RAP PUBLICATION: 1999/19

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EXPERT CONSULTATION ON AVOCADO PRODUCTION DEVELOPMENT IN ASIA AND THE PACIFIC

27-29 April, 1999
Bangkok, Thailand

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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Printed in June 1999

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EXPERT CONSULTATION ON AVOCADO PRODUCTION DEVELOPMENT IN ASIA AND THE PACIFIC

I. INTRODUCTION

1. The Expert Consultation on Avocado Production Development in Asia and the Pacific was held at the FAO Regional Office for Asia and the Pacific (RAP) in Bangkok, Thailand, from 27 to 29 April, 1999. It was organized and sponsored by FAO/RAP. Experts from Australia, China, India, Indonesia, Myanmar, Philippines, Sri Lanka, Thailand and Vietnam participated in the Expert Consultation, together with representatives of FAO. The list of participants is given in Annex 1.

2. The Senior Plant Production and Protection Officer, FAO/RAP, presented Introductory Remarks in his capacity as the organizer of the Consultation. The FAO Assistant Director-General and Regional Representative for Asia and the Pacific, Bangkok, Thailand, delivered the Welcome Address. The Deputy Regional Representative, FAO Regional Office for Asia and the Pacific, was present during the Opening Session.

II. OPENING OF THE MEETING

3. Mr. M.K. Papademetriou, Senior Plant Production and Protection Officer, FAO, Bangkok, Thailand, pointed out that avocado is highly regarded today as an important fruit for food and nutrition. Remarkable development of this fruit has been recorded in every continent, with the exception of Asia. Unfortunately, this fruit has not yet been popularized in Asia, most likely due to unawareness of its merits/qualities. However, Popenoe (1935) considered the avocado as "God's greatest gift to humanity". Now, more than a generation later, Asians need to listen freshly to the wisdom of this truth. Much real starvation and malnutrition in a number of Asian countries, such as Bangladesh and India, could be averted by growing avocados, whose product has a relatively high food and nutrition value.

4. Avocados are rich in important human nutrients. There has been recently increasing recognition of our need for antioxidants for good health, and the avocado is rich in three of the most important ones i.e. vitamins E, C and A (beta-carotene). It may help to prevent strokes; it is high in potassium and low in sodium. Among fruits, it is noted for the quantity and quality of its protein. It provides exceptional quantities of both types of dietary fiber. It makes a superior weaning food for babies. The avocado fat consists predominantly of mono-unsaturated oleic acid, which has been found to reduce harmful (LDL) cholesterol while maintaining beneficial cholesterol (HDL), performing better than the usual low-fat diet. In addition, the avocado has various uses as a natural cosmetic, with advantages in rapid skin penetration, and as a superior natural sunscreen.

5. Malnutrition is a serious problem in the region, and it is attributed to an imbalanced diet. The opportunity to build up demand for nutritious food-stuffs seems to beckon. There is an opportunity and potential here for the development of a Regional Avocado Industry, along with its nutritious products. Apart from the local markets, there are opportunities for the export markets of the region. Japan, Korea and Hong Kong are already importing avocados from countries of other continents (Mexico, U.S.A. etc.). Some other countries in the region are also importing avocados, but in small quantities. Imported avocados in Bangkok are selling for US$2.00 per fruit. In addition, Western European markets still have considerable growth potential. The opinion of many people is that the demand for avocado will continue to grow throughout the world markets.

6. The opportunities for the development of a viable avocado industry appear to be very good. However, at the same time the problems to be addressed are serious. With the exemption of Australia, New Zealand and Sri Lanka, no other country in the region has improved varieties available for the farmers. There is, therefore, a need for each country to embark on a strong varietal improvement programme. The problem of propagation/multiplication needs also to be addressed. In addition, the farmers need to become familiar with the improved cultural practices to be followed. Post-harvest handling, processing and marketing issues also need to be given due attention. The region should be in a position to produce best quality fruit at low cost.

7. Inter-country cooperation could be very helpful in achieving the common goal. Strengthening cooperation among countries, institutions and individual scientists in production development is very important. A forum like this will allow us to learn from each other. We must explore the possibilities of sharing our experiences for mutual benefit. It is in this context, that this Consultation has been convened. He then outlined the objectives of the Expert Consultation.

8. Dr. Prem Nath, Assistant Director-General and FAO Regional Representative for Asia and the Pacific, welcomed the participants on behalf of the Director-General of FAO, the staff of the Regional Office and on his own behalf. He stated that he was very happy to see the positive response received from scientists working on avocados in the Asia-Pacific Region. Considering the important role which this crop can play in Food and Nutrition Security of the Asia-Pacific countries and the need for inter-country cooperation on problems of common interest, FAO decided to hold this Expert Consultation in order to elaborate on issues relating to the development of this crop in the Region.

9. Avocados have been known for many years, dating back at least to 1519 when Hernando Cortez, Spanish soldier of fortune, was the first white man to set foot in Mexico City. However, the first written account of the avocado, so far as is known, is contained in the report of Gonzalo Hernandez de Oviedo (1526), who saw the tree in Colombia, near the Isthmus of Panama.

10. Mexico, Central America and northern South America are considered to be the centres of origin of avocados. Archaeological and other evidence indicates that avocados were cultivated there in very early times, possibly some 6000 years ago. They were there as nature presented them, a heterogeneous mixture of seedling trees. They were not commercially exploited until the first years of the present century, when their potential for commercialization was developed by Californians. It was in this state that avocado growing

became a recognizable industry. The crop has a wide adaptability, and avocados are now grown in most tropical and subtropical countries. Yields up to 35 tonnes/ha have been obtained in South Africa from high density planting of avocados.

11. Avocado is one of the finest salad fruits. It is a good source of vitamins (A,B,C, E, folacin, niacin etc.) and minerals (iron, magnesium, potassium etc.). Purseglove (1968) considered the avocado as the most nutritious of all fruits. Many horticulturists are accustomed to view the avocado as one of the greatest undeveloped sources of nutritious food which the tropics offer at present. However, while many people view the avocado as a possibility, to many others it is a realized possibility. "Four or five tortillas (corn cakes), an avocado, and a cup of coffee, - this is a good meal", say the Indians of Guatemala.

12. There are many reasons to believe that eventually the avocado will be as familiar to Asian housewives as the banana is today. However, at present, the avocado is not popular in the Asia-Pacific region. The great majority of the population do not appreciate this fruit. This is because very few people in the region are aware of the merits of this unique fruit.

13. It is high time for the countries of the region to start giving consideration to commercial avocado culture. The avocado has to be regarded as a fruit of great commercial possibilities. Some scattered plantations in certain countries of Asia have demonstrated excellent growth and heavy bearing of the trees. There is room for much more production in the region, but only of the best varieties that can be grown. At the same time the people in the region must become aware of the avocado and its merits and there is, therefore, a need to encourage, develop and implement an awareness programme about avocado.

14. Development of the avocado industry in the region will require a concerted effort on the part of the governments and the growers. Collaboration between countries of the region is important and rewarding. In view of the commonality of problems and issues, sharing of information and experience on various aspects of avocado production could lead to quicker and more remunerative results.

III. OBJECTIVES AND AGENDA

15. Mr. M.K. Papademetriou presented briefly the need and rationale for organizing the Consultation. He presented the objectives, the provisional agenda (Annex 2) and the details of the programme (Annex 3), which were duly adopted. The objectives of the Consultation, in brief, were as follows:

a) To review the status of avocado production in Asia and the Pacific, discuss the problems faced as well as strategies required for overcoming existing problems.

b) Elaborate on the potential and opportunities for avocado production development.

c) Discuss ways and means of strengthening collaboration on avocado research and development.

IV. COUNTRY REPORTS

Australia

16. Dr. Anthony W. Whiley stated that the Australia avocado industry was founded in the 1930's but it is only since the 1980's that the crop has shown significant expansion. Production in Australia is based on Guatemalan or Mexican race varieties that have a high oil content. The range of varieties and climates where the crop is grown gives year-round production; however, supply during the summer months is low and fruit is imported from New Zealand during this period to meet consumer demand.

17. The 1996/97 production was estimated at 18,000 tonnes of which approximately 60% is produced in Queensland and 30% in new South Wales. Other states with commercial avocado production include Victoria, South Australia and Western Australia, the latter with a rapidly increasing tree population. The main varieties grown are 'Hass', 'Shepard', 'Fuerte' and 'Sharwil' which cover the full range of maturity from early to late season production. The industry is based on seedling rootstocks although elite selections that have been vegetatively cloned are now being evaluated, e.g. 'Velvick', and 'Duke 7'.

18. The industry has a regulated nursery scheme (Avocado Nursery Voluntary Accreditation Scheme) for the production of "true-to-type", and disease-free trees which is supported by technical experts from the Queensland and New South Wales Agricultural Departments. Since its inception in the late 1970's there has been a marked improvement in the quality of trees produced by the nursery industry.

19. Orchard, postharvest and marketing technology has been traditionally delivered to the industry through the Departments of Agriculture of the various states but to counter shrinking government resources, software management and information packages (AVOMAN and AVOINFO) have been developed and enjoy widespread industry support. The average industry yield is about 7 t/ha though the best growers attain sustainable yields of 18 to 23 t/ha.

20. A minimum fruit maturity standard of 21% is set for the industry and fruit may not be legally marketed until this level has been reached. When direct marketing to the chain stores there is a requirement for growers to implement a Quality Assurance program to ensure that a minimum quality standard is met and fruit pesticide residues do not exceed the legal limits.

21. The industry has structured promotional and R, D & E programs in place that are supported by a mandatory production levy collected from all growers at the point of wholesale. Industry priorities are set every five years and a strategic plan is formulated to ensure that goals are met on schedule.

22. Fruit quality is the major constraint faced by Australian growers in further developing the domestic market. The presence of fruit-fly in Australia has prevented access to lucrative markets in Japan, Korea and New Zealand. Continued investment in R & D programs focussing on issues limiting market development is likely to yield results that will solve industry problems.

China

23. Professor Liu Kangde informed the participants that China has an area of about 133 ha under avocado cultivation and produces some 1,000 tonnes of fruit. Avocado is mainly grown in the South China provinces (Hainan, Guangdong, Guangxi, Yunnan, Fujian, Guizhou, etc.). The climate and soil in these provinces are suited to avocado cultivation. Large parts of land in the Southwest China provinces of Guangxi and Yunnan are also suitable for avocado cultivation. At present, there are no large orchards under commercial cultivation in China.

24. China has more than 70 imported varieties of Mexican, Guatemalan and West Indian race, and over 10 superior local selections. The present major varieties for commercial planting in Hainan include Bacon, Zutano, Duke and Mexicola of Mexican race; Hass, Nabal, Reed, Taylor and Linda of Guatemalan race; Pollock, Sharwil and Murashige of West Indian race; hybrids (Fuerte, Lula, Booth 7, Booth 8 and Hall); and local selections (ST_3, ST_6, ST_9, ST_{10}).

25. The planting materials used are mainly polybag-raised seedlings and polybag grafted plants. The latter are commonly used at present. Patch-budding of older stocks in polybags and cleft grafting of young seedlings (30 days old) have been successfully practiced; however, the grafted plants can be planted out 1 year earlier than the patch-budded plants.

26. Avocados are planted at a spacing of 4m $\times$ 5m or 5m $\times$ 6m in Hainan. Inter-planting of A and B group varieties needs to be considered when new orchards are to be established. Irrigation is necessary under dry conditions. Excessive dampness may promote root rot.

27. Root rot, caused by *Phytophthora cinnamomi*, is the most serious disease in mature orchards. It is controlled by Alliette (as a soil drench or for tree injection) or Ridomil (as a soil drench). Collar rot, caused by *Phytophthora citricola*, is the most serious disease in young orchards, and is also controlled by Alliete. The most serious pest is *Serica* sp., attacking the tender leaves of avocado in Hainan. It can be controlled by Dichlorvos (spraying or as soil drench).

28. Avocados give a commercial yield of 7.5 – 15 tonnes/ha in Hainan. Some varieties such as Lula, Pollock and the local selection ST_3 give a yield of 15 tonnes/ha, and their fruit quality is acceptable.

29. The constraints for development of avocado production include little awareness of the nutritional value of the fruit, difficulties in marketing, natural calamities, inadequate information on improved varieties for each agro-ecological zone, weak extension service etc. However, little awareness of its nutritional value and difficulties in marketing are the major constraints. Publicity for avocado is badly needed.

30. China has a great potential of developing avocado production. It has a large population and hence a large domestic market. There is a large part of hilly land suitable for avocado planting in South China. Moreover, there is a collection of over 70 avocado varieties in the country. The Chinese government has attached great importance to the research and development of avocado. Research on avocado was included in the key

priorities of the Ministry of Agriculture during 1986-1995. Companies and farmers are now encouraged to plant avocado, although no further large financial support is given to the development of avocado production at present.

India

31. Dr. S.P. Ghosh indicated that avocado is still a minor fruit crop for India. It was introduced from Sri Lanka in the early parts of the 20th century, and presently it is cultivated in a scattered way in tropical south Indian states like Tamil Nadu, Kerala, Karnataka and Maharashtra. The crop is also popular in the north eastern Himalayan state Sikkim, where it is grown successfully on hill slopes at an elevation range of 800-1,600 m. Climatically, it is grown both in tropical areas experiencing summer rains and in humid sub-tropics with mild winter. The range of mean maximum and minimum temperature in the Niligiri Hills of Tamil Nadu (South India) where avocado is grown is 27.2 ^{o}C to 33.9 ^{o}C and 14.9 ^{o}C to 22.2 ^{o}C, respectively. In the north eastern state Sikkim the avocado growing area experiences temperature range from 12 ^{o}C to 30 ^{o}C with average rainfall of 2,000 mm.

32. All three horticultural races, namely West Indian, Guatemalan and Mexican have been tried in India and the varieties Fuerte, Hass and Green performed well at different places. The harvesting season of fruit is from July to September and a tree of 10-15 years old produces 300-350 fruits per year. Vegetative propagation is still not a common practice, and in Sikkim all the trees are of seedling origin. There is no serious plant protection problem experienced so far and with a little technological support avocado can come up well in India.

33. For better nutritional security, the nutrient rich avocado is considered as a potential fruit crop for India. Moreover, the tourist industry is growing quickly and there is an opportunity to develop this crop to meet the demand by the hotels. There is, therefore, a large potential domestic market. In addition, the promotion of avocado as a shade tree for tea and coffee production may stimulate development of the crop.

34. The major limitation in avocado production development is the lack of awareness of the nutritional value of the fruit. Avocado is not widely recognised in India, and there is a strong competition from other fruit crops such as banana, mango, grapes etc. Also, there is a very limited varietal base at present.

Indonesia

35. Professor Sri Setyati Harjadi mentioned that avocado was introduced into Indonesia by Spanish merchants during the 17th century. The toal area under cultivation is estimated to be about 15,000 ha and the production about 117,000 tonnes. About 71,000 tonnes are produced in Java and 46,000 tonnes in the outer islands. The major producing area in the Java island is West Java followed by East Java, while Central Java produces much smaller quantities. In the outer islands the major producing areas are West Sumatra, Jambi, South East Nusa and South Sulawesi. Very small quantities of avocado are imported and exported annually.

36. The preferred varieties are Ijo Panjang, Ijo Bundar and Gondor, all of Mentega (butter) type. Avocados are mainly grown in home gardens. There are no organized

commercial plantations. After planting very little care is taken of the trees. Seedlings are widely used as planting material. Very few plants are vegetatively propagated. Presently, there are no specialized nurseries for the production of planting material.

37. There is a very good potential for avocado production development in the country. However, there are no government plans at present for the development of the avocado industry. Major limiting factors in avocado production development are: a) the unavailability of improved varieties and suitable rootstocks for each agro-ecological zone; b) the lack of quality planting material; c) very poor knowledge of the farmers in appropriate cultural practices to be followed; and d) lack of trained manpower (research and extension personnel) in avocado.

Myanmar

38. U Aung Soe explained that avocado was introduced into Myanmar over 60 years ago. It was first planted at Pyin Oo Lwin (formerly known as May Myo), a hilly resort in the Mandalay Division. From there it was taken to the Shan, Kayah and Chin States. Today, the main areas of cultivation are in the Shan State. Avocado is mainly grown as a backyard crop, although some scattered plantations can be seen in a few areas, especially in the Shan State.

39. The trees grown are all from seedlings. No budding or grafting is practiced. There has been no research or developmental work for this crop in the past. There has been no effort to introduce improved commercial varieties from abroad for testing and evaluation. As a result, such improved varieties are missing. The farmers raise their own seedlings and plant them in the field at the beginning of the rainy season. After planting, little care is taken of the plants.

40. There are very good prospects for avocado production development in the country. There is, at present, a serious human nutrition problem and the development of avocado, as a food source, would assist in alleviating the problem. In addition, there is an expansion of tourism in Myanmar, and this may provide an opportunity to develop this crop. It is quite possible that, because of the different agro-ecological zones, there will be a production all the year round. The main obstacles in the development of the crop are: a) the poor recognition of avocado as a food crop by the people of Myanmar; b) the unavailability of improved varieties; c) the lack of vegetatively propagated high quality planting material; d) lack of technical knowledge of the farmers on needed crop management practices; and e) lack of trained research and extension personnel on avocado.

Philippines

41. Dr. Rachel C. Sotto said that the avocado was first brought to the Philippines by the Spaniards in 1890 from Mexico, but it was only during the period of 1902-1907 that it was successfully introduced into the country by the Americans. At present, it can be found growing mostly in backyards all over the country. The top three leading producing regions in the country are Cagayan Valley, Central Visayas and Southern Tagalog. Two distinct forms of the avocado exist in the country. These are the purple-fruited form and the green-fruited form. Local varieties which fall under the purple-fruited forms are 'Calma', 'Cardinal', 'Parker', 'RCF Purple', 'Uno' and '227', while '240' and 'Cepillo Green' fall under the

green-fruited form. A few private nurseries and government institutions are involved in the production of seedlings as well as grafted plants of avocado.

42. Avocado is not grown on a commercial scale in the country. It is mostly planted in backyards or in mixed orchards with minimal care. The most serious disease attacking the avocado is root rot caused by the fungus *Phytophthora cinnamomi* and it seems that the best control measure is to avoid planting in waterlogged areas. Harvesting of the avocado is carried out when the fruits exhibit reddish-purple streaks on the stem-end in the case of purple-fruited forms and the change in color from green to light green in green-fruited forms. Harvesting of the fruits is done with the use of a long bamboo pole with a wire hook and a net attached to catch the fruits. These are then brought to the market together with other farm produce by the farmer himself. In other instances, the middleman or 'comprador' who dictates the farm-gate price buys the fruits from the farmers and sells them in the market at a higher price.

43. Though the avocado was introduced into the country a century ago and is distributed all over the archipelago, it has not gained the importance and acceptance enjoyed by mango, banana and pineapple. Primarily, the avocado does not appeal to the Filipino palate which favors fruits with sweet or sub-acid flavor. Most of the Filipinos are also not aware of its varied uses as well as its nutritional qualities. There is, at present, lack of funds for avocado research and development. Varieties with attributes like high oil content, long shelf-life and resistance to root rot are lacking. However, varieties with very good fruit qualities are available, but there is a lack of supply of certified planting material.

44. Inspite of all these limitations, there is a bright future for avocado production development in the Philippines. Firstly, being well naturalized and well distributed throughout the country, a wide variation in plant and fruit characters exists thus offering a rich material for the selection of superior trees. The existing climate in the Philippines is also ideal for the commercial cultivation of the avocado. Secondly, the long fruiting season of avocado which is from January to March and May to September provides the possibility of a year-round supply of avocado fruits. Thirdly, the excellent nutritional qualities of the avocado together with its varied uses are valid reasons for developing the production of this fruit. Lastly, the avocado can be easily propagated vegetatively and can, therefore, be easily multiplied on a commercial scale.

45. It is, therefore, foreseen that orchards of avocado, one of the country's promising fruits, will be established in the future for the production of high quality fruits for local consumption. The country has a "food for children" programme which provides meals at schools. There is an opportunity to tap into this programme with avocado, thereby developing the crop to address the malnutrition problems of the country.

Sri Lanka

46. Mr. Moses Dionysius reported that avocado is a popular fruit crop in Sri Lanka like mango, banana and rambutan. The first introduction of avocado into the country is unknown, but there is a recorded introduction on 12 May 1927. From that time up to 1940 several varieties were introduced including Datton, Puebla, Winslowson, Nabal, Grothfry and Pollock. During that period the Government was concentrating on promoting tea, rubber, coconut and rice. As a result fruit crops, including avocado, did not receive much attention.

47. The total area under cultivation with avocado is estimated to be 826 ha. The great majority of the trees are grown in home gardens, and over 95% of them are from seedlings. Presently, avocado is grown successfully in the districts of Kegalle, Kandy, Matale and certain areas of Nuwara Eliya. Other potential areas are Gampaha, Kurunegala and Colombo. Apart from the wet zone, avocado is becoming popular in the intermediate zone as a home garden crop. The fruit is consumed locally. However, very small quantities are exported to Middle East and European countries. In 1997 about 3 tonnes of fruit were exported.

48. A real breakthrough in avocados came during the period of 1986-1987 with the introduction of 17 varieties from Australia, U.S.A. and Cyprus, under the UNDP funded and FAO executed project SRL/84/013 – Horticulture (Fruit) Development. These varieties were planted in different agro-climatic regions for testing and evaluation. Four varieties (Fuerte, Booth 7, Simmonds and Tower II) were selected and released by the Varietal Releasing Committee of the Department of Agriculture in 1995. Already, 14,000 grafted plants of these four varieties were produced in the Government nurseries and distributed to the farmers. In addition, a "Top Working" programme with new varieties is successfully carried out in two districts.

49. The peak production period is between May and August and the low production period between September to March. However, a recent study on "On-tree Storage" indicated that it is possible to have avocados during the off-season period of April-May. Therefore, year round production appears to be possible.

50. Very recently, an attempt has been made by the Plantation Crops Sector to grow avocado on a large scale as an alternative to traditional export crops such as tea, rubber and coconut, under a crop diversification project. With the declining plantation crop prices there is a opportunity to develop avocado as an alternative revenue source. However, marketing is still unorganized and efforts in this direction will be much needed. The awareness programme undertaken by the Horticulture Research and Development Institute, regarding the nutritional value of avocado, is a step in the right direction. However, a stronger R & D programme is needed for the country.

Thailand

51. Prof. Chalongchai Babpraserth informed the participants that avocado was introduced into Thailand by missionaries 90 years ago and planted at Nan province. In 1985 the Department of Horticulture, Kasetsart University, introduced some varieties including Kanoe, Ruehle and Kampong Monk and planted them at Pakchong Research Station, Nakhon Rajasrima province. In 1975, 11 new varieties were introduced from Florida, U.S.A., and planted at the same Station. The introduced from Florida varieties were Buccanaer, Booth 7, Booth 8, Catalina, Choquette, Hall, Lula, Peterson, Queen, Taylor and Waldin. The varieties Hass, Bacon and Reed were introduced in 1993 from California. At present, avocado trees are found growing in Nakhon Rajasrima, Chaiyaphum, Nan, Tak, Chiang Mai, Chiang Rai, Rayong and Songkhla provinces. However, the biggest concentration is in the Northern and Northeastern regions. In 1998, the total area under cultivation in the North was 200 ha, in the Northeast 50 ha, in the East 5 ha and in the South 5 ha.

52. About 84 ha of avocado were planted in 1997 by hilltribe growers under the Royal Project Foundation in northern Thailand. However, many growers planted seedlings, and

efforts are being made to persuade them to graft or bud their seedlings with recommended varieties such as Buccanaer, Hass, Peterson, Booth 7 and Ruehle. Presently, about 4,000 grafted/budded plants are produced annually by the Pakchong Research Station and the Royal Project Foundation for distribution to the growers.

53. Harvesting time is from July to December. The production is small and the fruit is sold in the domestic market. The demand in the local market is limited at present as people are not aware of the nutritional value of the fruit. Some quantities of high quality fruit (mainly of the Hass variety) are imported from New Zealand and Australia and are available in the big supermarkets.

54. In general, avocado is relatively unknown to Thai people. Current prices for locally produced fruit are low with little interest by growers in producing avocados. Technical knowledge on growing avocado is poor and training for extension staff on cultural practices is required. Current production is largely from seedling trees. There is a need for a much vigorous Research and Development avocado programme. There is also a need for an awareness programme. Thai schools have a food programme for children and there are opportunities to introduce avocados into this programme. There are also opportunities to improve hillside tribe agriculture by growing avocados. The development of avocado as a crop of hillside tribes can assist in improving their income.

Vietnam

55. Dr. Nguyen Minh Chau pointed out that avocado was introduced into Vietnam by the French in 1940 and planted at Lam Dong province. In the 1960's, some new varieties were introduced from the Philippines. At that time the avocado growers were able to make good money from avocados due to high demand from consumers, mostly foreigners living in the country. The Southern Fruit Research Institute (SOFRI) has introduced recently from Australia the varieties Hass, Reed, Ettinger and Sharwil, which were planted in the South and North Vietnam. However, there has been no serious varietal improvement programme up to the present, except for a collection of varieties at the Hung Loc Agricultural Research Centre, Dong Nai province, by Professor Hau.

56. Presently, there are no statistical figures regarding the area and production of avocados in the country. However, the crop is grown extensively in the upland parts of Vietnam (provinces of Dong Nai, Ba Ria-Vung Tau, Lam Dong and Dac Loc in the South and Phu Tho in the North). The avocado trees are used for intercropping or to provide shade for coffee and other crops or as a backyard crop. There are no organized commercial plantations. The trees grown by growers are from seedlings. Avocado fruits are available in the domestic market from February to August, but the main fruit season is from May to July. The prices in the local market are very low in comparison with other fruits.

57. It appears that there are very good prospects for avocado production development in Vietnam, and the Government has started to pay due attention to this crop. In fact, avocado today is included in the list of the seven priority fruit crops for development. However, this development is hampered by a number of constraints. These are: a) unawareness of the Vietnamese people of the nutrition and health benefits to be derived from consuming avocados; b) unavailability of improved varieties for each agro-ecological zone; c) lack of vegetatively propagated high quality planting material for distribution to the farmers; d) lack

of knowledge of the farmers in crop management practices to be followed; and e) untrained research and extension personnel in avocados. A well-thought and prepared programme will be needed to address the above limitations.

V. CONCLUSIONS AND RECOMMENDATIONS

58. Avocado is a fruit crop that is indigenous to Central America where it is a staple food of the native people. Production of this crop has spread to every continent where climatic conditions are suited to its requirements. However, the development of the avocado as a commercial crop in Asia and the Pacific island nations is in its infancy as compared to other tropical and sub-tropical fruit crops of the region. The genetic diversity of the avocado, due to the three eco-races (Mexican, Guatamalan and West Indian) enable the successful production of this crop over a wide range of environments, from cool, summer-dry Mediterranean to sub-tropical and humid tropical. However, the avocado is little known throughout Asia and the Pacific island nations, although there are some exceptions which include Indonesia, Sri Lanka, Vietnam and the Philippines where the fruit is consumed by the people in both rural and urban areas. The developing tourist industry throughout the region was also identified as a market opportunity. Hence, the consultation recommends that through a program of research, development and education (which should include the appropriate health authorities), efforts be made to develop avocado as a significant fruit crop for Asia and the Pacific island nations with emphasis on its potential contribution to improve human health.

59. A major constraint identified by the consultation to develop avocado as a fruit crop for Asia and the Pacific island nations was the lack of availability of suitable varieties/rootstocks in the participating countries. Existing production in most countries is based on an extremely diverse seedling tree population that results in a wide range of fruit quality available to the consumers. Poor fruit types and inconsistency in quality are likely factors contributing to low prices paid for the fruit in many of the participating countries. The consultation identified the need to obtain germplasm of superior varieties for those countries that do not possess this material so they can be evaluated under local conditions. The rich diversity of seedling populations in some countries should be examined to identify superior types that may provide opportunities for future commercialization. An avocado contest as described by Dr. Chalongchai Babpraserth for the Royal Thai Project and Dr. Nguyen Minh Chau for Vietnam is a useful way of economically searching a seedling population. The process can be more effective if simple guidelines based on selection criteria on how fruit will be judged can be disseminated to the local farmers. It was generally agreed that each country maintains its own germplasm and varietal collection blocks, as requirements and priorities may differ throughout the region.

60. In several Asian countries, the most suitable climatic zones for avocado production are at high elevations in the mountainous areas which are prone to erosion and environmental degradation. The cultivation of perennial fruit crops such as avocado will promote sustainable land-use as well as provide a highly nutritious food and generate a regular income. Traditionally, hill-tribe farmers in mountainous areas of Asia practice organic farming and the avocado responds well to this type of culture. Companion cropping with coffee and banana is already practiced in some countries, and this production system can be effective in limiting pests and diseases, thereby enhancing production efficiency. Fruit produced through eco-

friendly practices with minimal agro-chemical usage would improve the local environment and produce an eco-friendly product that should receive consumer preference in selected markets.

61. Diverse agro-climatic zones in the region offer the scope for exploitation of off-season production opportunities. This can be extended by widening the varietal base to include early, mid-season and late season maturing cultivars. However, care must be taken in selecting cultivars for specific locations, as there are varying sensitivities of cultivars to temperature ranges during flowering and fruit-set. The successful implementation of this technology could see year-round production of this crop and promote trade opportunities among countries in the region. The fruit is traded at present in global markets and has potential to generate export earnings if suitable cultivars are identified and grown.

62. Propagation techniques were mostly well understood by members of the participating countries. It was, however, reported that in some countries there were problems concerning the ready availability of reputable nurseries able to supply grafted trees for commercial development of avocado. The development of skills in nursery practices, propagation methods and nursery hygiene were identified as high priorities to assist in the development of the avocado as a crop for Asia and the Pacific, e.g. grafting and rapid multiplication techniques, and solarization of potting media.

63. The consultation identified *Phytophthora* root rot, caused by *Phytophthora cinnamomi*, as a major disease of avocado in the region with the potential to limit production of this crop. This disease is a significant threat to all avocado production in countries worldwide that grow this crop. Effective control measures are available but were not widely known by country participants. Information on the practical aspects of controlling this disease should be made available to countries that require this technology. The consultation also identified the presence of fruit diseases such as anthracnose (*Colletotrichum gloeosporioides*), stem-end rot (*Dothiorella sp.*) and cercospora spot (*Pseudocercospora purpurea*) in participating countries. The consultation recommended the selection and development of improved cultivars and rootstocks and other management practices which will be beneficial in reducing the incidence of these diseases.

64. Participants also identified a wide range of insect pests that were prevalent in participating countries. Economically important pests, that are difficult to control, are the stem and fruit borers reported from Myanmar, Sri Lanka and Thailand. It was recommended that each country conducts its own research to address such pest control problems.

65. Most participants identified significant post-harvest fruit losses when handling avocado in their respective countries. This is likely due to a number of factors that include poor production technology, lack of storage facilities, and unsatisfactory handling and packaging systems. The consultation recommended the use of improved varieties and production technologies along with appropriate training on post-harvest handling techniques covering on-farm handling and storage, post-harvest treatments and conditioned storage which should assist in reducing post-harvest losses.

66. It is recognized that the avocado is one of the most nutritious fruits cultivated. The fruit is high in anti-oxidants such as vitamins E, C, A (beta carotene). The fruit is also high in potassium and low in sodium and contains both types of dietary fiber as well as being a good

source of protein. The fruit has a high nutrient density per calorie and the fat is predominantly mono-unsaturated oleic acid that has been found to reduce harmful low density lipoprotein cholesterol (LDL) while maintaining beneficial high density lipoprotein cholesterol (HDL), thereby reducing the risk of atherosclerotic heart disease. The flesh is highly palatable and easily digestible making it an ideal weaning food for infants. It was, therefore, recommended that avocado production be promoted in the region to improve the nutritional status of the people.

67. A general lack of awareness of the uses and benefits of avocado was identified by all participating countries, with the exception of Australia. Processing opportunities and oil extraction (for the cosmetic industry) were discussed and seen as future opportunities for the avocado in Asia. However, to support these activities there would be a need to expand present production of this crop, along with fruit production from cultivars suitable for these purposes. No development in this area was therefore recommended for the immediate future as considerable investment for research and development of processing technologies is required.

68. The consultation identified the need to improve skills and knowledge of research and extension officers in most of the participating countries along with the orchard management skills of avocado growers. This could be achieved by professional development of scientific and extension personnel, establishment of demonstration blocks, on-farm training, seminars, field days, study visits with people from countries interested in fostering this crop in Asia and the Pacific island nations, and by sharing information through publications.

69. It was realized from the discussions that there were different levels of development and government support for avocado production among the participating countries. However, there are many constraints hindering the development of the avocado as a commercial crop for the region. Most problems appeared to be common to all countries. The consultation, therefore, recommended that assistance be sought for the formulation, funding and implementation of a Regional Project to develop avocado as an alternative food crop for the Asia-Pacific Region (with the exception of Australia and New Zealand).

70. It was revealed that there was a low base level of technology for avocado production throughout many of the participating countries and there was a need to access reliable information to successfully advance the culture of the crop. It was felt that a Regional Network would facilitate the pooling of information and expedite the development of the crop. The consultation endorsed this approach for Regional Cooperation and recommended the establishment of such a Network. It is expected that if a Regional Project on avocado production and development is implemented, it will eventually lead to the establishment of a Regional Network to disseminate information on avocado research and development throughout the participating countries.

Annex 1

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Annex 2

AGENDA

1. Opening Session

2. Country Reports

3. Potential and opportunities for avocado production development

4. Recommendations

Annex 3

PROGRAMME

Tuesday, 27 April 1999

0830-0900	Registration
0900-1030	Remarks on the Meeting by Mr. M.K. Papademetriou, FAO/RAP Introduction of the Participants Election of Chairman and Rapporteur Welcome Address by Dr. Prem Nath, ADG/RR, RAP Group Photograph
1030-1100	**Coffee Break**
1100-1130	Avocado Production in Australia by Dr. Anthony W. Whiley
1130-1200	Avocado Production in China by Prof. Liu Kangde
1200-1400	**Lunch Break**
1400-1430	Avocado Production in India by Dr. S.P. Ghosh
1430-1500	Avocado Production in Indonesia by Prof. Sri Setyati Harjadi
1500-1530	**Coffee Break**
1530-1600	Avocado Production in Myanmar by U Aung Soe
1600-1630	Avocado Production in the Philippines by Dr. Rachel C. Sotto
1630-1700	Avocado Production in Sri Lanka by Mr. Moses Dionysius

Wednesday, 28 April 1999

0900-0930	Avocado Production in Thailand by Dr. Chalongchai Babpraserth
0930-1000	Avocado Production in Vietnam by Dr. Nguyen Minh Chau
1000-1030	**Coffee Break**
1030-1230	Discussion on the Potential and Opportunities for Avocado Production Development in Asia and the Pacific
1230-1400	**Lunch Break**
1400-1530	General Discussion
1530-1600	**Coffee Break**
1600-1800	Plenary Session

Thursday, 29 April 1999

0900-1030	Workshop's Conclusions and Recommendations (Presentation and Discussion)
1030-1100	**Coffee Break**
1100-1230	Continue with the Workshop's Conclusions and Recommendations Adoption of Recommendations

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