola	Queensland, Australia	fresh fruit

GENERAL RECOMMENDATIONS AND SUGGESTED PROCEDURES

1. Train as many fruit and vegetable specialists as possible overseas at B.S. and M.S. levels for all major crop development projects. Also expand the number of technicians being trained at the Escuela Agricola Panamericana in Honduras.
2. Send at least 2 men intimately concerned with the organization and administration of crop diversification programs in Colombia to Malaysia for at least 6 weeks to study the organization functioning and progress of the "Federal Land Development Agency" in that country. Malaysia, considered a model in planned land development, presently has the most advanced land development agency in the world. Thousands of landless families are being successfully established on newly developed agricultural projects through sophisticated planning, skilled supervision and adequate long time credit for settlers.
3. Provide adequate experimental food processing facilities for research on tropical and subtropical fruit products. This would consist of a strong well-organized adequately staffed food processing research laboratory with at least 2 or 3 Ph.D. level researchers. The facility should preferably be attached to the strongest possible University and located near a zone where it is proposed to produce fruit crops for processing. It would also be advisable for this facility to be attached to, or at least closely associated with, the University department and/or individuals and agencies working actively on fruit crop diversification. It would be best to have food processing research set up to function cooperatively within an established University or Experiment Station, rather than within or under a semi-autonomous section of a Federal Ministry.

4. Strengthen and increase the amount of specialized training in Horticultural Sciences at National Universities. The faculty should include adequately trained specialists in the following major fields: (1) Post harvest physiology, (2) Nutrition, (3) Plant Breeding, (4) Weed Control, (5) Food Processing, (6) Marketing and (7) Extension.

5. Graduate Study in horticulture (fruit and vegetable crops) should be initiated and expanded to the equivalent of U.S. Master of Science level at one or more National Universities in Colombia. This will involve a major effort in augmenting and strengthening the faculty, revising existing curriculum and establishing adequately equipped laboratories and research facilities. It should be emphasized that the traditional concept of "Ingeniero Agronomo" degree training is not sufficiently specialized or research oriented to provide adequately trained horticulturists necessary to deal with existing problems. Because of inadequate and insufficient specialization, these technicians cannot be expected to deal competently with complex problems encountered in growing, handling, processing and marketing which occur in developing a new fruit crop diversification program.

6. It is clear that all fruit crops proposed and discussed as well as their potential uses, are experimental and/or developmental. Pilot plantings and considerable risk capital would therefore necessarily be involved in their development and exploitation. No export crop could possibly be expected to succeed without an acceptable product or pack and sufficient volume of production to permit adequate test marketing. It is imperative to critically test consumer demand and acceptance of almost all fruit crops and products which have been discussed.