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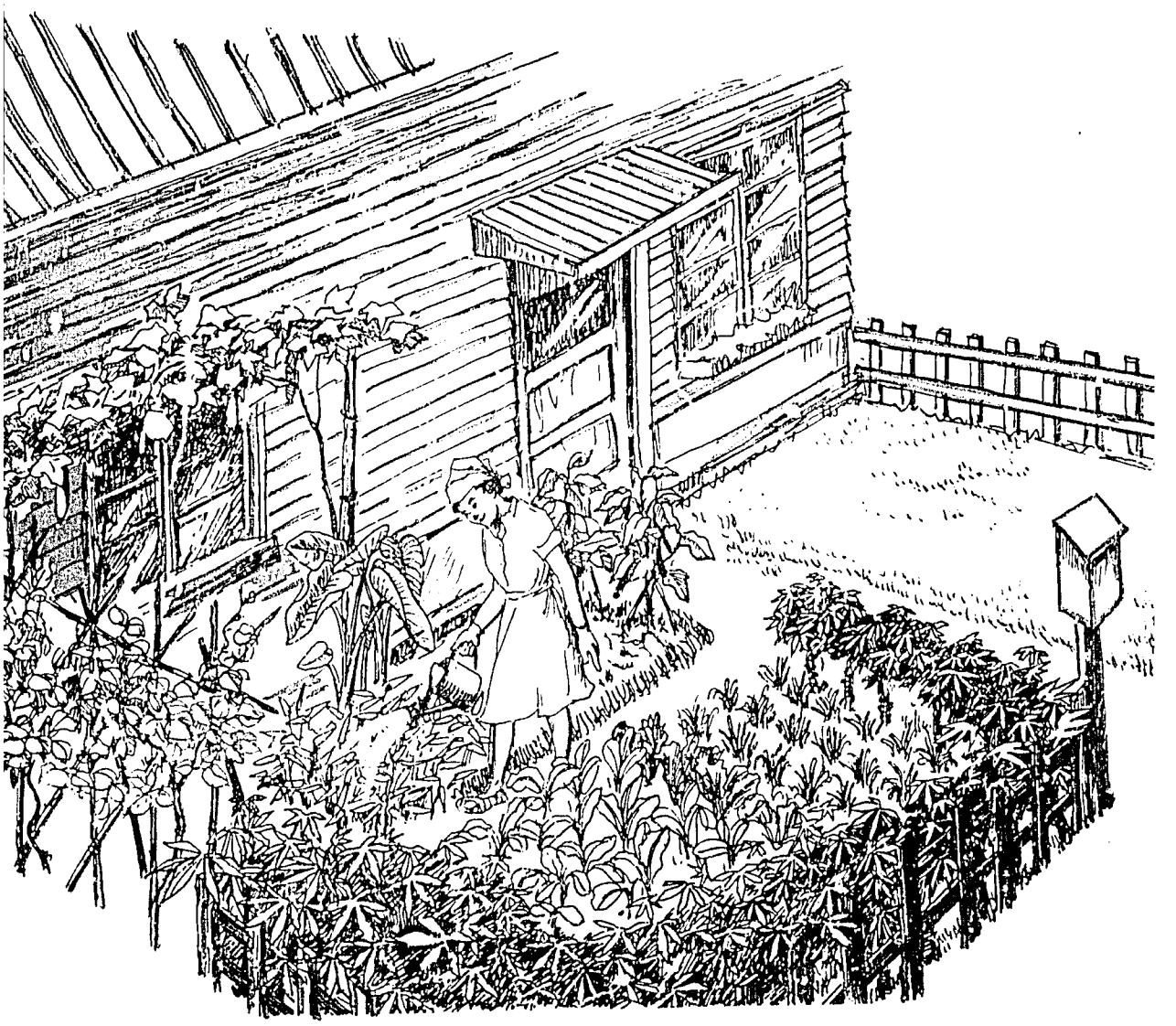
Gardening Nutritious Vegetables



Asian Vegetable Research and Development Center

Gardening Nutritious Vegetables

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Gardening Nutritious Vegetables

Proceedings of the Vegetable Improvement Gardening Workshop

Bangkok, Thailand and Shanhua, Taiwan, R.O.C.
22-26 April 1985

The Asian Vegetable Research and Development Center
Shanhua, Taiwan, R.O.C.

b

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Contents

1 Schedule

3 FOREWORD

5 THE AVRDC GARDEN PROGRAM: WHAT DOES IT OFFER TO LDCs?

6 The AVRDC Garden Program 1983-84
Jack Gershon, Yen-ching Chen and Jen-fong Kuo

40 Feasibility Studies on the Use of Permanent Composting Beds for Intensive Vegetable Production in Southeast Asian Countries
W. Chris Stearn and Lee-chu Chen

48 New Vegetable Project
Steve S. M. Lin

50 Biological Control of Diamondback Moth in Farmers' Fields
N.S. Talekar

55 STRATEGIES FOR INITIATING COLLABORATIVE GARDEN PROGRAMS IN INDONESIA

56 Home Gardening Activities at the Institut Pertanian Bogor
Edi Guhardja

71 Home Gardening and the Family Improvement Program in Indonesia
Darwin Karyadi

74 Research to Improve Gardening in Indonesia
Subijanto

78 STRATEGIES FOR INITIATING COLLABORATIVE GARDEN PROGRAMS IN THE PHILIPPINES

79 Food Production Through Home Gardening
Florentino S. Solon

85 Home Gardening Research and Development Program in the Philippines
Ruben L. Villareal and Flordeliz D. Tiamzon

93 Characteristics of the Bio-intensive Approach to Small-scale Household Food Production
J.F. Gonsalves

Contents (continued)

100 STRATEGIES FOR INITIATING COLLABORATIVE GARDEN PROGRAMS IN THAILAND

101 Strategies for Initiating Collaborative Efforts for Extending Present AVRDC/Thailand Garden Activities
C. Boonma and Y. Kachonpaduakitti

105 SUMMARY

106 Evaluation of the AVRDC Garden Project in Three Asian Countries
Henry M. Munger

111 Funding of Gardening Activities in LDCs: Thoughts and Suggestions
Jack Gershon

117 DISCUSSION

126 RECOMMENDATIONS FOR AGRICULTURE

130 RECOMMENDATIONS FOR NUTRITION

Vegetable Improvement Gardening Workshop Schedule, Thailand and AVRDC

22-26 April 1985

Monday, April 22, Thailand

0810	Leave for KU/AVRDC pilot project in Bangpae
1000	Arrive at Wangyen village, visit four representative farms where the AVRDC gardens have been introduced
1200	Lunch
1315	Leave for Don Prom village, visit three representative farms
1500	Leave the village for Bangkok
1730	Return to hotel

Tuesday, April 23, Thailand

0800	Breakfast meeting, Poly Rai Rm. (hotel basement), to discuss previous day's visit to pilot project
0930	Leave hotel for a field trip to the Rangsit Central Wholesale Vegetable Market
1200	Lunch
1400	Return to hotel
1400	Free afternoon and evening

Wednesday, April 24, Thailand

Morning	Free
1210	Leave for Bangkok International Airport

Thursday, April 25, AVRDC

0800	Welcome Address by AVRDC Director-General Dr. G. W. Selleck AVRDC slide show
0830	Briefing.....Dr. J. Gershon
0845-1015	The AVRDC Garden Program: What does it offer to LDCs?
	Technology development and transfers..Dr. J. Gershon
	Composting garden.....Dr. C. Stearn
	New crop development.....Dr. S. Lin
	Biological control of insect pests....Dr. N.S. Talekar
1015-1045	Coffee Break
1045-1200	Field visit to the AVRDC gardens and to the AVRDC nutritional biochemistry lab....Drs. J. Gershon, and S. Tsou
1200-1330	Lunch

1330-1500 Strategies for initiating collaborative garden programs in Indonesia.....Drs. Guhardja, Karyadi and Subijanto

1500-1530 Coffee Break

1530-1700 Strategies for initiating collaborative garden programs in the Philippines....Ms. Tiamzon, Drs. Arizala, Gonsalves, Solon, Valmayor, and Villareal.

Friday, April 26, AVRDC

0800 Group photo

0830-1000 Strategies for initiating collaborative efforts for extending present AVRDC/Thailand garden activities.....Drs. Boonma and Kachonpadunkitti

1000-1030 Coffee Break

1030-1200 Preparation by participants' for afternoon session

1200-1330 Lunch

1330-1445 Discussion and recommendations: agriculture. Moderator: Dr. Subijanto

1445-1515 Coffee Break

1515-1630 Discussion and recommendations: nutrition. Moderator: Dr. F. Solon

1630-1645 Closing remarks

Foreword

Malnutrition, especially among the undeveloped and developing countries, is becoming difficult to alleviate despite significant research breakthroughs made in food production. One way to raise the quality of life of the people in these nations is to increase nutritional status and income of the people through research, development, training and extension of school, home, and market garden technologies. One major factor to consider is that nutritional status of a nation is inherently determined by the availability of food and food consumption. Unless adequate food distribution, appropriate food habits and practices, and health protection are promoted, the realization of having a healthy population diminishes.

This publication, Gardening Nutritious Vegetables, is the proceedings of the International Vegetable Improvement Gardening Workshop held in Bangkok, Thailand and Shanhua, Taiwan on 22-26 April 1985. The proceedings contain country reports and detailed strategies for initiating garden programs in Indonesia, Thailand, and the Philippines. It also provides a comprehensive review of the garden programs at the Asian Vegetable Research and Development Center.

These proceedings also indicate the recommendations made by the scientists and nutrition experts who attended the workshop. There were two categories of recommendations made, one for agriculture and the other for nutrition. There was a unanimous agreement that home gardening is a very important component for national growth. There was a strong indication that the national government, especially among the undeveloped and developing countries, should establish and implement programs on home gardening to combat malnutrition.

We would like to acknowledge the financial support of the Agency for International Development, Washington D.C. for sponsoring the workshop. We would also like to express our appreciation to Cheng Lei-sun for his original cover design of this publication.

George A. Marlowe, Jr.

January 1988

GEORGE A. MARLOWE, JR.
Director General

-5-

The AVRDC Garden Program: What Does It Offer to LDCs?

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The AVRDC Garden Program 1983 to 1984

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Nutrition Consultant

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Jen-fong Kou
Research Aid

Summary

The goal of the AVRDC garden program is to do its part in raising the productivity and quality of life of the people in developing countries. One way to achieve the goal is to increase nutritional status and income of the people through research, development, training and extension of school, home, and market garden technologies. For the past three years, AVRDC has been working toward the goal through its nutrition-related garden activities.

A research project developed a 10 x 18 m school garden which can provide 142 children with ½ cup of vegetables per day throughout the school year.

Similarly, it was shown that a 4 x 4 m plot each of Indonesian, Thailand, and Philippine gardens can supply a family of five (two adults and three children) with significant percentages of the recommended dietary allowance of protein, calcium, iron, and Vitamins A and C.

A research on market gardens showed that a 10 x 20 m plot for small farm families can increase family income by approximately 30% on family labor.

Other research activities included a mandate crops garden for the commercial farmer, a dryland garden, an urban garden, and a compost garden.

The garden program is now more solidly phased into the training activities at AVRDC, and international collaboration has carried garden activities to Thailand.

Introduction

The goal of the AVRDC garden program is to do its part in raising the productivity and quality of life of the people in developing countries. One way to achieve the goal is to increase the people's nutritional status and income through research, development, training, and extension of school, home, and market garden technologies. For the past three years, AVRDC has been working toward this goal through its nutrition-related garden activities.

In the first year of the program, we concentrated on finding out which crops will give maximum yield and significant output of selected nutrients. The results were good but often the yields were greater than a family could utilize on a daily basis. The outcome could be that greater inputs would be needed to achieve the unnecessarily large outputs.

In the second year, we slightly reduced the yields to match a family's daily consumption pattern more reasonably. We also fine-tuned some of the garden technologies, such as using screens instead of insecticides to manage pests, growing small but various monocrops to make the gardens less attractive to pests that seek out a large monocrop environment, and increasing the number of crops grown during a season to ensure a ready daily supply to individuals.

In this, the third, year we continued the gardens' technology development, incorporated it into the AVRDC training program, and transferred the technology to Thailand. In Thailand, we conducted in-country garden research at AVRDC's Thailand Outreach Program (AVRDC/TOP), and initiated a socioeconomic study of gardens, as a part of the farming system of a group of small farm families in a village 100 km from Bangkok.

Each year we have added a few more promising crops to the garden activities. In the first year we grew 42 crops; the second year, 52; and in this third year we have slightly increased the number to 57 crops (Table 1). Different crops were grown in the three types of gardens, their selection reflecting the seasonal pattern of the AVRDC environment (Fig. 1).

Table 1. The 57 crops grown in the AVRDC gardens, 1983-84.

Common Name	Scientific Name
Amaranth	*Amaranthus mangostanus*
Basil	*Ocimum basilicum*
Bitter gourd (Balsam pear)	*Momordica Charantia*
Bottle gourd	*Lagenaria siceraria*
Broccoli	*Brassica oleracea* var. italica
Cabbage	*Brassica oleracea* var capitata
Carrot	*Daucus carota* var. sativa
Cassava	*Manihot esculenta*
Cauliflower	*Brassica oleracea* var. botrytis
Celery	*Apium graveolens*
Cherry radish	*Raphanus sativus*
Chinese cabbage	*Brassica campestris* ssp. pekinensis
Chinese leek	*Allium odorum*
Ching-chiang pai-tsai (Spoon cabbage)	*Brassica campestris* var. chinensis
Coriander	*Coriandrum sativum*
Corn	*Zea mays*
Cowpea	*Vigna unguiculata* subsp. unguiculata

Table 1. Continued.

Common Name	Scientific Name
Cucumber	Cucumis sativus
Eggplant	Solanum melongena
Garland chrysanthemum (Crowndaisy)	Chrysanthemum coronarium
Garlic	Allium sativum
Ginger	Zingiber officinale
Hot pepper (Bird chillies, Cherry capsicum)	Capsicum frutescens
Hyacinth bean	Dolichos lablab
Ipil-ipil	Leucaena leucocephala
Kale	Brassica oleracea var. acephala
Kang kong (Water convolvulus)	Ipomoea aquatica
Kohlrabi	Brassica oleracea var. gongylodes
Leaf beet	Beta vulgaris
Lemon grass (Citronella grass, Geronium grass	Cymbopogon citratus
Lettuce	Lactuca sativa
Malunggay	Moringa oleifera
Mango	Mangifera indica
Mungbean	Vigna radiata
Mustard	Brassica juncea
Okra	Hibiscus esculentus
Pai-tsai	Brassica campestris chinensis
Papaya	Carica papaya
Peanut	Arachis hypogaea
Pumpkin	Cucurbita moschata
Radish	Raphanus sativus
Rape green	Brassica napus
Shallot	Allium ascalonicum
Snake gourd	Trichosanthes cucumerina
Snap bean	Phaseolus vulgaris
Snow pea	Pisum sativum
Spinach	Spinacia oleracea
Sponge gourd	Luffa cylindrica
Sweet corn	Zea mays L.
Sweet pepper	Capsicum annuum
Sweet potato tips (leaves)	Ipomoea batatas
Taro	Colocasia esculenta
Tomato	Lycopersicon esculentum
Vegetable soybean	Glycine max.
Welsh onion	Allium fistulosum
Winged bean	Psophocarpus tetragonolobus
Yard-long bean (asparagus bean, pea bean)	Vigna unguiculata var. sesquipedalis

School Garden

Schoolchildren need energy food and body-building protein foods to meet the demands of their growing bodies. In addition,

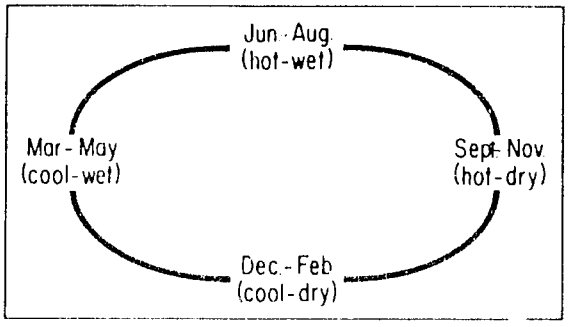

Figure 1.
Seasonal pattern of AVRDC gardens, Taiwan.

they require vitamins and minerals which vegetables can provide. A small amount of cooked vegetables added to the rice in the lunch boxes that many children bring to school throughout Southeast Asia could significantly contribute to a child's daily needs for certain vitamins and minerals.

The objective of this project is to develop a garden that can be grown at school to provide ½ cup (approximately 113 g edible portion) of nutritious vegetables to a minimum of 100 children, five days per week, during a school year.

Materials and Methods

Four "seasonal" gardens were planted, from December 1983 to November 1984, in a 10 x 18 m plot consisting of twelve raised beds (10 x 1.5 m, 24 cm high). A commercial basal fertilizer was applied when the beds were constructed and compost was applied thereafter throughout the year. The choice of vegetables grown was based on seasonal adaptability, cultural acceptability, and nutritional value. Low-input agricultural procedures were practiced, with minimum use of pesticides. Where possible, hand weeding and manual pest control were practiced. Screening was also used over the beds to control airborne insects during the early stages of crop growth.

Edible yield was recorded for each vegetable in each planting period. The vegetables were also analyzed for their content of protein, calcium, iron, and Vitamins A and C. The contribution that ½ cup of vegetables would make to the daily recommended dietary allowance (RDA) of an average 10-year-old schoolchild was also calculated.

Results

The yield and nutritional composition of vegetables in the four seasonal school gardens are shown in Tables 2 to 5. During the complete year the school garden produced an average of 16.09 kg of nutritious, culturally acceptable vegetables per day. Significant amounts of protein, iron, calcium, and Vitamins A and C were contained in the 16.09 kg (Table 6).

The ½ cup portion can contribute significantly to the daily diet of a ten-year-old schoolchild, especially in iron and Vitamins A and C (Table 7).

Conclusion

A 10 x 18 m school garden can provide 142 children with ½ cup of vegetables per day. Garden size can be expanded or reduced to better reflect a school population size. During long school vacations, the gardens can be turned into food for the community, or their harvests can be sold and turned into income for the school.

Home Garden

Vegetables, especially the green leafy types, contain nutrients (e.g., protein, calcium, iron, and Vitamin A) that are lacking in the diets of many people in Southeast Asia and other parts of the world. If small-farm families can be shown how to grow home gardens containing recognizable and nutritious crops, the outputs from these gardens can make a significant contribution towards alleviating their nutritional problems. The objective of this project was to develop small home gardens that contain an intercrop of nutritious vegetables (and a few fruits) which are culturally acceptable in Southeast Asia, and that can provide a family of five (two adults and three children) with reasonable percentages of their RDA of calcium, iron, Vitamins A and C, plus measurable amounts of protein. The protein yield from the gardens was not expected to be high, but the protein quality from dark-green leafy vegetables is good and it should be recorded.

Home gardens have been developed at AVRDC for Indonesia, the Philippines, and Thailand. A Vitamin A garden has been developed to demonstrate the amount of this nutrient (deficient in many Southeast Asian diets) that can be produced in a small garden of culturally acceptable plants. An urban home garden was also initiated this year in response to trends toward urbanization in developing countries.

Materials and Methods

In the Indonesia, Thailand, Philippines and Vitamin A gardens, a culturally acceptable intercrop of vegetables and a few fruits was planted in 4 x 4.5 m plots consisting of three raised beds (4 x 1.5 m, 25 cm high) per plot. Herbs and spices (e.g., coriander, lemon grass, garlic, shallot, hot pepper, ginger) were planted around the edges of garden beds. As with the school garden, each type of home garden was planted four

times during the year in response to the slight seasonal changes in the AVRDC environment.

A smaller selection of crops was planted in the urban home garden. The crops were planted in eight wooden boxes, 115 cm x 35 cm x 15 cm. The area of each box was 0.4 m^2 or a total of 3.2 m^2. Boxes were stacked in step-wise fashion on a metal frame to receive equal and maximum sunlight. Crops were replanted after each harvest, with each box planted five to eight times during the year. Compost was used as the main source of fertilizer, with small amounts of chemical fertilizer added to make up the nutrient losses in the small amounts of soil used in the boxes.

Low-input agricultural management was practiced in all gardens, such as hand-weeding, manual insect removal, rice-straw mulch, and plastic screening over beds or boxes during the early growth stages to protect the crops from insect damage.

During the seasonal growing periods, data were collected on the yield of each crop in each garden. Samples of each crop were analyzed for content of the five selected nutrients - protein, calcium, iron, and Vitamins A and C. The RDA for a family of five was obtained from literature (Table 8); and from these data, the percentage of the RDA available for a family of five was determined from each crop and for each garden.

Results

The yield and nutritional composition of the crops grown in representative seasonal gardens are shown for the Indonesia (Tables 9 to 12), Thailand (Tables 13 to 16), Philippines (Tables 17 to 20), and the Vitamin A gardens (Tables 21 to 24). The four-season mean contribution of each type of garden is summarized in Table 25. The output of all of the gardens in all seasons was good this year. Daily harvests were kept between 0.8 and 1.0 kg per day, resulting in more uniform nutritional outputs during the year. Normally low yields during the hot and wet seasons were raised by increasing the variety of crops grown during the period.

The yield and nutritional output of the crops grown throughout the year in the urban home garden are summarized in Table 26. The garden produced an average of 0.24 kg per day of nutritious vegetables, with something to harvest 326 times during the year. The nutritional contribution to the RDA of a family of five was not particularly high in any nutrient, except in Vitamin C.

Conclusion

The yields and nutritional outputs reflect the value of a small 4 x 4 m garden to a family of five in a developing coun-

try. These gardens have consistently produced an impressive amount of selected nutrients necessary for human beings. If these nutrients are normally lacking in the diets of some people, then gardens of this type can help alleviate certain nutritional problems that often result in poor health and low individual productivity.

The yield and nutritional output of the urban home garden was comparatively low. However, there can be 326 harvests during a year from the 3.2 m^2 area. Therefore, crop choice was good, but in the future we might have to make the area larger by increasing the number or the size of the boxes in which the crops are grown.

Market Garden

The objective of the market garden is to increase the income of small-farm families in developing countries (households earning between US $500 and $1,000 per year) by approximately 30%, by developing small income-generating market gardens. These gardens are designed to grow vegetable crops that are in demand at local markets and that can be sold by family members who have no other opportunity for employment.

Materials and Methods

Surveys were first conducted at local markets to find out which vegetables in the coming months would be low in supply and high in demand, and could, therefore, command a good price. The most promising of these vegetables were grown in a 10 x 20 m plot consisting of 13 raised beds (10 x 1.5 m, 25 cm high). Standard commercial cultural practices were followed, with commercial fertilizers and pesticides being used as needed. Seeds were purchased from commercial companies. At harvest time the vegetables were sold wholesale at local markets. The yield of each vegetable in each seasonal garden, the corresponding wholesale market price, and the gross monetary returns per kilo were recorded for the year (Tables 27 to 30).

Results

A summary of all four seasonal gardens (Table 31) shows that the garden produced 2,012 kg of market-quality vegetables. These sold at the wholesale market for NT$ 16,818 (US$ 425). Deducting cash costs (seeds, fertilizer, and pesticide) of NT$ 1,618 (US$ 41), the market garden made a net profit of NT$ 15,200 (US$ 385). Labor costs were not included under the assumption that unemployed household members will do the labor.

Conclusion

The market garden demonstrated that it could increase the annual net income of a small-farm family by more than 30%. This

percentage could be increased by selling the produce directly to the consumer, instead of to wholesalers as in the case of the AVRDC demonstration market garden.

This type of garden is of value in developing countries where the availability of vegetables at local markets is low, where there is a rural labor pool without jobs, where there exist certain malnutrition problems, and where governments are attempting to plan and implement income-generating projects in rural areas.

Training at AVRDC

This year the garden program was more solidly phased into the training activities at AVRDC in the five-month vegetable crop-production course, in a special two-week course in gardening, and in short-term special purpose training.

The linkage between agriculture and human nutrition was taught to training scholars in the five-month course. One of the scholars from Sri Lanka specialized in home and seed gardens for his field project. He is now back in Sri Lanka introducing the garden approach to solving nutritional problems.

In the two-week course sponsored by the German Agency for Technical Cooperation (CTZ), 14 participants from Asian and African developing countries and their West German counterparts were given firsthand experience in nutrition-related garden design, implementation, harvesting, and food preparation. In-country follow-up activities are being planned for 1985 in collaboration with AVRDC's new outreach program in Indonesia.

A Thai graduate student was brought to AVRDC for special purpose training in the AVRDC gardening technologies. She is now in Thailand introducing AVRDC-type gardens to small-farm families in an AVRDC/Kasetsart University project.

New Gardens

A garden of mandate crops was added this year to take advantage of some of the least utilized planting materials of the AVRDC mandate crops. The target population for AVRDC's crops is mainly the commercial farmer, who might require the most utilized varieties of the mandate crops, such as uniform-maturing tomatoes, large-headed Chinese cabbage, sweet potato and mungbean for starch production, and soybean for processing. However, for gardens and home consumption, there are different requirements, such as indeterminate varieties of tomato, small-headed open-pollinated Chinese cabbage, vegetable soybean, sweet potato for nutritious leaf production, and mungbean for sprouts

in the hot, wet season. The Mandate Crops Garden will be used for demonstration and for screening purposes.

Work was also started this year on a dryland garden, subjecting all 52 garden crops to water-stress to find any that are tolerant to semi-arid conditions, such as those found on the island of Madura, in Indonesia. This garden has not been successful. Few crops have produced reasonable yields or have even survived.

This year Dr. Chris Stearn AVRDC microbiologist, initiated a composting garden in the gardening research plots. This garden has a number of attractions, one of them that of being a potentially better dryland garden than the one we have. The unique design of the composting garden allows for a minimum use of water, perhaps as little as 50% of what is normally required. If this proves to be the case the composting garden will take the place of present dryland garden activities and be further researched.

International Collaboration

Supported by funds from the Asia Bureau, USAID, the AVRDC gardening technologies were transferred to Thailand. Gardens were planted at AVRDC/TOP for in-country research. The gardens were also used by agricultural economists at Kasetsart University to test an evaluation methodology (Farming/Family Living Systems, or F/FLS) prior to using it in an AVRDC/Kasetsart University pilot project.

The pilot project at Bangpae, 100 km southwest of Bangkok, will assess the value of gardens in small-farm family farming systems. During 1984 the F/FLS methodology was tested at AVRDC/TOP, modified for Thailand conditions, and baseline data taken on 28 small-farm families. A student from the Horticultural Department of Kasetsart University was then brought to AVRDC for a short-term overview of the AVRDC gardens. The student is now back in Thailand working at the pilot project, introducing AVRDC-type gardens to cooperating families. This is all part of a socioeconomic study to assess the value of the gardens to the well-being of farm families. A report on the first six months of activities is in the AVRDC library and at AID-Washington. The pilot project will continue until December 1985. The gardens earlier established by the project at AVRDC/TOP are now being used in the AVRDC/TOP training program.

Conclusion/Comments

The garden activities have been ongoing at AVRDC for three years. Their efficacy has been established and in-country

feasibility research has been initiated in Thailand. The garden program is also now a part of the training activities at AVRDC. In addition, the gardens serve as demonstration plots to promote vegetables to the thousands of visitors who come to AVRDC each year.

Pending approval by the Board of Directors, Nutrition, Environment and Management, of which the garden program is a part, will be changed to Production Systems. Perhaps the garden activities should then be altered to reflect the new objectives of this new group.

With the expansion of AVRDC outreach activities to Indonesia, Malaysia, and Latin America, there should be some thought given toward incorporating nutrition-related gardening outreach into the plans of those nations that have nutrition as a priority in their five-year national development plans. If the Board of Directors agrees with this approach, then AVRDC should begin to look for outside funding sources to support the activities. Based on our Thailand experience, it is suggested that funding be sought for projects that run for a minimum of three to five years.

Table 2. Yield and nutrient contribution of school garden I, December 1983 to February 1984, AVRDC.

Crop	Times Harvested	Edible Yield (kg)	Edible Yield/Day (kg)	Nutrient Yield/Day				
				Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (μg,RE)	Vitamin C (mg)
Garland chrysanthemum	22	125.90	1.94	29.10	52.40	1474.40	8497.20	327.90
Spinach	9	101.70	1.57	40.80	47.10	1428.70	8525.10	648.40
Garlic	2	.29	.004	.10	.10	4.50	4.60	1.30
Cauliflower	3	26.88	.41	10.70	4.50	155.80	25.00	207.90
Pai-tsai	15	125.40	1.93	34.70	92.60	2856.40	3435.40	1428.20
Ching chiang	6	148.20	2.28	57.00	77.50	4742.40	9074.40	1954.00
Rape green	11	100.40	1.55	32.60	89.90	2232.00	6401.50	742.50
Mustard	6	189.90	2.92	70.10	58.40	5197.60	9198.00	3328.80
Kale	8	51.40	.79	19.00	26.10	1840.70	1975.00	908.50
Radish	2	41.80	.64	6.40	2.60	172.80	-	268.80
Coriander	5	4.44	.07	1.30	1.20	95.10	124.80	37.40
Shallot	25	144.13	2.22	46.60	44.40	2308.80	2841.60	290.80
Eggplant	13	33.33	.51	7.14	3.57	30.60	42.30	60.18
Mustard	10	199.30	3.07	73.70	61.40	5464.60	9670.50	3499.80
Sweet pepper	5	7.10	.11	1.43	.99	13.20	320.76	113.30
Lettuce	12	55.00	.85	14.45	57.80	782.00	3799.50	204.00
Welsh onion	9	42.40	.65	9.56	8.26	560.37	2101.45	250.90
Celery	8	68.90	1.06	5.72	12.83	816.62	140.98	179.88
Total	171	1466.47	22.574	460.40	641.65	30176.59	66178.09	14452.56

Table 3. Yield and nutrient contribution of school garden II, March to May 1984, AVRDC.

Crop	Times Harvested	Edible Yield (kg)	Edible Yield/Day (kg)	Nutrient Yield/Day				
				Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (ug,RE)	Vitamin C (mg)
Ching chiang	10	110.50	1.67	41.75	56.78	3473.60	6646.60	1431.19
Shallot	14	55.00	.83	17.43	16.60	863.20	1062.40	108.73
Pai-tsai	15	201.40	3.05	54.90	146.40	4514.00	5429.00	2257.00
Celery	5	89.20	1.35	7.29	16.34	1040.04	179.55	229.10
Garland chrysanthemum	5	57.50	.87	13.05	23.49	661.20	3810.60	147.03
Rape green	4	38.00	.58	12.18	33.64	835.20	2395.40	277.82
Lettuce	19	112.70	1.71	29.07	116.28	1573.20	7643.70	410.40
Mustard	7	64.40	.98	23.52	19.60	1744.40	3087.00	1117.20
Kale	2	2.80	.04	.96	1.32	93.20	100.00	46.00
Spinach	4	38.90	.59	15.34	17.70	536.90	3203.70	243.67
Garlic	45	45.90	.70	16.80	14.00	784.00	798.00	227.50
Amaranth	11	68.80	1.04	31.20	48.88	3026.40	2839.20	551.20
Kang kong	17	163.00	2.47	74.10	148.20	2865.20	8076.90	1185.60
Vegetable soybean	4	13.30	.20	29.34	10.24	31.24	76.60	32.64
Broccoli	8	22.70	.34	10.20	2.72	119.00	792.20	168.64
Yard-long bean	1	1.00	.02	.56	.36	10.20	6.66	5.60
Okra	2	.65	.01	.18	.10	9.00	2.33	1.80
Corn	2	19.30	.29	12.18	2.61	14.50	-	23.20
Total	175	1105.05	16.74	390.05	675.26	22194.48	46149.84	8464.32

Table 4. Yield and nutrient contribution of school garden III, June to August 1984, AVRDC.

Crop	Times Harvested	Edible Yield (kg)	Edible Yield/Day (kg)	Nutrient Yield/Day				
				Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (μg,RE)	Vitamin C (mg)
Kang kong	28	307.20	4.66	139.80	279.60	5405.60	15238.20	2236.80
Amaranth	22	143.70	2.18	65.40	102.46	6343.80	5951.40	1155.40
Shallot	5	16.30	.25	5.25	5.00	260.00	320.00	32.75
Okra	40	14.65	.22	3.96	2.20	198.00	51.26	39.60
Lettuce	2	8.50	.13	2.21	8.84	119.60	581.10	31.20
Pai-tsai	32	84.66	1.28	23.04	61.44	1894.40	2278.40	947.20
Cucumber	11	40.10	.61	2.44	1.83	85.40	15.25	42.09
Kale	1	.80	.01	.24	.33	23.30	25.00	11.50
Ching chiang	16	58.36	.88	22.00	29.92	1830.40	3502.40	754.16
Rape green	19	65.20	.99	20.79	57.42	1425.60	4088.70	474.21
Mustard	24	72.05	1.09	26.16	21.80	1940.20	3433.50	1242.60
Cauliflower	4	15.30	.23	5.98	2.53	87.40	15.41	116.61
Carrot	4	23.80	.36	3.60	7.56	129.60	5857.20	37.08
Broccoli	2	9.10	.14	4.20	1.12	49.00	326.20	69.44
Chinese cabbage	1	10.20	.16	2.72	4.16	163.20	614.67	84.80
Yard-long bean	4	21.50	.33	9.24	5.94	168.30	109.89	92.40
Total	215	891.42	13.52	337.03	592.15	20123.80	42408.58	7367.84

Table 5. Yield and nutrient contribution of school garden IV, September to November 1984, AVRDC.

Crop	Times Harvested	Edible Yield (kg)	Edible Yield/Day (kg)	Nutrient Yield/Day				
				Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (μg,RE)	Vitamin C (mg)
Kang kong	17	148.00	2.26	68.40	136.80	2644.80	7455.60	1094.40
Okra	8	6.13	.09	1.62	.90	81.00	20.97	16.20
Mustard	16	96.60	1.49	35.76	29.80	2652.20	4693.50	1598.60
Yard-long bean	16	9.16	.14	3.92	2.52	71.40	46.62	39.20
Ching chiang	18	82.50	1.27	31.75	43.18	2641.60	5054.60	1088.39
Broccoli	21	28.02	.43	12.90	3.44	150.50	1001.90	213.28
Pai-tsai	31	125.50	1.93	34.74	92.64	2856.40	3435.40	1428.20
Cucumber	6	12.00	.19	.76	.57	26.60	4.75	13.11
Rape green	23	101.80	1.57	32.97	91.06	2260.80	6484.10	752.03
Shallot	2	2.60	.04	.84	.80	41.60	51.20	5.24
Garlic	2	.90	.01	.24	.20	11.20	11.40	3.25
Kale	9	38.10	.59	14.16	19.47	1374.70	1475.00	678.50
Amaranth	12	41.60	.64	19.20	30.08	1862.40	1747.20	339.20
Hyacinth bean	4	1.08	.02	42.10	25.90	464.40	-	75.60
Vegetable soybean	4	12.80	.20	29.34	10.24	31.24	76.60	32.64
Chinese cabbage	6	25.80	.40	6.80	10.40	408.00	1536.68	212.00
Garland chrysanthemum	3	12.30	.19	2.85	5.13	144.40	832.20	32.11
Spinach	1	1.90	.03	.78	.90	27.30	162.90	12.39
Total	199	746.79	11.51	339.13	504.03	17750.54	34090.62	7734.34

Table 6. Contribution in selected nutrients of the AVRDC school garden, December 1983 through November 1984.

	Edible Yield/Day (kg)	Nutrient Yield/Day				
		Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (ug,RE)	Vitamin C (mg)
Garden I	22.57	460.40	461.65	30176.59	66178.09	14452.56
Garden II	16.74	390.05	675.26	22194.48	46149.84	8464.32
Garden III	13.52	337.03	592.15	20123.80	42408.53	7367.84
Garden IV	11.51	339.13	504.03	17750.54	34090.62	7734.34
Average	16.09	381.65	603.37	18033.85	47206.78	9504.77

Table 7. Percentage of a 10-year-old child's RDA contained in ½ cup (113 g) of garden vegetables.[a]

	Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (µg,RE)	Vitamin C (mg)
RDA for a 10-year-old	38.00	650.00	7.00	575.00	20.00
Contents in ½ cup vegetables	3.23	192.17	6.16	333.23	57.00
Contribution in ½ cup to the RDA of a 10-year-old (%)	8.50	29.56	88.00	57.95	285.00

[a] RDA = Recommended Dietary Allowance.

Source: Food and Agriculture Organization. 1974. Handbook on Human Nutritional Requirements. FAO, Rome.

During the 1983-84 year the school garden produced 16.09 kg vegetables per day. This translates to 142 ½ cup servings.

Table 8. Recommended dietary allowance (RDA) for a family of five (two adults and three children, ages 1 to 12)[a].

	Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (µg,RE)	Vitamin C (mg)
Father	37	450	7	750	30
Pregnant mother	38	1100	21	750	50
Child (ages 1 to 3)	16	450	7	250	20
Child (ages 4 to 6)	20	450	7	300	20
Child (ages 10 to 12)	38	650	7	575	20
Total	149	3100	49	2625	140

[a] Source: Food and Agriculture Organization. 1974. Handbook on Human Nutritional Requirements. FAO, Rome.

Table 9. Yield and nutrient contribution of Indonesia home garden I, December 1983 to February 1984, AVRDC.

Plot	Crop	Growing Period (days)	Edible Yield (kg)	Edible Yield/Day (kg)	Times Harvested	Nutrient Yield/Day: Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (ugRE)	Vitamin C (mg)
1	Chinese leek	91	1.75	.019	8	.57	.41	16.53	82.27	6.65
2	Pai-tsai	88	17.18	.189	27	3.40	9.07	279.72	336.42	139.86
	Rape green	38	.72	.008	1	.16	.46	11.52	33.04	3.83
3	Kale	86	6.18	.068	11	1.63	2.24	158.44	170.00	78.20
	Mustard	43	2.06	.023	3	.55	.46	40.94	72.45	26.22
4	Mustard	75	12.82	.141	27	3.38	2.82	260.98	444.15	160.74
	Mustard	55	1.07	.012	2	.28	.24	21.36	37.80	13.68
5	Lettuce	65	3.31	.036	7	.61	2.44	33.12	160.92	8.64
	Amaranth	16	1.68	.018	3	.54	.84	52.38	49.14	9.54
	Radish	51	.94	.010	2	.10	.04	2.70	-	4.20
	Shallot	91	3.08	.034	7	.71	.68	35.36	42.52	4.45
	Garlic	91	1.32	.015	4	.36	.30	16.80	17.10	4.87
6	Ching Chiang	91	20.31	.223	27	5.57	7.58	463.84	887.54	191.11
7	Garland chrysanthemum	78	8.82	.097	12	1.45	2.61	73.72	424.86	16.39
	Radish	8	2.59	.028	2	.28	.11	7.56	-	11.76
	Mustard	59	2.16	.024	4	.57	.48	42.72	75.60	27.36
8	Kang kong	7	1.23	.014	2	.42	.84	16.24	45.78	6.72
	Spinach	71	4.28	.047	8	1.22	1.41	42.77	255.21	19.41
9	Chinese cabbage	15	4.24	.047	6	.79	1.22	47.94	180.55	24.91
	Rape green	52	5.02	.055	7	1.15	3.19	79.20	227.15	26.34
	Celery	76	.39	.004	1	.02	.04	3.08	5.32	.67
Fence										
	Cassava	91	.23	.003	1	.06	.33	4.53	6.36	1.11
	Tomato	91	.16	.002	1	.02	.03	2.71	3.56	1.06
Total			102.27	1.125	177	23.93	37.89	1707.59	3573.98	790.04
RDA for a family of five						149.00	49.00	3100.00	2625.00	140.00
RDA contributed by garden (%)						16.06	77.33	55.08	136.15	564.31

Table 10. Yield and nutrient contribution of Indonesia home garden II, March to May 1984, AVRDC.

Plot	Crop	Growing Period (days)	Edible Yield (kg)	Edible Yield/Day (kg)	Times Harvested	Nutrient Yield/Day Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (µgRE)	Vitamin C (mg)
1	Chinese leek	92	4.97	.054	8	1.62	1.19	46.98	233.82	18.90
2	Rape green	92	3.51	.038	5	.80	2.20	54.72	156.94	18.20
	Spinach	40	1.63	.018	2	.47	.54	16.38	97.74	7.43
	Lettuce	35	1.37	.015	1	.26	1.02	13.80	67.05	3.60
	Amaranth	58	2.14	.023	3	.69	1.08	66.93	62.79	12.19
3	Kang kong	92	6.90	.075	10	2.25	4.50	87.00	245.25	36.00
4	Mustard	15	.31	.003	1	.07	.06	5.34	9.45	3.42
	Leaf beet	33	3.53	.038	5	.91	.76	67.64	119.70	43.32
	Kale	77	2.18	.024	2	.58	.80	55.92	60.00	27.60
5	Pai-tsai	56	6.27	.068	7	1.22	3.26	100.64	121.04	50.32
	Lettuce	39	2.71	.029	4	.49	1.97	26.68	129.63	6.96
6	Ching chiang	36	5.25	.057	8	1.43	1.94	118.56	226.86	48.85
	Yard-long bean	84	2.35	.026	5	.73	.47	13.26	8.66	7.29
	Lettuce	51	2.74	.030	4	.51	2.04	27.60	134.10	7.20
7	Ching chiang	64	5.23	.057	6	1.43	1.94	118.56	226.86	48.35
	Kang kong	56	1.92	.021	3	.63	1.26	24.36	68.67	10.08
8	Spinach	14	3.84	.042	6	1.09	1.26	38.22	228.06	17.35
	Celery	64	3.28	.036	3	.19	.44	27.73	4.79	6.11
	Mustard	59	2.98	.032	5	.77	.64	56.96	100.80	36.48
9	Pai-tsai	19	3.70	.040	2	.72	1.92	59.20	71.20	29.60
	Celery	5	3.13	.034	5	.18	.41	26.19	4.52	5.77
	Cherry radish	74	1.90	.021	7	.21	.08	5.67	-	8.82
Fence										
	Tomato	92	1.22	.013	4	.12	.07	2.21	14.43	3.04
	Cassava	92	5.39	.059	7	1.30	6.49	89.09	125.08	22.00
	Ginger	92	.14	.002	1	.03	.03	.38	.18	.08
Total			78.59	.855	114	18.70	36.37	1150.02	2517.62	479.45
RDA for a family of five						149.00	49.00	3100.00	2625.00	140.00
RDA contributed by garder (%)						12.55	74.22	37.10	95.91	342.46

Table 11. Yield and nutrient contribution of Indonesia home garden III, June to August 1984, AVRDC.

Plot	Crop	Growing Period (days)	Edible Yield (kg)	Edible Yield/Day (kg)	Times Harvested	Nutrient Yield/Day Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (μgRE)	Vitamin C (mg)
1	Chinese leek	92	3.68	.040	11	1.20	.88	34.80	173.20	14.00
	Chinese leek flower	92	.58	.006	2	.15	.13	1.52	12.20	2.21
2	Amaranth	20	1.54	.017	3	.51	.60	49.47	46.41	9.01
	Kang kong	67	4.85	.053	6	1.59	3.18	61.48	173.31	25.44
3	Kang kong	21	1.48	.016	3	.48	.96	18.56	52.32	7.68
	Amaranth	56	1.78	.019	4	.57	.89	55.29	51.87	10.07
4	Kale	7	.79	.009	1	.22	.30	20.97	22.50	10.35
	Pai-tsai	58	3.26	.035	5	.63	1.68	51.80	62.30	25.90
	Rape green	32	.21	.002	1	.04	.12	2.68	8.26	.96
5	Lettuce	1	.72	.008	1	.14	.54	7.36	35.76	1.92
	Rape green	62	4.27	.046	6	.97	2.67	66.34	189.98	22.03
6	Yard-long bean	5	.24	.003	1	.08	.05	1.53	1.00	.84
	Welsh onion	87	6.17	.067	11	.98	.85	57.76	216.61	25.86
7	Kang kong	27	2.36	.026	4	.78	1.56	30.16	85.02	12.48
8	Rape green	32	1.25	.014	4	.29	.81	20.16	57.82	6.71
	Mustard	17	.54	.006	1	.14	.12	10.68	18.90	6.84
	Pai-tsai	55	1.61	.018	3	.32	.86	26.64	32.04	13.32
9	Pai-tsai	46	.95	.010	3	.18	.48	14.80	17.80	17.40
	Rape green	71	1.80	.020	4	.42	1.16	28.80	82.60	9.58
Fence										
	Cassava	92	22.53	.245	38	5.39	26.95	369.95	519.40	91.39
	Shallot	92	.81	.009	1	.19	.18	9.36	11.52	1.18
	Bottle gourd	92	1.79	.019	2	.11	.03	7.47	7.09	1.60
	Onion	92	1.30	.014	1	.21	.18	12.07	45.26	5.40
Total			64.52	.702	116	15.59	45.38	959.75	1923.17	312.17
RDA for a family of five						149.00	49.00	3100.00	2625.00	140.00
RDA contributed by garden (%)						10.46	92.61	30.96	73.26	222.98

Table 12. Yield and nutrient contribution of Indonesia home garden IV, September to November 1984, AVRDC.

Plot	Crop	Growing Period (days)	Edible Yield (kg)	Edible Yield/Day (kg)	Times Harvested	Nutrient Yield/Day Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (µgRE)	Vitamin C (mg)
1	Chinese leek	70	2.22	.024	5	.72	.53	20.88	103.92	8.40
	Chinese leek flower	70	.66	.007	4	.18	.15	1.78	14.23	2.58
	Kale	66	1.70	.019	3	.46	.63	44.27	47.50	21.85
2	Amaranth	45	1.38	.015	3	.45	.71	43.65	40.95	7.95
	Chinese cabbage	49	1.87	.021	3	.36	.55	21.42	80.68	11.13
3	Pai-tsai	35	1.48	.016	3	.29	.77	23.68	28.48	11.84
	Rape green	50	1.68	.019	3	.40	1.10	27.36	78.47	9.10
4	Rape green	31	2.62	.029	5	.61	1.68	41.76	119.77	13.89
	Mustard	71	5.49	.060	7	1.44	1.20	106.80	189.00	68.40
5	Mustard	21	4.02	.044	7	.106	.88	78.32	138.60	50.16
	Pai-tsai	49	3.58	.039	4	.70	1.37	57.72	69.42	28.86
	Ching chiang	40	3.01	.033	4	.83	1.12	66.64	131.34	28.28
6	Kang kong	56	5.73	.063	10	1.89	3.78	73.08	206.01	30.24
	Lettuce	59	2.30	.025	5	.43	1.70	23.00	111.75	6.00
7	Kale	13	1.43	.016	3	.38	.53	37.28	40.00	18.40
	Rape green	38	1.00	.011	2	.23	.64	15.84	45.43	5.27
8	Mustard	63	6.95	.076	11	1.82	1.52	135.28	239.40	86.64
	Rape green	43	.51	.006	1	.13	.35	8.64	24.78	2.87
9	Amaranth	40	.82	.009	3	.27	.42	26.19	24.57	4.77
	Pai-tsai	36	.65	.007	1	.13	.34	10.36	12.46	5.18
	Yard-long bean	71	1.84	.020	7	.56	.36	10.20	6.66	5.60
Fence										
	Yard-long bean	85	5.92	.065	16	1.82	1.17	33.15	21.65	18.20
	Cassava	91	.89	.010	2	.22	1.10	15.10	21.20	3.73
	Bottle gourd	91	41.87	.460	28	2.62	.64	180.78	171.58	33.73
	Taro (tuber)	91	.94	.010	2	.22	.12	3.40	-	.80
	Taro (leaf stalk)	91	.25	.003	2	.02	.03	1.47	.90	.39
Total			100.81	1.107	144	18.24	23.89	1110.05	1968.75	489.26
RDA for a family of five						149.00	49.00	3100.00	2625.00	140.00
RDA contributed by garden (%)						12.24	48.76	35.81	75.00	349.47

Table 13. Yield and nutrient contribution of Thailand home garden I, December 1983 to February 1984, AVRDC.

Plot	Crop	Growing Period (days)	Edible Yield (kg)	Edible Yield/Day (kg)	Times Harvested	Nutrient Yield/Day Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (μgRE)	Vitamin C (mg)
1	Lemon grass	91	.23	.003	1	.05	.14	3.49	4.20	.63
	Garland chrysanthemum	91	3.36	.037	7	.56	1.00	28.12	162.06	6.25
2	Lettuce	21	2.39	.026	7	.44	1.77	23.92	116.22	6.24
	Pai-tsai	82	9.19	.101	14	1.82	4.65	149.48	179.78	74.74
	Mustard	75	.64	.007	2	.17	.14	12.46	22.05	7.98
3	Kale	91	5.98	.066	11	1.58	2.18	153.78	165.00	75.90
	Mustard	75	1.48	.016	2	.38	.32	28.48	50.40	18.24
	Shallot	91	2.49	.027	4	.57	.54	28.08	34.56	3.54
4	Mustard	71	11.74	.129	21	3.10	2.38	229.62	406.35	147.06
	Shallot	91	1.72	.019	3	.40	.38	19.76	24.32	2.49
	Mustard	75	.62	.007	1	.17	.14	12.46	22.05	7.98
5	Lettuce	70	7.10	.078	15	1.33	5.30	71.76	348.66	18.72
	Shallot	91	5.33	.059	9	1.24	1.18	61.36	75.52	7.73
	Garlic	91	1.47	.016	5	.38	.32	17.92	18.24	5.20
6	Ching chiang	85	24.48	.269	23	6.73	9.15	559.52	1070.62	230.53
7	Radish	15	5.96	.065	6	.39	.45	11.79	6.83	11.17
	Garland chrysanthemum	76	3.62	.040	8	.60	1.08	30.40	175.20	6.76
	Celery	71	.77	.008	2	.04	.10	6.16	1.06	1.36
8	Kang kong	12	1.33	.015	4	.45	.90	17.40	49.05	7.20
	Spinach	89	4.16	.046	6	1.20	1.38	41.86	249.78	19.00
	Shallot		1.61	.018	2	.38	.36	18.72	23.04	2.36
9	Lettuce	16	4.29	.047	8	.80	3.20	43.24	210.09	11.28
	Coriander	9	.17	.002	1	.04	.10	1.57	10.57	1.67
	Rape green	50	4.16	.046	6	1.00	2.67	66.24	189.98	22.03
	Shallot		1.73	.019	2	.40	.38	19.76	24.32	2.49
Fence										
	Tomato	91	7.51	.083	19	.75	.42	14.11	92.13	19.42
	Ipil-ipil	91	1.07	.012	3	.80	.87	6.68	84.96	6.07
	Cucumber	91	.91	.010	2	.04	.03	1.40	.25	.69
	Ginger		.36	.004	1	.06	.05	.76	.37	.16
	Snap bean		.06	.001	1	.03	.01	.30	.30	.28
Total			115.93	1.276	196	25.90	39.11	1680.60	3817.56	625.17
RDA for a family of five						149.00	49.00	3100.00	2625.00	140.00
RDA contributed by garden (%)						17.38	79.82	54.20	145.43	446.55

Table 14. Yield and nutrient contribution of Thailand home garden II, March to May 1984, AVRDC.

Plot	Crop	Growing Period (days)	Edible Yield (kg)	Edible Yield/Day (kg)	Times Harvested	Nutrient Yield/Day Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (μgRE)	Vitamin C (mg)
1	Lemon grass	92	6.19	.067	9	1.18	3.09	78.01	93.80	13.99
	Garland chrysanthemum	34	2.18	.024	3	.36	.65	18.24	105.12	4.06
	Kang kong	58	1.36	.016	1	.45	.90	17.40	49.05	7.20
2	Rape green	30	2.85	.031	3	.65	1.80	44.64	128.03	14.85
	Lettuce	46	3.12	.034	3	.58	2.31	31.28	151.98	8.16
3	Kale	5	.58	.006	1	.14	.20	13.98	15.00	6.90
	Lettuce	77	5.70	.062	7	1.05	4.22	57.04	277.14	14.88
	Amaranth	55	1.07	.012	2	.36	.56	34.92	32.76	6.36
4	Mustard	19	3.39	.037	5	.89	.74	65.86	116.55	42.18
	Celery	50	2.53	.028	4	.15	.34	21.57	3.72	4.75
	Kang kong	79	6.26	.068	7	2.04	4.08	78.88	222.36	32.64
5	Spinach	26	.20	.002	1	.05	.06	1.82	10.86	.83
	Pai-tsai	91	6.53	.071	8	1.28	3.41	105.08	126.38	52.54
6	Ching chiang	20	3.56	.039	2	.98	1.33	81.12	155.22	33.42
	Mustard	59	4.88	.053	6	1.27	1.06	94.34	166.95	60.42
	Amaranth	53	.71	.008	1	.24	.38	23.28	21.84	4.24
7	Lettuce	31	2.26	.025	4	.43	1.70	23.00	111.75	6.00
	Celery	16	3.22	.035	6	.19	.42	26.96	4.66	5.94
	Ching chiang	68	4.30	.047	5	1.18	1.60	97.76	187.06	40.28
8	Spinach	33	3.98	.043	7	1.12	1.29	39.13	233.49	17.76
	Shallot	5	1.17	.013	2	.27	.26	13.52	16.64	1.70
	Amaranth	90	3.54	.038	4	1.14	1.79	110.56	103.74	10.14
9	Rape green	1	.45	.005	1	.11	.29	7.20	20.65	2.40
	Pai-tsai	19	3.90	.042	2	.76	2.02	62.16	74.76	31.08
	Kale	86	3.39	.037	4	.89	1.22	86.21	92.50	42.55
	Leaf beet	32	1.12	.012	2	.20	.58	5.33	19.60	.33
Fence										
	Tomato	92	9.02	.098	16	.88	.49	16.66	108.78	22.93
	Sweet potato tips	92	1.20	.013	4	.52	1.49	17.90	16.25	6.16
	Ipil-ipil	92	8.42	.092	12	6.16	6.70	51.18	651.36	46.56
	Shallot	92	1.60	.017	2	.36	.34	17.68	21.76	2.23
	Garlic	92	1.32	.014	2	.34	.28	15.68	15.96	4.55
Total			100.00	1.088	136	26.22	45.60	1358.41	3355.72	558.03
RDA for a family of five						149.00	49.00	3100.00	2625.00	140.00
RDA contributed by garden (%)						17.60	93.06	43.82	127.84	398.59

Table 15. Yield and nutrient contribution of Thailand home garden III, June to August 1984, AVRDC.

Plot	Crop	Growing Period (days)	Edible Yield (kg)	Edible Yield/Day (kg)	Times Harvested	Nutrient Yield/Day Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (μgRE)	Vitamin C (mg)
1	Lemon grass	92	19.31	.210	24	3.69	9.68	244.50	234.00	43.84
	Kang kong	14	.58	.006	1	.18	.36	6.96	19.62	2.88
	Amaranth	58	1.28	.014	3	.42	.85	40.74	38.22	7.42
2	Rape greens	8	.74	.008	3	.16	.46	11.52	33.04	3.83
	Ching chiang	43	.98	.011	3	.27	.37	22.88	13.78	9.42
	Kang kong	38	1.29	.014	3	.42	.84	16.24	45.78	6.72
3	Sweet pepper	92	1.93	.021	9	.27	.18	2.52	61.23	21.63
	Amaranth	28	.94	.010	2	.30	.47	29.10	27.30	5.30
	Basil	92	3.58	.039	11	1.38	1.87	124.80	292.50	10.53
4	Kang kong	34	4.23	.046	5	1.38	2.76	53.38	150.42	22.08
	Pai-tsai	65	1.21	.013	3	.23	.62	19.24	23.14	9.62
5	Sweet pepper	83	5.56	.060	28	.78	.54	7.20	174.96	61.80
6	Amaranth	26	1.74	.019	3	.57	.89	55.29	51.87	10.07
	Yard-long bean	53	3.07	.033	18	.92	.59	16.89	10.98	9.24
	Rape green	39	1.37	.015	2	.31	.87	21.60	61.95	7.18
7	Kang kong	46	2.79	.030	4	.90	1.80	34.90	98.10	14.40
	Mustard	60	.34	.004	3	.06	.27	3.68	17.88	.96
8	Amaranth	19	2.35	.026	3	.78	1.22	75.66	70.98	13.78
9	Lettuce	60	.34	.004	3	.06	.27	3.68	17.88	.96
Fence										
	Ipil Ipil	92	16.40	.178	33	11.90	12.93	99.02	1260.24	90.08
	Bottle gourd	92	7.88	.086	6	.49	.12	33.79	32.07	7.24
	Yard-long bean	92	10.46	.114	29	3.19	2.05	58.14	37.96	31.92
	Sweet potato tips	92	.63	.007	2	.23	.53	9.03	17.99	3.92
Total			89.16	.969	199	28.85	40.19	995.80	2879.76	399.56
RDA for a family of five						149.00	49.00	3100.00	2625.00	140.00
RDA contributed by garden (%)						19.36	82.02	32.12	109.71	285.40

Table 16. Yield and nutrient contribution of Thailand home garden IV, September to November 1984, AVRDC.

Plot	Crop	Growing Period (days)	Edible Yield (kg)	Edible Yield/Day (kg)	Times Harvested	Nutrient Yield/Day Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (μgRE)	Vitamin C (mg)
1	Lemon grass	9	7.29	.080	5	1.41	3.69	93.14	112.00	16.70
	Pai-tsai	48	.46	.005	1	.09	.24	7.40	8.90	3.70
	Rape green	30	1.39	.015	3	.32	.87	21.60	61.95	7.19
2	Kang kong	32	1.87	.021	4	.63	1.26	24.36	68.67	10.08
	Lettuce	31	1.54	.017	6	.29	1.16	15.64	75.99	4.08
3	Basil	91	6.38	.070	21	2.31	3.36	224.00	525.00	18.90
	Ginger	91	1.20	.013	3	.21	.17	2.47	1.20	.52
4	Amaranth	43	2.83	.031	6	.93	1.46	90.21	84.63	16.43
	Kale	47	1.35	.015	3	.36	.50	34.45	37.50	17.25
5	Mustard	56	7.40	.081	9	1.94	1.62	144.18	255.15	92.34
	Pai-tsai	49	2.12	.023	4	.41	1.10	34.04	40.94	17.02
6	Rape green	8	1.85	.020	3	.42	1.16	28.80	82.60	9.58
	Kale	61	1.66	.018	4	.43	.59	41.94	45.00	20.70
	Eggplant	69	3.07	.034	14	.48	.24	2.04	2.82	4.01
7	Mustard	41	3.13	.034	5	.82	.68	60.52	107.10	38.76
	Pai-tsai	52	1.96	.022	2	.40	1.06	32.56	39.16	16.28
	Rape green	39	.53	.007	1	.15	.41	10.08	28.91	3.35
8	Kale	11	.40	.004	3	.10	.13	9.32	10.00	4.60
	Yard-long bean	39	1.21	.013	6	.36	.23	6.63	4.33	3.64
	Lettuce	27	1.32	.015	5	.26	1.02	13.80	67.05	3.60
9	Ching chiang	48	4.07	.045	5	1.13	1.53	93.60	179.10	38.57
	Kang kong	45	.98	.011	2	.33	.66	12.76	35.97	5.28
Fence										
	Ipil-ipil	91	15.66	.172	29	11.51	12.52	95.68	1717.76	87.05
	Bottle gourd	91	1.28	.014	2	.08	.02	5.50	5.22	1.18
	Sweet potato tips	91	.44	.005	2	.20	.57	6.89	6.25	2.37
	Taro (tuber)	91	1.10	.012	2	.26	.14	4.08	-	.96
	Taro (leaf stalk)	91	.44	.005	1	.03	.05	2.45	1.50	.65
	Winged bean	91	.18	.002	2	.08	.03	1.62	1.28	.44
	Cucumber	91	.08	.001	1	.004	.003	.14	.03	.07
Total			73.29	.805	154	25.94	36.47	1120.40	3106.01	445.30
RDA for a family of five						149.00	49.00	3100.00	2625.00	140.00
RDA contributed by garden (%)						17.41	74.43	36.14	118.32	318.07

Table 17. Yield and nutrient contribution of Philippines home garden I, December 1983 to February 1984, AVRDC.

Plot	Crop	Growing Period (days)	Edible Yield (kg)	Edible Yield/Day (kg)	Times Harvested	Nutrient Yield/Day Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (µgRE)	Vitamin C (mg)
1	Lemon grass	91	1.69	.019	2	.33	.88	22.12	26.60	3.97
	Lettuce	43	.41	.005	1	.09	.34	4.60	22.35	1.20
	Garland chrysanthemum	42	1.44	.016	4	.24	.43	12.16	70.08	2.70
2	Pai-tsai	70	9.64	.106	19	1.91	5.09	156.88	188.68	78.44
	Rape green	40	.85	.009	2	.19	.52	12.96	37.17	4.31
	Mustard	53	.14	.002	1	.05	.04	3.56	6.30	2.28
3	Kale	79	5.61	.062	16	1.49	2.05	144.46	155.00	71.30
4	Mustard	91	10.57	.116	23	2.78	2.32	206.48	365.40	132.24
5	Spinach	71	7.39	.081	12	2.11	2.43	73.71	439.83	33.45
	Coriander	29	.08	.001	1	.02	.05	.79	5.28	.83
6	Ching chiang	89	14.23	.156	23	3.90	5.30	324.48	620.88	133.69
	Celery	76	1.87	.021	5	.11	.25	16.18	2.79	3.56
7	Garland chrysanthemum	51	2.20	.024	5	.36	.65	18.24	105.12	4.06
	Radish	12	2.43	.027	5	.16	.19	4.90	2.84	4.64
	Spinach	79	1.15	.013	2	.34	.39	11.83	70.59	5.37
	Eggplant	91	.30	.003	3	.04	.02	.18	.25	.35
	Coriander	72	.31	.003	2	.06	.15	2.36	15.85	2.50
8	Kang kong	5	1.10	.012	3	.36	.72	13.92	39.24	5.76
	Mustard	84	7.95	.087	14	2.09	1.74	154.86	274.05	99.18
9	Coriander	62	2.13	.023	14	.48	1.13	18.07	121.51	19.19
	Shallot	90	2.33	.026	6	.55	.52	27.04	33.28	3.41
	Garlic		1.15	.013	3	.31	.26	14.56	14.82	4.23
	Lettuce	91	2.11	.023	7	.39	1.56	21.16	102.81	5.52
Fence										
	Tomato	91	10.70	.118	29	1.06	.59	20.06	130.98	27.61
	Cowpea		.41	.005	4	1.14	.33	5.50	.08	.05
	Mustard	75	1.76	.019	5	.46	.38	33.82	59.85	21.66
	Coriander	35	.20	.002	1	.04	.10	1.57	10.57	1.67
	Sweet potato tips		.16	.002	1	.08	.23	2.75	2.50	.95
	Ginger		.10	.001	1	.02	.01	.19	.09	.04
	Snap bean		.08	.001	1	.03	.01	.30	.30	.28
Total			90.49	.996	215	21.19	28.68	1329.69	2823.09	674.44
RDA for a family of five						149.00	49.00	3100.00	2625.00	140.00
RDA contributed by garden (%)						14.22	58.53	42.89	107.62	481.74

Table 18. Yield and nutrient contribution of Philippines home garden II, March to May 1984, AVRDC.

Plot	Crop	Growing Period (days)	Edible Yield (kg)	Edible Yield/Day (kg)	Times Harvested	Nutrient Yield/Day				
						Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (μgRE)	Vitamin C (mg)
1	Lemon grass	92	10.34	.112	13	1.97	5.16	130.40	156.38	23.38
	Pai-tsai	19	4.44	.048	2	.86	2.30	71.04	85.44	35.52
	Shallot	29	.60	.007	1	.14	.14	7.28	8.96	.91
	Kang kong	52	1.01	.011	2	.33	.66	12.76	35.97	5.28
2	Spinach	42	.30	.003	1	.07	.09	2.73	16.29	1.23
	Leaf beet	41	2.00	.022	4	.37	1.06	9.77	35.92	.60
	Rape green	19	1.30	.014	2	.29	.81	20.16	57.82	6.70
	Ching chiang	67	3.68	.040	6	1.00	1.36	83.20	159.20	34.28
3	Lettuce	43	2.07	.023	5	.39	1.56	21.16	102.81	5.52
	Pai-tsai	58	3.58	.039	4	.70	1.87	57.72	69.42	28.86
	Amaranth	58	.86	.009	1	.27	.42	26.19	24.57	4.77
4	Mustard	19	1.71	.019	2	.45	.38	33.82	59.85	21.66
	Lettuce	42	6.40	.070	8	1.19	4.76	64.40	312.90	16.80
	Amaranth	53	1.31	.014	2	.42	.65	40.74	38.22	7.42
5	Pai-tsai	48	3.81	.041	3	.73	1.96	60.68	72.98	30.34
	Celery	47	1.93	.021	2	.11	.25	16.17	2.79	3.56
	Spinach	14	.98	.011	2	.28	.33	10.01	59.73	4.54
6	Celery	63	4.71	.051	7	.27	.61	39.29	6.78	8.65
	Ching chiang	13	1.24	.013	2	.32	.44	27.04	51.74	11.14
	Rape green	51	2.16	.023	4	.48	1.33	33.12	94.88	11.01
	Okra	38	.15	.002	2	.03	.02	1.80	.46	.36
7	Ching chiang	37	3.14	.034	3	.85	1.15	70.72	135.32	29.13
	Eggplant	91	5.48	.060	15	.84	.42	3.60	4.88	7.08
	Kang kong	73	1.35	.015	3	.45	.90	17.40	49.05	7.20
8	Pai-tsai	76	4.41	.048	5	.86	2.30	71.04	85.44	35.52
	Mustard	40	1.18	.013	2	.31	.26	34.14	40.95	14.82
	Kang kong	43	1.45	.016	2	.48	.96	18.56	52.32	7.68
9	Lettuce	41	5.04	.055	7	.93	3.74	50.60	245.85	13.20
	Amaranth	57	1.88	.020	3	.60	.94	58.20	54.60	10.60
Fence										
	Tomato	92	17.29	.188	28	1.69	.94	31.96	208.68	43.99
	Sweet potato tips	92	1.82	.020	6	.68	1.52	25.80	51.40	11.20
	Shallot	92	11.78	.128	8	2.68	2.56	133.12	163.84	16.76
	Garlic	92	1.80	.020	1	.48	.40	22.40	22.80	6.50
	Yard-long bean		.10	.001	1	.02	.01	.51	.33	.28
Total			11.30	1.211	159	21.54	42.26	1296.53	2589.20	466.49
RDA for a family of five						149.00	49.00	3100.00	2625.00	140.00
RDA contributed by garden (%)						14.46	86.24	41.82	97.87	333.21

Table 19. Yield and nutrient contribution of Philippines home garden III, June to August 1984, AVRDC.

Plot	Crop	Growing Period (days)	Edible Yield (kg)	Edible Yield/Day (kg)	Times Harvested	Nutrient Yield/Day Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (µgRE)	Vitamin C (mg)
1	Lemon grass	92	19.46	.212	28	3.73	9.77	246.83	296.80	44.27
	Kang kong	11	1.43	.016	2	.48	.96	18.56	52.32	7.68
	Mustard	71	2.84	.031	5	.74	.62	55.18	97.65	35.34
2	Lettuce	28	1.37	.015	3	.26	1.02	13.80	67.05	3.60
	Kale	63	.46	.005	1	.12	.17	11.65	12.50	5.75
3	Amaranth	40	5.81	.063	6	1.89	2.96	183.33	171.99	33.39
4	Amaranth	22	3.45	.038	4	1.14	1.79	110.58	103.74	20.14
	Kang kong	50	4.56	.050	7	1.50	3.00	58.00	163.50	24.00
5	Pai-tsai	60	2.00	.022	3	.40	1.06	32.56	39.16	16.28
6	Amaranth	19	2.45	.027	3	.81	1.27	78.57	73.71	14.31
	Okra	65	3.20	.035	29	.63	.35	31.50	8.16	6.30
7	Eggplant	46	5.29	.068	16	.95	.48	4.08	5.64	8.02
	Kang kong	23	.28	.003	1	.09	.18	3.48	9.81	1.44
	Pai-tsai	47	.12	.001	1	.02	.05	1.48	1.78	.74
	Chinese cabbage	47	.69	.008	3	.14	.21	8.16	30.73	4.24
8	Kang kong	34	3.67	.040	5	1.20	2.40	46.40	130.80	19.20
	Amaranth	59	3.09	.034	5	1.02	1.60	98.94	92.82	18.02
9	Amaranth	21	2.02	.022	3	.66	1.03	64.02	60.06	11.66
	Ching chiang	72	.25	.003	1	.08	.10	6.24	11.94	2.57
Fence										
	Sweet potato tips		1.68	.018	5	.72	2.06	24.79	22.50	8.53
	Yard-long bean		6.16	.067	22	1.88	1.21	34.17	22.31	18.76
	Bitter gourd		9.42	.102	18	.82	2.35	26.52	18.67	58.14
	Cucumber		.11	.001	2	.004	.003	.14	.03	.07
Total			80.82	.881	173	19.28	34.64	1158.98	1493.67	362.45
RDA for a family of five						149.00	49.00	3100.00	2625.00	140.00
RDA contributed by garden (%)						12.94	70.69	37.39	56.90	258.89

Table 20. Yield and nutrient contribution of Philippines home garden IV, September to November 1984, AVRDC.

Plot	Crop	Growing Period (days)	Edible Yield (kg)	Edible Yield/Day (kg)	Times Harvested	Nutrient Yield/Day				
						Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (µgRE)	Vitamin C (mg)
1	Lemon grass	53	7.96	.088	12	1.55	4.06	102.46	123.20	18.37
	Ching chiang	61	3.87	.043	7	1.08	1.46	89.44	171.14	36.85
2	Amaranth	53	1.66	.018	3	.54	.85	52.38	49.14	9.54
	Kale	11	1.52	.017	2	.41	.56	39.61	42.50	19.55
	Lettuce	52	1.96	.022	4	.37	1.50	20.24	98.34	5.28
3	Vegetable soybean	17	.79	.009	4	1.32	.46	1.41	3.45	1.47
	Ching chiang	28	3.61	.040	5	1.00	1.36	83.20	159.20	34.28
	Eggplant	67	.83	.009	4	.13	.06	.54	.75	1.06
4	Okra	80	10.99	.121	34	2.18	1.21	108.90	28.19	21.78
5	Kale	63	2.71	.030	5	.72	.99	69.90	75.00	34.50
6	Yard-long bean	39	2.30	.025	9	.70	.45	12.75	8.33	7.00
	Lettuce	28	1.47	.016	4	.27	1.09	14.72	71.52	3.84
7	Chinese cabbage	4	1.24	.014	2	.24	.35	14.28	53.78	7.42
	Mustard	49	2.56	.028	4	.67	.56	49.84	88.20	31.92
	Pai-tsai	50	1.71	.019	3	.34	.91	28.12	33.82	14.06
8	Amaranth	2	.59	.007	1	.21	.33	20.37	19.11	3.71
	Ching chiang	54	3.34	.037	6	.93	1.26	76.96	147.26	31.71
	Garland chrysanthemum	43	.46	.005	2	.08	.14	3.80	21.90	.85
9	Ching chiang	3	.30	.003	1	.08	.10	6.24	11.94	2.57
	Kang kong	42	1.90	.021	4	.63	1.26	24.36	68.67	10.08
	Mustard	52	3.76	.041	9	.98	.82	72.98	129.15	46.74
Fence										
	Bitter gourd	4	.25	.003	1	.02	.07	.78	.55	1.71
	Moringa (leaf)	91	3.84	.042	8	2.14	7.52	97.09	287.70	48.40
	Moringa (pod)	91	2.42	.027	5	.70	.87	.88	-	34.86
	Cucumber	91	.42	.005	2	.02	.02	.70	.13	.35
	Sweet potato tips	91	1.16	.013	3	.52	1.49	17.90	16.25	6.16
	Taro (tuber)	91	.79	.009	2	.20	.11	3.06	-	.72
	Taro (leaf stalk)	91	.33	.004	2	.02	.04	1.96	1.20	.52
	Yard-long bean	91	2.27	.025	9	.70	.45	12.75	8.33	7.00
Total			67.01	.741	157	18.75	30.36	1027.62	1718.75	442.30
RDA for a family of five						149.00	49.00	3100.00	2625.00	140.00
RDA contributed by garden (%)						12.58	61.96	33.15	65.48	315.93

Table 21. Yield and nutrient contribution of Vitamin A home garden I. December 1983 to February 1984, AVRDC.

Plot	Crop	Growing Period (days)	Edible Yield (kg)	Edible Yield/Day (kg)	Times Harvested	Nutrient Yield/Day Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (μgRE)	Vitamin C (mg)
1	Carrot	91	1.68	.018	4	.18	.30	6.48	292.86	1.85
	Sweet pepper	70	1.34	.015	7	.20	.14	1.80	43.74	15.45
	Cuing chiang	91	7.66	.084	16	2.10	2.86	174.72	334.32	72.00
2	Pai-tsai	77	10.09	.111	20	2.00	5.33	164.26	197.58	82.14
	Rape green	41	.67	.007	1	.15	.41	10.08	28.91	3.35
	Mustard	61	.15	.002	1	.05	.04	3.56	6.30	2.28
3	Chinese leek	91	1.51	.017	5	.51	.37	14.79	73.61	5.95
4	Rape green	54	6.89	.076	15	1.60	4.41	109.44	313.88	36.40
	Radish	76	1.46	.016	2	.10	.11	2.90	1.68	2.75
	Mustard	54	.23	.003	1	.07	.06	5.34	9.45	3.42
5	Mustard	85	15.20	.167	25	4.01	3.34	297.26	526.05	190.38
6	Kale	87	9.16	.101	18	2.42	3.33	235.33	252.50	116.15
7	Radish	15	6.65	.073	8	.44	.50	13.24	7.67	12.55
	Garland chrysanthemum	76	5.01	.055	11	.83	1.49	41.80	240.90	9.30
	Lettuce	40	.37	.004	1	.07	.27	3.68	17.88	.96
	Celery	75	2.75	.030	4	.16	.36	23.11	3.99	5.09
8	Kang kong	4	.99	.011	4	.33	.66	12.76	35.97	5.28
	Spinach	69	7.49	.082	17	2.13	2.45	74.62	445.26	33.87
	Pai-tsai	17	1.04	.011	1	.20	.53	16.28	19.58	8.14
9	Coriander	22	.25	.003	2	.06	.15	2.36	15.85	2.50
	Mustard	56	1.73	.019	2	.46	.38	33.82	59.85	21.66
Fence										
	Tomato		3.10	.034	13	.31	.17	5.78	37.74	7.96
	Sweet potato tips		.92	.010	2	.40	1.14	13.70	12.50	4.74
	Coriander		.08	.001	1	.02	.05	.79	5.28	.83
	Mustard		4.69	.052	11	1.25	1.04	92.56	163.80	59.28
Total			91.11	1.002	192	20.05	29.98	1360.48	3147.15	704.28
RDA for a family of five						149.00	49.00	3100.00	2625.00	140.00
RDA contributed by garden (%)						13.46	61.18	43.89	119.89	503.06

Table 22. Yield and nutrient contribution of Vitamin A home garden II, March to May 1984, AVRDC.

Plot	Crop	Growing Period (days)	Edible Yield (kg)	Edible Yield/Day (kg)	Times Harvested	Nutrient Yield/Day Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (μgRE)	Vitamin C (mg)
1	Carrot	6	4.23	.046	6	.46	.97	16.56	748.42	4.74
	Celery	53	6.42	.070	8	.38	.85	53.93	9.31	11.88
	Amaranth	47	.74	.008	1	.24	.38	23.28	21.84	4.24
2	Rape green	65	5.11	.056	6	1.18	3.25	80.64	231.28	26.82
	Ching chiang	64	2.43	.026	4	.65	.98	54.09	103.48	22.28
3	Chinese leek	92	5.85	.064	9	1.92	1.41	55.68	277.12	22.40
4	Ching chiang	19	3.62	.039	5	.98	1.33	81.12	155.22	33.42
	Leaf beet	32	2.05	.022	3	.37	1.06	9.78	35.93	.61
	Pai-tsai	44	.40	.004	1	.07	.19	5.92	7.12	2.96
	Kang kong	73	2.38	.026	5	.78	1.56	30.16	85.02	12.48
5	Mustard	12	.69	.008	1	.19	.16	14.24	25.20	9.12
	Ching chiang	62	6.33	.069	10	1.73	2.35	143.52	274.62	59.13
6	Lettuce	40	5.04	.055	6	.94	3.74	50.60	245.85	13.20
7	Lettuce	32	2.15	.023	5	.39	1.56	21.16	102.81	5.52
	Ching chiang	33	1.02	.011	2	.28	.37	22.88	43.78	9.43
	Pai-tsai	33	.40	.004	1	.07	.19	5.92	7.12	2.96
	Amaranth	78	3.26	.035	5	1.05	1.65	101.85	95.55	18.55
8	Pai-tsai	54	7.02	.076	5	1.37	3.65	112.48	135.28	56.24
	Kang kong	38	3.66	.040	5	1.20	2.40	46.40	130.80	19.20
9	Carrot	92	5.44	.059	9	.59	1.24	21.24	959.93	6.08
Fence										
	Tomato	92	5.00	.054	11	.49	.27	9.18	59.94	12.64
	Sweet potato tips	92	6.63	.072	15	2.45	5.47	92.88	185.04	40.32
	Papaya	92	6.49	.071	5	-	-	-	156.20	22.78
	Shallot	49	.25	.003	1	.06	.06	3.12	3.84	.39
Total			86.61	.941	129	17.84	34.99	1056.62	4100.70	417.39
RDA for a family of five						149.00	49.00	3100.00	2625.00	140.00
RDA contributed by garden (%)						11.97	71.41	34.08	156.22	298.14

Table 23. Yield and nutrient contribution of Vitamin A home garden III, June to August 1984, AVRDC.

Plot	Crop	Growing Period (days)	Edible Yield (kg)	Edible Yield/Day (kg)	Times Harvested	Nutrient Yield/Day Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (μgRE)	Vitamin C (mg)
1	Amaranth	12	1.36	.015	3	.45	.71	43.65	40.95	7.95
2	Mustard	52	3.01	.033	8	.79	.66	58.74	103.95	37.62
	Kang kong	61	1.86	.020	5	.60	1.20	23.20	65.40	9.60
3	Chinese leek	92	5.03	.055	13	1.65	1.21	47.85	238.15	19.25
	Chinese leek flower	92	.23	.003	1	.08	.07	.76	6.10	1.10
4	Kang kong	34	3.29	.036	4	1.08	2.16	47.76	117.72	17.28
	Pai-tsai	45	2.10	.023	5	.41	1.10	34.04	40.94	17.02
5	Pai-tsai	15	.66	.007	3	.13	.34	10.36	12.46	5.18
	Amaranth	39	3.13	.034	6	1.02	1.60	98.94	92.82	18.02
	Welsh onion	36	.82	.009	2	.13	.11	7.76	29.10	3.47
6	Sweet pepper	92	4.92	.053	29	.69	.48	6.36	154.55	54.59
	Amaranth	22	1.49	.016	3	.48	.75	46.56	43.58	8.48
7	Amaranth	14	3.19	.035	4	1.05	1.65	101.85	95.55	18.55
	Rape green	48	1.91	.021	4	.44	1.22	30.24	86.73	10.06
	Mustard	48	1.10	.012	4	.29	.24	21.36	37.80	13.68
8	Kang kong	28	2.41	.026	3	.78	1.56	30.16	85.02	12.48
	Kale	78	1.37	.015	4	.36	.50	34.95	37.50	17.25
9	Carrot	6	3.06	.033	3	.33	.70	11.88	536.91	3.40
	Ching chiang	53	2.31	.025	5	.63	.85	52.00	99.50	21.43
	Rape green	50	1.52	.017	4	.36	.99	24.48	70.21	8.14
Fence										
	Onion		.60	.007	1	.10	.09	6.30	22.63	2.70
	Sweet potato tips		1.89	.021	8	.84	2.40	28.92	26.25	9.95
	Yard-long bean		11.85	.129	28	3.61	2.32	65.79	42.96	36.12
	Shallot		3.05	.033	10	.69	.66	34.32	42.24	4.32
	Papaya		1.50	.016	3	-	-	-	35.20	5.13
	Mango		1.49	.016	3	.10	.05	1.60	50.13	5.76
	Cucumber		.37	.004	2	.02	.01	.56	.10	.28
Total			65.52	.714	168	17.11	23.63	870.12	2214.55	368.81
RDA for a family of five						149.00	49.00	3100.00	2625.00	140.00
RDA contributed by garden (%)						11.48	48.22	28.07	84.36	263.44

Table 24. Yield and nutrient contribution of Vitamin A home garden IV, September to November 1984, AVRDC.

Plot	Crop	Growing Period (days)	Edible Yield (kg)	Edible Yield/Day (kg)	Times Harvested	Nutrient Yield/Day Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (μgRE)	Vitamin C (mg)
1	Taro (stem)	46	1.70	.019	1	.42	.23	6.46	-	1.52
	Taro (stalk)	46	.52	.006	1	.03	.05	2.94	1.80	.78
2	Amaranth	52	1.18	.013	3	.39	.61	37.82	35.49	6.89
	Rape green	37	5.29	.085	8	1.22	3.36	83.51	239.54	27.78
3	Chinese leek	66	2.76	.030	5	.90	.66	26.10	129.90	10.50
	Chinese leek flower	66	.60	.007	5	.18	.15	1.73	14.23	2.58
	Lettuce	59	2.10	.023	5	.39	1.56	21.16	102.81	5.52
4	Basil	32	1.62	.018	9	.59	.86	57.60	135.00	4.86
	Rape green	30	2.26	.025	4	.53	1.45	36.00	103.25	11.98
	Lettuce	30	1.28	.014	4	.24	.95	12.88	62.58	3.36
5	Pai-tsai	18	1.18	.013	3	.23	.62	19.24	23.14	9.62
	Yard-long bean	62	4.50	.050	11	1.40	.90	25.50	16.65	14.00
6	Mustard	57	9.52	.105	13	2.52	2.10	186.90	330.75	119.70
	Lettuce	29	1.29	.014	2	.24	.95	12.88	62.58	3.36
7	Mustard	12	2.40	.026	6	.62	.52	46.28	81.90	29.64
8	Kale	15	1.35	.015	3	.36	.50	34.95	37.50	17.25
	Pai-tsai	70	1.74	.019	3	.34	.91	28.12	33.82	14.06
	Kang kong	57	1.53	.017	3	.51	1.02	19.72	55.59	8.16
9	Kale	80	3.29	.036	8	.86	1.19	83.88	90.00	41.40
Fence										
	Cucumber	91	.40	.004	3	.02	.01	.56	.10	.28
	Sweet potato tips	91	.82	.009	3	.36	1.03	12.39	11.25	4.26
	Mango	91	1.16	.013	2	.08	.04	1.30	40.73	4.68
	Papaya	91	12.52	.138	19	-	-	-	303.60	44.27
	Taro (stem)	91	.44	.005	1	.11	.06	1.70	-	.40
	Taro (stalk)	91	.15	.002	1	.01	.02	.98	.60	.26
	Pumpkin	91	7.72	.085	9	.49	.62	2.79	331.50	4.62
Total			69.33	.764	135	13.04	20.37	763.46	2244.31	391.73
RDA for a family of five						149.00	49.00	3100.00	2625.00	140.00
RDA contributed by garden (%)						8.75	41.57	24.63	85.50	279.81

Table 25. Results from four AVRDC home gardens[a].

	Yield/Day (kg)	Contribution (%) to the RDA[b] of a family of five				
		Protein	Iron	Calcium	Vitamin A	Vitamin C
Indonesia garden	0.947	12.83	73.23	39.74	95.08	369.81
Thailand garden	1.035	17.94	82.33	41.57	125.33	362.15
Philippine garden	0.957	13.55	69.36	38.81	81.97	374.44
Vitamin A garden	0.855	11.42	55.60	32.67	111.49	336.11

[a] Means of four seasons, December 1983 to November 1984.
[b] Recommended Daily Dietary Allowance.

Table 26. Yearly yield and nutrient contribution of urban home garden, August 1983 to August 1984.

Crop	Edible Yield (kg)	Edible Yield/Day (kg)	Times Harvested	Nutrient Yield/Day				
				Protein (g)	Iron (mg)	Calcium (mg)	Vitamin A (μg,RE)	Vitamin C (mg)
Kang kong	11.46	.029	34	.87	1.74	33.64	94.83	13.92
Spinach	3.25	.008	10	.21	.24	7.28	43.44	3.30
Lettuce	10.46	.026	32	.44	1.77	23.92	116.22	6.24
Ching chiang	9.78	.025	30	.63	.85	52.00	99.50	21.43
Rape green	9.62	.024	30	.50	1.39	34.56	99.12	11.50
Kale	5.09	.013	16	.31	.43	30.29	32.50	14.95
Mustard	10.13	.026	33	.62	.52	46.28	81.90	29.64
Amaranth	6.47	.016	21	.48	.75	46.56	43.68	8.48
Pai-tsai	12.26	.031	37	.56	1.49	45.88	55.18	22.94
Garland chrysanthemum	4.06	.010	20	.15	.27	7.60	43.80	1.69
Leaf beet	1.62	.004	7	.07	.19	1.78	6.53	.11
Chinese leek	7.64	.019	41	.57	.42	16.53	82.27	6.65
Celery	3.90	.010	14	.05	.12	7.70	1.33	1.70
Chinese cabbage	1.25	.003	1	.05	.08	3.06	1.53	1.59
Total	96.99	.244	326	5.51	10.26	357.08	811.83	144.14
RDA for a family of five				149.00	49.00	3100.00	2625.00	140.00
RDA contributed by garden (%)				3.70	20.94	11.52	30.93	102.96

Table 27. Yield and price record of market garden I, July to September 1983.

Plot	Crop	Growing Period (days)	Times Harvested	Marketable Yield (kg)	Market Price (NT$)	Gross Returns (NT$ per kg)
1-2	Bitter melon	18	4	11.0	77.0	7.00
	Pai-tsai	24	1	26.5	235.0	8.87
	Kang kong	24	2	84.5	341.0	4.04
3-4	Pai-tsai	6	1	11.0	75.0	6.82
	Welsh onion	60	2	40.0	685.0	17.13
5-6	Sponge gourd	15	3	4.5	51.0	11.33
	Kang kong	24	2	60.0	333.0	5.55
	Pai-tsai	46	2	17.5	115.0	6.57
7-8	Welsh onion	12	4	80.5	2144.0	26.63
	Kang kong	21	2	75.0	365.0	4.87
	Chinese cabbage	40	1	9.0	13.0	1.44
9-10	Kang kong	28	4	109.0	506.0	4.64
	Pai-tsai	32	2	44.0	162.5	3.69
11-12	Yard-long bean	46	1	1.8	5.5	3.06
	Amaranth	34	1	23.5	170.0	7.23
Total			32	597.8	5278.0	

Table 28. Yield and price record of market garden II, October to December 1983.

Plot	Crop	Growing Period (days)	Times Harvested	Marketable Yield (kg)	Market Price (NT$)	Gross Returns (NT$ per kg)
1-2	Yard-long bean	60	7	25.0	502.0	20.08
3-4	Chinese cabbage	12	2	38.8	552.0	14.23
	Garland chrysanthemum	71	3	22.0	199.0	9.05
	Sweet pepper	74	1	5.0	16.0	3.20
5-6	Chinese cabbage	26	1	41.5	581.0	14.00
	Broccoli	57	3	36.5	119.0	3.26
7-8	Pai-tsai	46	3	81.0	422.0	5.21
	Broccoli	57	3	36.5	119.0	3.26
7-8	Pai-tsai	46	3	81.0	422.0	5.21
	Broccoli	33	1	7.5	245.0	32.67
	Eggplant	54	1	2.0	3.0	1.50
9-10	Pai-tsai	11	1	16.0	144.0	9.00
	Broccoli	59	5	28.0	406.0	14.50
11-12	Kang kong	18	2	38.5	375.0	9.74
	Cauliflower	68	3	57.5	288.0	5.01
13	Chinese leek	92	1	10.0	200.0	20.00
Total			34	409.3	4052.0	

Table 29. Yield and price record of market garden III, January to March 1984.

Plot	Crop	Growing Period (days)	Times Harvested	Marketable Yield (kg)	Market Price (NT$)	Gross Returns (NT$ per kg)
1-2	Mustard	6	1	12.0	12.0	1.00
	Broccoli	30	3	26.5	79.0	2.98
	Spinach	38	1	55.5	233.0	4.20
3-4	Sweet pepper	25	3	19.0	110.0	5.79
	Kohlrabi	20	2	36.0	103.0	2.86
	Celery	56	2	88.0	858.0	9.75
5-6	Spinach	45	2	52.5	297.0	5.66
	Kang kong	48	2	24.0	129.0	5.38
7-8	Eggplant	39	5	26.0	91.0	3.50
	Kang kong	52	1	22.5	97.0	4.31
9-10	Garland chrysanthemum	45	3	76.0	443.0	5.83
	Spinach	36	2	29.5	708.0	24.00
11-12	Mustard	20	1	24.0	24.0	1.00
	Celery	56	3	64.0	436.0	6.81
13	Chinese leek	91	2	40.0	479.0	11.98
Total			33	595.5	4099.0	

Table 30. Yield and price record of market garden IV, April to June 1984.

Plot	Crop	Growing Period (days)	Times Harvested	Marketable Yield (kg)	Market Price (NT$)	Gross Returns (NT$ per kg)
1-2	Kang kong	20	2	43.0	262.0	6.09
	Yard-long bean	65	1	2.0	29.0	14.50
3-4	Amaranth	25	3	52.4	451.0	8.61
	Kang kong	28	1	40.5	138.5	3.42
5-6	Broccoli	47	3	23.9	348.5	14.56
	Rape green	32	2	40.8	260.5	6.38
7-8	Yard-long bean	61	3	12.0	155.0	12.92
	Amaranth	23	1	29.1	274.0	9.42
9-10	Kang kong	24	2	45.5	303.0	6.66
	Mustard	35	1	10.0	72.0	7.20
11-12	Amaranth	19	2	37.5	290.0	7.73
	Kang kong	30	1	32.7	161.0	4.92
13	Chinese cabbage	91	2	40.0	379.0	9.48
Total			24	409.4	3389.5	

Table 31. Yield and profit of AVRDC market gardens July 1983 to June 1984.

	Marketable Yield (kg)	Wholesale Market Price (NT$)	Cash Cost[a] (NT$)	Profit (NT$)
Garden I	597.8	5278	513	4756
Garden II	409.3	4052	454	3598
Garden III	595.5	4099	438	3661
Garden IV	409.4	3389	231	3176
Total net wholesale profit	2012.0	16818	1618	15200 (US$385)

[a] Cash cost includes the cost of seeds, pesticide and chemical fertilizer.

40

2

Feasibility Studies on the Use of Permanent Composting Beds for Intensive Vegetable Production in Southeast Asian Countries

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Summary

The addition of organic matter to the soil is essential to maintain good soil tilth, release plant nutrients over the growing season, maximize yield, and retain moisture. This project aimed to determine the feasibility, cost, water requirements, and area of application of this type of sheet composting system in relation to the home garden project. The materials used in the sheet compost/planting bed layers are rice hulls, straw, and soybean leaves, to name a few.

Results showed that compost beds allow tremendous root penetration and proliferation, thus, allowing optimal nutrient feeding. Generally, the composting/planting bed concept, with reduced labor input, potentially reduced watering requirements (due to the high organic matter content), good yield, better insect and disease resistance, and the ability to plant high density crops year-round, appears to have potential for tropical areas. The evaluation of this type of growing bed, however, is still in the early stages and overall recommendations cannot be made yet.

The addition of composted organic matter to the soil has long been recognized as an essential component of any good cropping system to maintain good soil tilth, release plant nutrients over the growing season, maximize yield, retain soil moisture, etc.

Composting is done on a commercial scale in Taiwan for mushroom growing, potting soil mixtures and to a lesser extent for agricultural use. The more traditional labor intensive methods are being replaced with inorganic chemical fertilizers, pesticides, and herbicides. Traditional methods, however, are still being practiced on small hill and subsistence type farms.

Realizing the importance of maintaining organic matter, especially in the tropics, a composting component was initiated in the Garden Program at the Asian Vegetable Research and Development Center (AVRDC) in Tainan, Taiwan.

This component was eventually dropped due to the unfamiliarity with the process of composting as well as the lack of enthusiasm for turning piles in the hot tropical sun.

A modified sheet composting method was designed to eliminate the intensive labor requirement usually associated with more traditional composting methods. The objectives of his project were to determine the feasibility, cost, water requirements and impact of this type of sheet composting within the Home Garden Project objectives.

The compost/growing beds were designed to be constructed once and then maintained with the addition of organic household or agricultural waste materials.

Some of the general concepts employed came from traditional sheet composting methodology, layering composting techniques as well as methods described by Bill Mollison, founder of the Permaculture movement in Tasmania.

The specific material, depth as well as the carbon to nitrogen (C:N) ratio of each layer of the sheet compost/planting bed are shown in Table 1.

Table 1. Actual composition of layers of permanent compost/planting beds used at AVRDC.

6-9"	Compost Covering Material Rice hulls, peanut hulls, dried soybean leaves and stems.	C:N 60:1
3-4"	Nutrient Release Layer Rice straw, poultry manure, peanut hulls, dried leaves, expended mushroom compost.	C:N 20:1
Cover Area	Weed Barrier Cardboard, newspaper, rice straw (Prevent weeds from penetrating through the pile.)	
Thin Layer	Long-Term Decomposition Layer Chicken manure, palm leaves, small twigs, rock phosphate.	C:N 35:1
	Ground Level	

Plant refuse was gathered from various disposal sites around the AVRDC facility. Chicken manure and rice hulls were purchased locally . Peanut hulls were gathered from local

farmers. The gathered materials were weighed, analyzed and the carbon to nitrogen ratio was determined for each layer.

Four 1.2 x 2 m plots were marked off, hand-tilled and formed into raised beds. Normal fertility practices used by the AVRDC Garden Project were applied to two diagonal plots (approximately 5.5 kg of bagasse/plot) while the compost piles were layered as indicated in Fig. 1. Each layer was watered after it was constructed. Cost of construction for one 1.2 x 2 m plot was US$1.90.

Immediately after construction and just prior to planting, a hole was made through the top covering material to the top of the middle layer. A sharpened stick was pushed down through this layer and hole punched through the cardboard. The hole was partially filled with a small amount of composted bagasse. Tomatoes and Chinese cabbage were planted into the prepared holes, covered with a small amount of composted bagasse and the covering material pulled around the stems of the transplants. Flowering plants and other aromatic plants were inter-planted in all plots as insect traps. These traps were planted in the sides of the piles as well to reduce the amount of trapped solar radiation. When intensively planted, the composting beds could not be seen.

As plants are harvested, middle layer material is placed on the old mulch and new mulch applied. The next plant in the rotation is then planted.

One of the main advantages of this type of planting bed is the fact that the nutrient status of the soil is not an initial critical factor. This type of bed provides all the necessary nutrients for vigorous growth. It allows tremendous root penetration and proliferation thus increasing root surface area and allowing optimum nutrient intake. Eventually the soil below the beds will benefit from the translocated water soluble nutrients and decaying roots.

One of the important criteria of these beds is rapid transformation of the organic material into stable, moisture conserving, humus. It was found, in an "unofficial" side experiment, that using the Biodynamic (B.D.) Compost Starter provided much more rapid breakdown of the raw organic beds. Most of the material in the original beds were chopped to provide rapid breakdown. In the B.D. beds the raw materials were not chopped to retard the breakdown rate and provide nutrient release over a longer period of time. The B.D. treatment was not included in the experiment due to lack of space in the experimental plot area.

Initial observations indicate that the compost/planting beds provide all the nutrients required for vigorous healthy

growth of both the tomato and Chinese cabbage plants. The check plot plants showed nutrient deficiencies, more disease and insect damage on the tomato plants and fruits and less than optimal growth. The same was observed for the Chinese cabbage.

Table 2 summarizes the yield information on the crops grown in the planting through the summer of 1985. The data in Table 2 is mainly expressed on a per plant basis. Interpolation of the yield data to larger areas, considering plant populations, is easily done from this table.

There was a substantial difference observed in plant health and vigor, disease resistance and production when comparing the composting beds to the control beds. The tomatoes especially showed a marked difference. Variety 77M(3)-35, which is an indeterminate variety developed for the tropics, showed very little fruit and insect damage until late in the production cycle when senescence was occurring PT 858, a determinate variety of tomato, grew vigorously and again showed much better growth and resistance to disease and insect attack than the control. Both tomato varieties, yielded substantially higher than the controls (506% and 371%, respectively).

Sweet potatoes were planted in the spring using vine cuttings from NT 66. The cut end of the vines were inserted into the end of the beds and the compost pressed around the stem. The sweet potatoes in the composting beds were ready for harvesting 3 months after planting the vines. The usual growth period for TN 66 is 5 to 6 months. The harvesting was done after a 3-week rainy period. Several of the control plot tubers showed severe symptoms of soft rot due to the previously mentioned waterlogging conditions. The tubers were also small and rather typical of 3 months of growth. The range in weight was 10.14 to 190.3 g for the control plots. The tubers from the composting beds showed no signs of soft rot due to very good drainage and had a range of tuber weight from 19.6 g to 1.1 kg.

Overall there were fewer tubers in the composting beds but they were much larger and ready for harvest 2 to 3 months sooner than the control plots.

Vegetable type soybeans AGS 66 were planted directly into the layer below the mulch cover. The mulch was kept off the rows until the soybean had sprouted. The mulch was then pulled around the stems. There was some difference in yield per plant but no difference in 100-seed weight. The soybeans matured during the same rainy period mentioned previously and all of the plots harvested had many diseased seeds. Both the control and composting bed soybean population grew vigorously and were well nodulated. A severe infestation of spider mites occurred during the growth cycle and was controlled effectively with a 1% soap solution.

Table 2. Summary of yield data of crops grown in the permanent composting and control beds.

Crop	Variety	Mean Yld. /Plant Control (kg)	Mean Yld. /Plant Compost (kg)	Percent Difference Compost/Control	Mean No. Tubers, Fruits or Heads Control	Mean No. Tubers, Fruits or Heads Compost	Percent Difference Compost/Control	Mean Wt. Tubers, Fruits or Heads Control (kg)	Mean Wt. Tubers, Fruits or Heads Compost (kg)	Percent Difference Compost/Control	100-Seed Weight (@ 15% moisture)
Tomato	77M(3)-35	1.10	4.08	506.0	23.5	86.0	366.0	46.9	47.4	101.1	
Tomato	PT 858	0.31	1.55	371.0	4.2	21.4	514.0	73.7	72.2	98.0	
Sweet potato	TN 66	0.31	0.85	274.0	5.1	3.1	63.0	62.2	272.5	438.4	
Soybean	AGS 66	1.48 g	2.3 g	156.0	Wet weather just prior to harvest. Poor quality seed.						14.7 g cont 14.8 g comp
Chinese cabbage	ASVEG-1							139.8	338.9	242.3	
Chinese cabbage	Fong luk	No heads formed. All plants bolted.									

Chinese cabbage seedlings planted in the composted beds showed much better growth over the control plots. The traditional variety, Fong Luk, never formed heads. All plants bolted and produced flowers. ASVEG 1, an improved AVRDC hybrid variety, produced heads and again the composting beds showed a 242% increase in head weight over those produced in the control plots.

Research has continued at AVRDC during the fall of 1985. The main interest was in determining the water requirement of the composting beds vs controls.

An experiment was set up similar to the one previously described. Some of the raw materials were different and the plots were built under a canopy to prevent rain from confounding the experiment.

Table 3 summarizes the data generated from those experiments. As can be seen in the table, there was an increase in yield in the composting beds (except eggplant) with 57% less water used. This is of extreme importance when considering areas such as southern Taiwan, northeast Thailand or other areas that have a very wet season followed by several months of extremely dry conditions.

Table 3. Summary of yield and water used in the permanent composting and control plots.

Crop	Yield Control (kg)	Yield Compost (kg)	Difference Compost Control (%)
Eggplant	3.30	2.15	65
Sweet potato tip	1.52	3.50	230
Lettuce (wrinkle leaf)	0.38	0.83	218
Cherry radish	0.40	0.52	130
Tomato	6.73	9.54	141
Lettuce (native)	0.12	0.30	250
Amaranth	1.71	2.30	134
Corn	0.71	0.81	115
Total	14.86	19.95	132
Water used (gal.)	336.80	145.00	43

The permanent composting planting bed concept appears to have tremendous potential for increased yield, better plant health, reduced water requirements, resistance to disease and insect attack and reduced inorganic inputs e.g. pesticides, herbicides and fertilizers. It is, however, not the panacea for increased vegetable production in the tropics. There are many variables to consider to make these composting beds viable and economically feasible. Each situation in each country is unique and must be taken into consideration when developing and designing permanent composting beds.

The concept of this type of growing bed is scientifically sound. Potential problem areas that will arise in trying to transfer this technology are seen in availability of enough diversified organic material to build the initial growing beds and in providing enough water in arid areas to allow good breakdown of the organic material to form good water holding humus. Further investigations should be done with the B.D. Compost Starter in aiding the rapid production of stable humus.

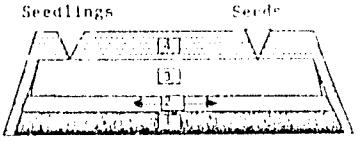
Another potential problem area is analysis of raw materials. There is little information in the literature and few reference manuals with analysis of organic materials that can be used to determine C:N ratios. Consequently, analysis of raw materials within a particular country would have to be done to determine meaningful carbon to nitrogen ratios.

Lack of chemical analysis of raw materials, however, should not deter the use of the compost/planting bed concept. The general philosophy of building these layers is fairly simple (Fig. 1), and once understood can be easily modified and be within a "reasonable" C:N ratio.

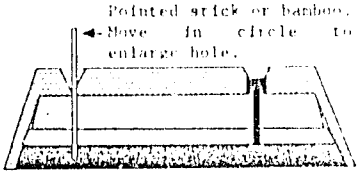
If there is too much nitrogen the beds will heat up similar to traditional composting. If the beds remain cool, monitor the plants for nitrogen deficiencies. In either case it is recommended that the beds be allowed to equilibrate for 3 to 7 days. If the beds heat up, allow them to cool before planting.

The composting/planting bed concept appears to have many advantages e.g. reduced labor input, potentially reduced watering requirements, good yield, and the ability to plant high density crops year-round in the tropics.

This method has proven potential and it is hoped that AVRDC or other international organizations will continue to investigate the potential of this method and its practical application in solving problems of intensive vegetable production in the tropics.

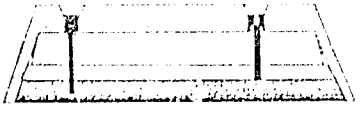


For both seedlings and seeds Dig through the covering material to layer 3.



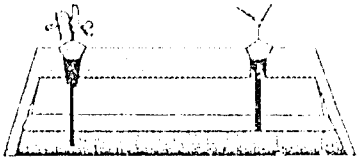
For seedlings: Use a pointed stick or piece of bamboo. Push into bed where seedling will be planted. Push through layer 2 and into the soil (layer 1). Move stick in a circle to make the hole larger.

For seeds: Punch several holes in layer 2 down row. Put soil down row on top of layer 3.



For seedlings: Fill hole partially with good soil.

For seeds: Push seed into soil, sprinkle a little more soil on top and press again. Water but do not pull covering (layer 4) over soil.



For seedlings: Plant seedlings in soil. Pack soil around roots. Pull covering material to stem.

For seeds: After seeds have sprouted pull covering material around stem.

Fig. 1. Planting Seedlings and Seeds in Permanent Composting Beds.

Additional Comments.

- Holes have to be made only the first time the bed is planted.
- Plant many different types of vegetables. This will help with insect control.
- Plant flowers in the sides and ends for insect control as well as esthetics.
- If you cannot "feed" the bed daily, when a crop is harvested, build up that area with additional materials (layer 3), cover (layer 4) and replant. Eventually as all the crops are harvested the entire bed will be rebuilt.
- Sweet potato vines can be planted in the ends of the beds. Insert vines into layer 3.

New Vegetable Project

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Summary

To generate information for the tropics on the vegetables which are not covered under the intensive varietal improvement program of AVRDC, the Center has initiated the new vegetable program in 1981 to evaluate commercial cultivars of five vegetables developed in temperate countries. The five vegetables include: sweet and hot pepper, cauliflower, mustard, radish, and snap bean.

Introduction

Of the 400 vegetables consumed in Southeast Asia, only about 115 are routinely cultivated. Fewer than 40 of these are suitable for commercial production. Most modern cultivars of these vegetables were developed in temperate countries and can only be produced in the limited highland areas or during the cool-dry months in Southeast Asia.

AVRDC's New Vegetable Program was established in 1981 with the objectives of (1) screening commercial varieties of selected vegetables prior to their use by national programs and (2) identifying crops that might warrant future research at AVRDC. By the end of 1984, 62 separate trials, including 45 observational and 17 replicated trials, had been conducted since the beginning of the project. Of the five crops tested, cauliflower (*Brassica oleracea* var. *botrytis*) and hot pepper seemed to have the most potential.

Cauliflower

The outstanding cauliflower lines included "Chia Tai No. 1" from Thailand, "F_1 451" from Taiwan and "Mikado 40 Days" from Japan. The cultivars tested were, however, susceptible to black rot and soft rot.

Hot Pepper (*Capsicum annuum*)

The best cultivars were a Taiwanese hybrid known as "Passion", the American variety "Hungarian Yellow Wax", and the

Korean cultivars "Twist Hot" and "Hong Shan Ho". Viral diseases, southern blight, and bacterial wilt were the major constraints.

Mustard (*Brassica juncea*)

Mustard cultivars of leafy form was more promising than the heading type for lowland production in the tropics because the latter was less susceptible to bolting. Turnip mosaic virus, soft rot, and bolting seemed to be the major constraints of this crop.

Radish (*Raphunus sativus*)

Several useful Chinese cultivars had adequate heat resistance, but the right water, soil, and insect management is needed for them to have good standing and perform normally in the wet season. Most cultivars, particularly open-pollinated ones, showed poor uniformity in root size and shape.

Snap Bean (*Phaseolus vulgaris*)

This vegetable did not perform well as a bush type. The pole bean performed slightly better; "Creasback Yuang Ching" (Taiwan) and "Witsa" (South Africa) being the best. The major problems were rust, charcoal rot, and poor germination.

Sweet Pepper (*Capsicum annuum*)

This type of pepper was less promising. Most test cultivars lacked heat tolerance, although "Gypsy", "Green Boy" (both from USA), and Taiwanese "Blue Star" yielded high. Viruses seemed to be the foremost problem for production in the tropics.

50

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Biological Control of Diamondback Moth in Farmers' Fields

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Summary

In 1984, AVRDC imported a larval parasite, Diadegma eucerophaga, for the control of diamondback moth (DBM) which has become resistant to practically all insecticides being used in Taiwan and elsewhere in Asia. In a preliminary test in 15 x 40 m net house in the field, the insect successfully parasitized DBM larvae and the parasitism significantly increased cabbage yield over the control. Cocoons of D. eucerophaga and a local parasite Apanteles. plutellae were released in the farmers' fields during the study. Results showed that the parasitism of D. eucerophaga increased from 0 to 16% in one month and combined parasitism of both reached 27%. Mass-release of the two parasites together with the application of a microbial insecticide, Bacillus thuringiensis was effective in controlling diamondback moth without the use of chemical insecticides.

Introduction

As a result of intensive insecticide use, the diamondback moth (DBM), Plutella xylostella L. (Lepidoptera:Yponomeutidae), has become resistant to practically all insecticides presently being used. The farmers' indiscriminate use of insecticide results in yet higher level of resistance, exposes farmers and consumers to pesticides, and degrades the environment. In 1984, AVRDC imported from Indonesia, a larval parasite, Diadegma eucerophaga Horstm (Hymenoptera:Icheumonidae) which is specific to DBM. This parasite is established in Indonesia where it is giving good control of DBM (Sastrosiswojo and Sastrodihardjo 1986) and it has been introduced in Malaysia (Ooi 1986, Chua and Ooi 1986). After some tests in large cages on AVRDC field, we initiated a mass-release in the farmers' field.

Materials and Methods

Mass-rearing of Parasites

The host insect, the DBM, was reared initially on common cabbage or rape seedlings in the laboratory. A large number of

cocoons were collected and placed in 0.5 x 0.5 x 0.5 m screen cages. The emerging insects were allowed to oviposit on potted cabbage seedlings for one day. The cabbage seedlings with eggs were maintained in the greenhouse for five days during which the eggs hatched into first-instar larvae.

These seedlings with the larvae were then placed for two days in a 0.5 x 0.5 x 0.5 m cage containing a large number of D. eucerophaga adults provided with honey smeared on a sheet of plastic paper for food. These adults readily laid eggs inside the DBM larvae. The cabbage plants were removed and maintained in a large cage until the larvae pupated. The parasitized cocoons were collected for field release.

The A. plutellae parasite was collected from a Chinese cabbage field in Luchu township and reared on DBM larvae. The rearing procedure is essentially the same as that of D. eucerophaga except that, instead of potted large cabbage plants, one-week-old rape seedlings raised on vermiculite in plastic containers (5 cm diam, 2 cm high) were used.

The seedlings were exposed for one day to a large number of DBM adults for oviposition. After the eggs hatched into first-instar larvae, they were exposed to A. plutellae adults in a cage (0.5 x 0.5 x 0.5 m) for oviposition. The parasitized larvae were transferred to a fresh lot of rape seedlings, and the A. plutellae cocoons were collected for release in the field.

AVRDC test: A 40 x 45 m land was planted to common cabbage in spring 1985. The area was further divided into 40 m x 15 m parcels and each was enclosed in 1.5 m high nylon net. Three weeks after transplanting 250 DBM cocoons were introduced in first two cages and the third cage was maintained as an insect free check. Starting within a week after DBM release D. eucerophaga adults were introduced periodically in one of the two cages where DBM was released. Parasitism of DBM larvae was monitored by sampling the third or fourth instar DBM larvae and recording the number of insects turning DBM or parasite pupae. At harvest we sampled four 5 m x 1.5 m area and recorded the weights of all cabbage head. The yield data were extrapolated to tons/ha.

Farmers' fields: With the help of the Luchu Vegetable Growers Association, a 9-ha area owned by 23 farmers who grew cauliflower and broccoli were selected. Eight release stations were established. Each station consisted of a perforated wooden box mounted on a 1-m-high support. A large number of parasitized cocoons were placed inside each station once every week starting in early August.

Once every two weeks, 500 g of Bactospeine, a *Bacillus thuringiensis* formulation, were distributed free of charge to each farmer to protect their crop against other lepidopterous pests such as cabbage looper, tobacco cutworm, cabbage butterfly, and cabbage webworm. Meetings with all farmers were held once every two weeks to explain the purpose and benefits of DBM biological control and the proper use of *B. thuringiensis*. During the meetings, the farmers' queries about their insect pest problems were also answered.

Observation on Parasitism

Starting early November the whole area was sampled periodically by collecting at random 100 to 150 3rd to 4th-instar DBM larvae, dissecting each, and recording the parasite larvae feeding within.

Results and Discussion

AVRDC test: The parasite readily infested DBM larvae. The average parasitism which was only 13.1% about a month after the parasite was released, reached 65.4% just before the harvest. The yield response of cabbage raised under three regimes of DBM infestation is summarized in Table 1. When *D. eucerophaga* was introduced, the parasitism increased the cabbage yield significantly. In fact the yield was doubled over the control plot where only DBM was introduced. In a cage where no DMB was introduced, the yield was significantly greater over two remaining cages.

Table 1. Yield response of cabbage subjected to infestation by diamondback moth with and without parasite.

Diamondback moth status	Yield (t/ha)
Only Diamondback moth released	7.67c
Diamondback moth + parasite	14.83b
No insect release	30.93a

Planting date: 85/1/16, DBM released: 85/2/7, *D. eucerophaga* released: 85/2/14 to 85/3/4. Harvest date: 85/4/4. Means followed by the same letters are not significantly different at 5% level according to Duncan's multiple range test.

Farmers fields: Until 18 December, about 9,000 cocoons of *D. eucerophaga* and 1,400 of *A. plutellae* were released over the area. Soon after emergence, the adults moved out and were observed searching for DBM larvae throughout the field. Because no chemical insecticides were used, the native parasite, *A.*

Plutellae, started infesting DBM larvae. These parasites were collected, mass-reared, and released back in the field.

The results of the rate of parasitism of diamondback moth by each of the two parasites are summarized in Table 2. A month after the first release, the parasites started infesting DBM larvae. The parasitism of D. eucerophaga increased from 0 to 16% and that of A. plutellae from 0 to 10.6% in one month. This rate was constantly growing with a greater and greater proportion of A. plutellae doing the parasitism. This level of parasitism is inadequate to give complete DBM control; nonetheless, in combination with B. thuringiensis, DBM infestation was under reasonable control without resorting to chemical insecticides.

Table 2. Rates of parasitism of DBM by two larval parasites.[z]

Observation date	Parasitism Percentage		Total Parasitism (%)
	D. eucerophaga	A. Plutellae	
11-5-85	0	0	0
11-12-85	0	0	0
11-18-85	12.2	3.6	15.8
11-25-85	2.0	5.0	7.0
12-3-85	12.6	3.5	16.1
12-11-85	12.8	9.6	22.4
12-18-85	16.3	10.6	26.9

[z]Location: Luchu township in Kaohsiung county.

Some farmers reported unusually large sizes of cauliflower heads and the absence of any DBM larvae in broccoli heads. This level of control was never achieved in the past despite drenching with insecticide cocktails.

The following problems were encountered in the course of the research:

- It is very difficult to convince farmers not to use chemical insecticides despite their unsatisfactory results in pest control. Cauliflower growers also tend to drench flower heads with insecticide mixtures a week before harvest.

- Mass-rearing of parasites should be streamlined to produce a maximum number of parasite cocoons in the shortest possible time. At times unexpected large-scale mortalities occur because of diseases.

- Although a large number of D. eucerophaga was released and the parasite larvae within the DBM larvae was observed, the D. eucerophaga cocoons was not yet seen. This will require continuous release of this parasite until they are established.

Conclusion

Attempts are being made to control DBM by a mass-release of two of its larval parasites, together with the application of Bacillus thuringiensis, in farmers fields in Luchu township in Taiwan. This combined approach gave effective DBM control without the use of chemical insecticides. This program is now being expanded to other areas.

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Strategies for Initiating Collaborative Garden Programs in Indonesia

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Home Gardening Activities at the Institut Pertanian Bogor

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Summary

As an institution of higher learning, the Institut of Pertanian Bogor (IPB) promotes instruction, research, and extension activities in science and technology with emphasis on agriculture.

Two home garden proposals are introduced in this paper: one for the village in Java and the other for the transmigration areas.

The Department of Community Nutrition and Family Resources (CFNR) of IPB proposed the home-and-village-garden approach through the Family/Family Living System (F/FLS) program. The project aims to assist rural families develop a well-balanced system of farm production to increase their income; assist rural families, especially malnourished families, provide nutritious food from limited resources; use underutilized yards in the village to increase local production of nutritious food; improve the village environment economically and aesthetically; encourage women in the village to improve their roles and activities in rural/community development which will directly benefit their families; and assist rural families develop their managerial and technological skills for handling and processing food products (postharvest technology).

The Cikarawang study for the villages of Java aims to develop and use the resources available; improve nutrition, especially of Vitamin A; encourage women's participation in activities that are beneficial to and profitable for the family; and improve the environment. To date, the Cikarawang study consists of four main activities, namely; identifying the location, participants, problems, and solutions; encouraging the main group of participants to recruit their neighbors into the home-garden activity; educating the participants in the preparation, preservation, and marketing of food; and analyzing the data for future garden research.

The Department of Agronomy of IPB, on the other hand, proposed a home-garden model for the transmigration areas (TA).

It recognized that the problems in this areas are different from those of established villages in Java. The TA is considered as test which may determine the success of subsequent trasmigration programs. A successful TA home garden (HG) is one that is functional to the owner in socioeconomic terms. To plan a strategy of HG development, one must know that problems of the area. The proposal set goals of achievement after six months, one year, two years, and three years in self-sufficiency in food and income and in the cultivation of the PIR land. With special aid funds, the target dates are expected to accelerate by one year.

To induce the inhabitants to adopt home gardens, some factors were considered. Priority plants were to be chosen on the following basis: quick-yielding, marketable, industrial, and export. Other considerations were the rate of canopy growth and low labor supply which makes minitillage technique, cropping intensity, multiple cropping, and soil management important and relevant.

An action-oriented research program, in cooperation with agronomists, soil experts, and agricultural socioeconomic experts and farmers, is to be carried out. The research design consists of 12 treatments with three farmers each as replicates. Each year's progress is evaluated in terms of the quickest pay-offs in economy in labor, food stock security, land improvement, increase in productivity, and income.

The Institut Pertanian Bogor

As an institute of higher education, the Institut Pertanian Bogor (IPB) in Indonesia promotes instruction, research, and extension activities in sciences and technology with emphasis on agriculture as a whole.

The development of these activities considers past, present, and future conditions. The outline of the National Goal (GBHN) which is reviewed every ten years, and the Five-Year Development Plan (PPLT) which is reviewed every five years are used as guidelines in constructing the Annual Plan.

As IPB is involved in higher education in agriculture, four different sectors should at least be included: education and culture, agriculture as a whole, health, and manpower. The curricula in four levels - the Diploma (S0), the Sarjana (S1), the Magister (S2), and the Doktor (S3) - in different fields of study within the agricultural field are flexible enough to review the existing academic activities and introduce new ones. Besides those formal programs, short courses can also be organized.

As indicated in the Fourth Five-Year Plan from 1984-85 to 1988-89, agriculture development will include activities in intensification, extension, diversification, rehabilitation, and conservation of natural resources and environment. Activities that advance self-sufficiency in food, improve food quality, increase farm income, and build a happy family life are closely related areas in which IPB can play an important role.

These objectives are translated to courses, trainings, and in the Student Field Work (KKN) where the students directly work, learn and teach, and extend activities such as home gardening in the villages.

In this paper two home garden proposals will be introduced: one for the villages in Java and the other for the transmigration areas. A report on the home-garden-management project is also presented as a precursor of those two activities.

Contribution of Home and Village Gardens to the Improvement of Small-Farm Families [1]

Nutrition improvement is one of the priorities of Indonesian development planning, since it is realized that nutrition affects the growth and development of infants and children, the productivity and well-being of adults, economic development, and sociopolitical stability. In short, nutrition affects the quality of human resources and, hence, the success of Indonesian development. In the Indonesia Five-Year Development Plan IV (Repelita IV), nutrition will be improved through the integrated effort among several sectors, including health, family planning, and agriculture.

Malnutrition and Gardens

The malnutrition problems, although different in magnitude and severity among different areas in Indonesia, are protein and energy malnutrition (PEM), Vitamin A deficiency, iron deficiency, and endemic goiter. During Repelita III, 9.9 million preschool children had PEM; 29 million school-age children, Vitamin A deficiency; 13 million people, endemic goiter; and 12.5 million preschool children, 9 million school-age children, and 14 million adult women had iron deficiency.

The rural poor, including the landless and subsistence farmers are among the most vulnerable groups who require special attention. Limited land resources, low education, and lack of capital and managerial skill make the acquisition of food a critical human basic need.

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[1] Proposed by the Department of Community Nutrition and Family Resources, Faculty of Agriculture, IPB. 1984.

The number of small farmers, however, is evidently increasing from 6.6 million in 1973 to 11 million in 1980. Since the goal of national development is to improve the people's standard of living, it is necessary to set up a program to minimize poverty especially of the landless and subsistence farmers. The programs should consider the existing sociocultural and economic milieu, as well as the felt needs of the farm families.

One alternative approach for this purpose is Farming/Family Living System (F/FLS) research, development, and extension activities on home and village gardens. This choice is based on the following considerations:

1. Home gardens are resources that the poor rural community is fully aware of or utilized for their benefit.

2. Home and village gardens can be used as a safeguard against crop failure, drought, and rural poverty.

3. Home and village gardens are sources of nutritious foods, especially of vitamins and minerals, for the needy families in urban areas.

4. Due to their proximity to households, these gardens can be managed continually and intensively by the families.

5. Home and village gardens can also be used as educational and recreational resource and a place for family interaction in the rural areas.

Goal and Objectives

The home and village garden project is aimed at increasing the quality of life of landless and small farm families in terms of improved nutrition, higher income, and better living by helping them to utilize their available resources.

The objectives of the project are as follows:

1. To help rural families develop well-balanced farm production system to increase their income.

2. To help rural families, especially malnourished families, provide nutritious foods from their own limited resources.

3. To use underutilized yards in the village to increase local production of nutritious foods.

4. To improve the village environment economically and aesthetically.

5. To encourage women in the village to participate in rural/community development which will directly benefit their families.

6. To help rural families develop their managerial and technological skills for handling and processing food products (postharvest technology)

Scope of Work

As proposed by Gershon (AVRDC, 1984), IPB will participate in workshops and overseas training, and will be responsible for in-country training, research, and development of methodologies and evaluation mechanisms.

Research/action research which include extension can be conducted as soon as possible and need not depend on overseas workshop and training, since IPB has enough experienced faculty members to implement the farming/family living system through the home and village garden project. One of the significant and promising activities of IPB in this system is conducted by the Department of Community Nutrition and Family Resources (CNFR), IPB. Since March 1984, CNFR has been doing a preliminary action research on home gardening in Cikarawang village, Bogor. Cikarawang is one of the seven villages around the IPB Darmaga campus, which is frequently used as a social laboratory by the IPB faculty and students for research and extension programs.

This project at Cikarawang village can be improved and developed and used as an important source of information, as well as field experience for the umbrella project on F/FLS in Indonesia. The scope may be broadened to include activities on on-farm research, extension, and development. It will emphasize not only the technical aspect but also the sociocultural and economic factors. The IPB Departments of Agronomy and Agricultural Economics and Sociology will be involved in the project activities with CNFR.

Work Plan

The home and village garden project will be initially pretested at Cikarawang and then expanded to other selected villages around the IPB Darmaga campus and other villages in Indonesia. The plan of work (Fig. 1) is described, as follows:

Step 1. Evaluation of the Cikarawang home gardening management project and collection of base-line data from other selected villages. The socioeconomic and demographic data, as well as technical aspects of home gardens, will be collected from all participating families. Data and information required will also be collected from formal and informal leaders, as well as institutions in the Cikarawang Village.

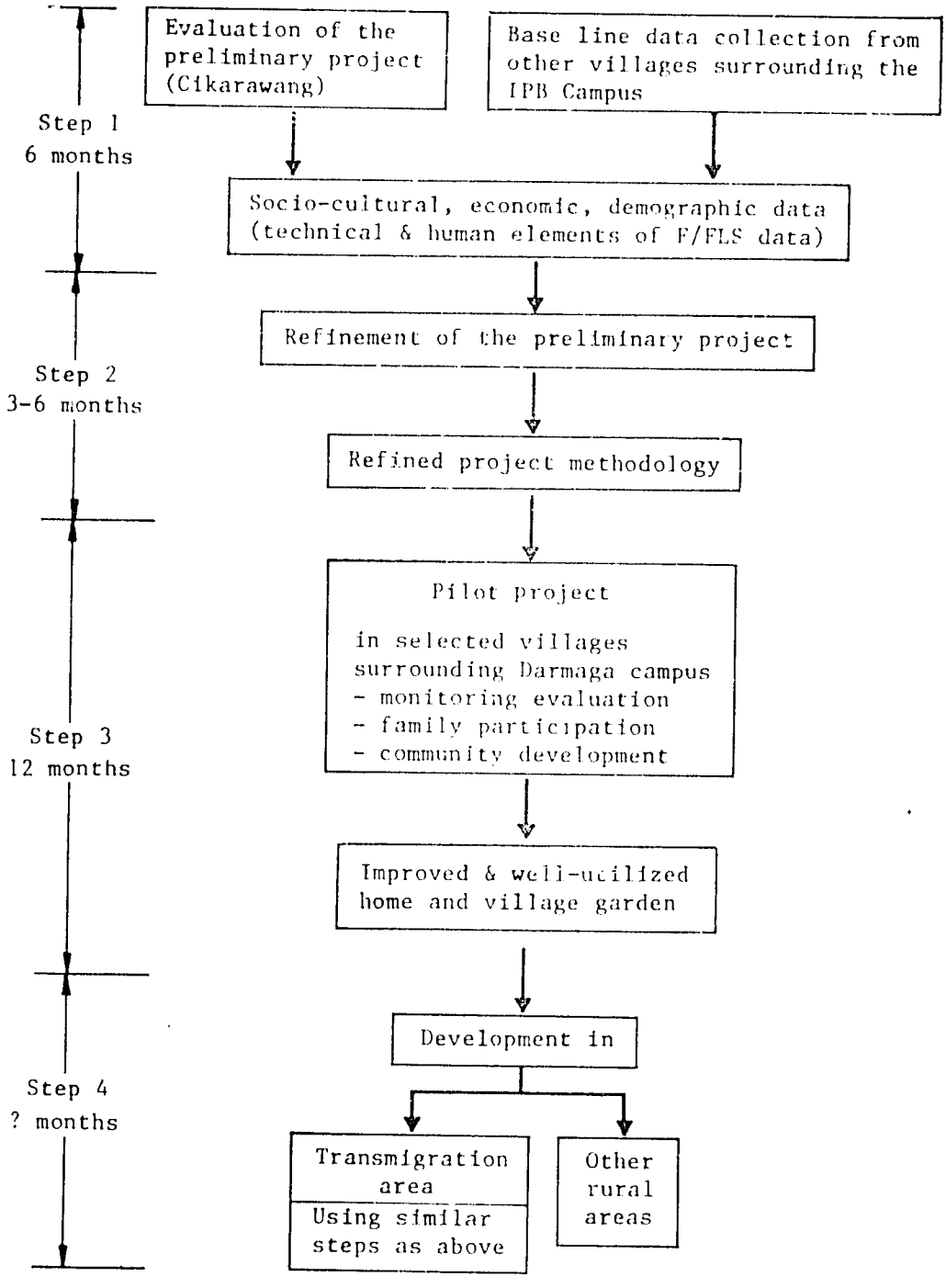

Fig. 1. Work plan diagram

A random sample of families will be selected for in-depth case studies. Nutritional data will be collected in an anthropometric, dietary survey or the subsistence potential ratio (SPR) method from each sample family. Evaluation will also include discussion with the families to find out if the preliminary project fit them and meet their felt needs.

Along with the evaluation of the preliminary Cikarawang project, base-line data on farming/family living systems (both technical and human elements) will be collected from other selected villages surrounding the IPB Darmaga campus.

Step 2. Refinement of the project methodology. Since the data and information collected at step 1 is analyzed and evaluated, the pretested project methodology will be refined to meet the overall objectives of the project being implemented and developed. The refinements will include methodology of research, action research, and extension programs. The implementation and the development of the refined programs will be based on the needs of target families in relation to available resources (human and nonhuman).

Step 3. Pilot project. The refined preliminary project will be implemented and studied in more detail in a pilot project of selected villages. Monitoring and evaluation during the implementation of the pilot project will be conducted continually. Required data and information on both human and technical elements of F/FLS will be collected monthly, to get detailed information of the dynamics of the project for the improvement of future activities.

Participating families will be encouraged to develop their own capabilities in properly utilizing available resources for the improvement of their welfare (better nutrition, higher income, and better living). Therefore, the main characteristic of the project is on-farm research/action research which will continue family activities even in our absence.

Step 4. Development. Project development include the implementation of research and action-oriented research programs in other untested rural areas, especially in transmigration areas. Activities will be similar to the above three steps. In addition, the development of the project will include implementation of the results in other rural areas with similar conditions as in the pilot projects.

Home Gardening at Cikarawang Village[2]

Cikarawang is one of the seven villages in West Java, Indonesia around the campus of the Institut Pertanian Bogor which is under the supervision of the IPB Extension Program. It is frequently used as a social laboratory by the staff members and students for research and practical work.

[2] Siti Nurisjah, Lecturer in the Department of Community Nutrition and Family Resources, Faculty of Agriculture, Institut Pertanian Bogor.

Since March 1984, the Department of Community Nutrition and Family Resources (GMSK) has been doing home gardening (HG) action-oriented research in this village. Besides this project, there are also some others which are currently being conducted, such as the family planning, nutrition, and clean water projects.

The Home Garden Management Project

Low Vitamin A consumption is a major problem in many villages in Indonesia, including Cikarawang. Within the village itself, however, there are some resources of which the villagers have not been aware of or which they have not fully used for their own benefit. Among these are locally grown vegetables that are rich in Vitamin A, an existing yard, or an unused area nearby.

Accordingly, the GMSK department planned an action-oriented research project in home gardening with the following main objectives:

1. Development and use of available resources around villagers' houses;

2. Improvement of nutrition, especially in Vitamin A;

3. Encouragement of women's participation in an activity that will directly benefit the family and is potentially profitable; and

4. Improvement of the environment

Activities

The action-oriented program, starting in March 1984, was planned to last for one year. To date, there were four main activities in this research:

Step 1: Finding the participants for the project, identifying the problems, and helping them in the field. This involved finding the right and proper location, assisting in garden planting, and consulting on maintenance.

Step 2: Encouraging the first or main group of participants to recruit other neighbors initiate a home garden project.

Step 3: Using the garden products. This included nutrition education and instruction in food preparation, preservation, and marketing.

Step 4: Analyzing the data obtained for future garden research.

Other activities were planned on a weekly basis to support the main activities. Among others are cooking contest to evaluate creativity and application of nutrition principles in the preparation of salads and snack food, discussions on the nutritional value of Vitamin-A-rich foods in the diet, and home garden competition on every national day, such as Independence Day.

Results

Up to now, three main results have been observed from this action-oriented research:

1. The factors that discourage the adoption of their home gardens have been assessed: Some houses had a very small yard or none at all. Some yards were shady, and a number of chickens wander in the yards and ate the growing plants. Finally, the local residents were not eating leafy vegetables and were unaware of the benefits of home gardens.

2. The type of extension service that need to be established to encourage villagers, especially women, to use their gardens has been determined: The seed and plant exchange ("arisan tanaman") was one of the appropriate ways of encouraging them to grow gardens. It also trained them to make full use of their own resources and not to depend on others, except on the new garden technology.

3. The number of participants grew from 17 to 42, mainly because they knew the benefits of gardens especially of their economic value. They are now saving money from the vegetables they raised and improving their diet.

The action-oriented research is still continuing up to now. Some other data are still being collected.

Home Garden Model - As a Starter in a Complete FRS in the Transmigration Area [3]

Aside from the functions of the home garden (HG) mentioned by Terra, several other experts emphasized its role as a recourse, especially in famine (Harjono Danoesastro), as a means of land conservation and ecology stabilizer (Otto Soemarwoto), as a germplasm bank (LBN), as a source of income for subsistence farmers (Anne Stoler, David Penny, and Meneth Ginting), and as a source of nutrition (Sri Setyati low-income subsistence Harjadi).

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[3] Proposed by the Department of Agronomy, IPB, 1984.

Lately, interest in transmigration gardens has been increasing. Problems in transmigration areas (TA) are different from those in Java. Their ecology, extent, and role are diverse. The TA is viewed as an initial capital whose proper utilization is important to the success of subsequent transmigration programs.

To a transmigrant, a successful home garden is an "extensive garden with several productive clove trees, a few tens of coconut trees and heavily fruited citrus grown with some livestock, a fish pond, and various plants ready to be enjoyed by city visitors or even given as presents to guests."

It can be said then that a successful garden is one that has a functional relationship with the owner, that is to say, his economic and social functions are fulfilled at the same time. His garden does not only supply him with income and nutrition; it also gives him the opportunity to relate with the community (meeting, sharing) and with himself (resting, enjoying).

In order to be able to plan a strategy to develop successful home gardens, it is necessary to know the constraints and the problems in the transmigration area, in general.

Problems and Potential

The development of the home garden in the transmigration areas generally proceeds by fits and starts. There are only a few kinds of vegetables and fruit trees and not enough shade trees available. Soil maintenance is lacking. Crops cannot be harvested because of floods or pest infestation. If there is any yield at all, it cannot be marketed.

A well thought-out plan for gardening is sadly lacking. Capital is needed for seeds or seedlings. Soil conditions are poor (low pH, clayey), the topography is bad (sloping, often flooded), and labor is scarce.

Despite the many problems and constraints, there are a number of potentials that merit attention, in addition to the size of the area. Women labor is waiting to be tapped in the home garden and marketing of yields. The farmers and their wives have always wanted to increase the types of plants for the "apotik hidup". There are HG skills in the region of origin and available soil improvement technology that need to be used. Improved drainage and good soil management can do much to improve the soil. Better transportation and marketing facilities will go a long way towards pushing the gardening project forward.

Stages of Achievement

After we have understood the problems, the following objectives are expected to be realized within certain reasonable periods of time:

1. After eight months on location there should be a production of carbohydrates (calories for three months), legumes as a source of proteins, vegetables as a nutrient supplement, and a source of cash for kerosene and salt. It should be possible to realize this from ¼ ha of home garden.

2. After one year on location, the family should be self-sufficient in cereals and beans. He should be earning more. This may be possible from 1 ha of land and ½ ha of home garden (Fig. 2).

Area	3months	3 months	3 months	3 months
a. 500 m^2	C_1	L_1	C_2	L_2
b. 500 m^2	L_1	C_1	L_2	C_2
c. 500 m^2	L_2	C_2	L_1	C_1
d. 500 m^2	L_2	C_2	L_1	C_1
e. 500 m^2	Various vegetables : leaves, fruit, roots			

$C_{1,2}$ = cereal 1 and 2. $L_{1,2}$ = Legumes 1 and 2.

Fig. 2. Simple cropping sequences for a ¼ ha HG at the early time, using minimum labor.

3. After two years, there should be enough of cereals and legumes for food and for the market. By this time, the land has increased to 1.75 ha with the home garden steady at ¼ ha.

4. After three years, the farmer should not only be self-sufficient in food and cash, but has also started to cultivate the PIR land (NES-plantation).

This will be achieved if 2 ha of land has been cultivated on the minimum tillage system.

With special aid funds, these objectives are expected to be accelerated by one year. To accomplish this, the following are required:

1. Help in the form of knowledge and skills in planning;

2. Production inputs (hand tractors, lime, rock phosphate, all the seeds needed, etc.);

3. Marketing facilities; and

4. Special instruction or a manual in the use of production inputs.

Plant Priorities

The following priorities should be made in choosing the plants for home and village gardens:

1. Quick-yielding plants: jackfruit, rambutan, jeruk, bananas, pineapple, soursop, and papaya.

2. Plants marketable to Jakarta (for the Trans-Sumatra track): coconut, gandaria, young jackfruit, ginger, jeruk, avocado, petai, and plantain. These command high prices and are suitable for long-distance transport.

3. For industries: clove, gnetum, coffee, pisang ambon (for sun-dried banana), soursop, nutmeg, and certain kinds of pineapples.

4. For export: ginger, camphor rhizome (kencur), nutmeg, and other garden plants.

5. For food and nutrition.

Furthermore, the rate of canopy growth must also be considered. The ones that quickly provide cover must be chosen, especially near the slow-growing trees, such as clove, to decrease erosion, suppress weeds, reduce competition among different crowns. In this case, it is necessary to consider the final canopy at maturity (after ten or more years) to attain the ideal "etage bouw" or "multi-storied canopy" (Table 1).

Another consideration is labor which is in short supply. Therefore, minimum tillage, intensive multiple cropping, and the right cropping intensity must be observed. In addition, the use of the hand tractor is necessary during the initial land clearing stage but must be minimal in the later stages. A correct knowledge of crop rotation (information on types of "heavy feeder," "light feeder," and "high giver" plants) is important.

Action Research

Action research programs must be carried out whose results are immediately felt by the community and tested for improvement

and dissemination to other areas. This program will require the cooperation of the agronomists, soil experts, and socioeconomic experts as extension workers, motivators, cost-analysis investigators, or marketing instructors.

Table 1. Types of crops for which seeds/seedlings to be made available for the first year as input.

Plant	No.	Plant
A. Upper Story and Second Story		C. Herbs & Vegetables[a]
		Ginger, kencur, cucumber, string bean, pigeon pea, taro, pineapple, setaria (forage crop)
1. Coconut (Nias/Hybrid):	10	
2. Clove	16	
3. Tangerine/mandarin	10-20	
4. Coffee	20	
5. Rambutan	5	
6. Jackfruit	10-15	D. Cereals + Legumes[a]
7. Petai/Jengkol	5	
8. Nutmeg	16	Maize
9. Lanson	5	Sorghum
10. Gnetum	10	Upland rice
11. Avocado	2-3	Sweet potato
12. Guayave (big type)	3	Mungbean
13. Jambu air		Peanut
14. Soursop	10	Soybean
15. Durian	2	Kudzu
16. Breadfruit	2	Cassava
17. Gandaria	2	
18. Jeruk Bali (pomelo)	2	
B. Middle Story		
1. Papaya	[illegible]	
2. Pisang ambon	5	
3. Plantain (p. tanduk)	5	
4. Plantain (p. uli)	5	
5. Pisang raja	3	
6. Pisang sereh (susu)	3	
7. Sugarcane		

[a] Plants under C and D groups can be interplanted with the A and B groups.

Table 2 shows the complete HG research program as part of FSR. The time of attainment depends on the funds available. However, it should be possible to set three to five years as the deadline.

In this action-oriented program, the first thing to do is to develop the farmer's ability to plan, that is, the ability to lay out a home garden design. This means knowledge in zoning, plant combination and composition, rotation pattern of annual crops, diversification or choosing a complete set of annual crops, soil conservation, planting and care of fruit-plant seedlings.

Table 2. Action-oriented research program, with the home garden model as a starter in a complete FRS.

Activity	Description
Year 1:	Home garden
a. Soil preparation: liming use of rock phosphate terracing of sloping land	
b. Planting of cereals Planting of legumes, vegetables	
c. Composting Preparation of planting holes for trees Planting of hedges	
d. Planting of trees	
Year 2:	
a. Correct plant rotation (cereal, legumes, vegetables	Home garden
b. Preparation of fields (½ - 1 ha)	Field for agronomic crops
c. Continuation of tree planting	Home garden
d. Livestock & poultry raising	Home garden
Year 3:	
a. Cultivation of 2 ha of field	Field for agronomic crops
b. Maintenance of trees (fertilization & pruning)	Home garden
c. Continuation of coverage of the soil with camphor roots, ginger	Home garden
d. Livestock & poultry raising	Home garden
Year 4:	
a. Start with work on the land for PIR garden	Field for agronomic crops
b. Maintenance of the home garden during spare time	Home garden
c. Planting and maintenance of the field according to the season	Field for agronomic crops
d. Livestock & poultry raising	Home garden
Year 5:	
a. Maintenance of the garden	Estate crops
b. Maintenance of the home garden	Home garden
c. Maintenance of the field	Field for agronomic crops
d. Livestock & poultry raising	Home garden

Table 3 shows the plan of the action research. There are a total of 12 treatments with three farmers in each treatment as replicates. Each year, progress is evaluated in terms of savings on labor and food stock, land resource improvement, and increase in productivity and income. From a complete study with sufficient replications, reliable conclusions can be drawn and concrete suggestions made. In all this, stress is laid on the agronomic aspects of guidance, since most physical constraints to be faced by the farmers are new.

Table 3. The design of the action research for transmigration farmers.[a]

A_1. Institution provided

- B_1. Production inputs provided
  - C_1. Given design D_1 (interculture type)
  - C_2. Given design D_2 (multistoried type)
  - C_3. Without design (farmer's own design)
- B_2. Without production inputs
  - C_1. Given design D_1 (interculture type)
  - C_2. Given design D_2 (multistoried type)
  - C_3. Without design (farmer's own design)

A_2. Without instructions

- C_1. Given design D_1 (interculture type)
- C_2. Given design D_2 (multistoried type)
- C_3. Without design (farmer's own design)
- B_2. Without production inputs
  - C_1. Given design D_1 (interculture type)
  - C_2. Given design D_2 (multistoried type)
  - C_3. Without design (farmer's own design)

[a] Three farmers are chosen from each neighborhood, so the total is 36 farmers.

The HG system can be considered a complete farming system including perennial trees, forage crops, and animals instead of annual crops only. This can stimulate soil improvement (for clay and peat soils) by manure and compost production, rendering upland farming more productive and averting environmental deterioration by preventing weeds and erosion.

The HG research, especially the action-oriented research, can be a multidisciplinary activity which is easily designed on a group of village farmers. By following the instructions, the farmers are expected to develop a sense of responsibility within a year after implementation. Cooperation among farmers is started at the planning stage and continues until the marketing of their products. This type of activity will influence the construction of a marketing system that will include collecting, packaging houses, group transportation, etc.

The HG development guidance, especially in transmigration areas, should help small farm families improve their standard of living from the development of a well-balanced nutrition, and health, in increased income, and better social life.

Home Gardening and the Family Improvement Program in Indonesia

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Summary

The family nutrition-improvement program (UPGK) in Indonesia especially aims to remedy Vitamin A deficiency, nutritional anemia, goiter, and protein energy mulnutrition (PEM). The inclusion of the home gardening component is expected to improve family diet and to serve as channel for teaching nutrition and food production at the family level.

Hopefully, the project would change the people's food consumption behavior and attitude towards leafy vegetables, establish a market system for garden products, improve family income, and provide a regular source of seeds.

The project will be carried out informally through the local social organizations in West Java and other provinces where anemia and xerophthalmia prevail.

The Institute of Horticulture, Bogor Agricultural University at Pasar Minggu Jakarta, Center for Research Development in Nutrition (CRDN), the agricultural institutes at the district level, and other relevant agencies will be involved in the preparation, implementation, and evaluation of the project. Possible funding could be provided by the Indonesian government, in conjunction with foreign agencies, such as the United Nations Children's Fund (UNICEF), United States Agency for International Development (USAID), Helen Keller International (HKI), International Development Research Center (IDRC), Food and Agriculture Organization of the United Nations (FAO), and World Health Organization (WHO).

Introduction

The Family Nutrition-Improvement Program (UPGK) in Indonesia is a part of its national health development program. The main goal of the program is to improve family nutrition throughout this country to eliminate protein energy malnutrition (PEM), nutritional anemia, Vitamin A deficiency, and goiter. One of the operational components of the program is concerned with home gardening.

The justifications for including home garden in the UPGK program are discussed below.

Relevance and Approach

This component is expected to motivate people to be self-sufficient nutritionally and financially. It could also be used as a strategy to further educate the family in proper nutrition and to encourage each one in the household to do his share.

Home gardening is very relevant to research development of Indonesia. Much fertile land around the houses at most village areas is not being intensively utilized to prevent malnutrition within the community, especially that of nutritional anemia and xerophthalmia.

To motivate people to participate in home gardening activities, these should proceed along at least, four approaches. First, the food habits of the household especially of the children under five (CUP), should be changed and directed towards the consumption of more dark green leafy vegetables (DGLV). A better marketing system must be established to absorb the products and improve family income to motivate them to grow gardens.

Strategies have to be studied which will override the negative beliefs and perceptions within the culture towards leafy vegetables and other garden foods. Finally, provisions should be made for a constant and ready availability of seeds for home gardening.

Design of the Study

The nutrition education for the home garden intervention project should be carried out informally through local social organizations. The change agents within and outside of the community should be given important roles to do. The study could be carried out in West Java and other provinces where nutritional anemia and xerophthalmia are still highly prevalent.

An evaluation of the process and impact of the project has to be done. Any variable, such as food consumption behavior, biochemical components, etc. which are relevant to those operational activities will be recorded.

Expertise is available at the CRDN, in the district agricultural institutes at Bogor Agricultural University, Institute of Horticulture at Pasar Minggu Jakarta, and other relevant institutions involved in the preparation, implementation, and evaluation stages.

Possible funds could be provided by the Indonesian Government in conjunction with foreign agencies, such as the United Nations Children's Fund (UNICEF), United States Agency for International Development (USAID), Helen Keller International (HKI), International Development Research Centre (IDRC), Food and Agriculture Organization of the United Nations (FAO), and World Health Organization (WHO).

-14-

7

Research to Improve Gardening in Indonesia

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Summary

Gardening protects the soil, improves land capability, settles people down, and provides a relatively stable income. A good gardening system can also provide a healthy environment.

Most gardening systems are, however, small and managed traditionally. In the urban areas, gardens are maintained for commercial purposes without regard for environment and plant-resource conservation. In the transmigration area, however, the garden space is often too big for the farmer's family to handle; and less attention is paid to producing nutritious vegetables.

The system can be improved through intensification, diversification, and area extension where productivity is low. It should also aim at efficiently utilizing indigenous resources, improving soil productivity, protecting the environment, and increasing family income. The research approach should, therefore, include the following:

- Testing of various crops with the following characteristics:

  a. adaptable to local conditions
  b. nutritious
  c. with a high market value
  d. soil-enriching

- Testing farming models which are productive and amenable to an integrated research approach.

Suggested steps to implement research are as follows:

- Select proper site which represents the existing soil, agroclimate, and socioeconomic conditions.

- Collect data regarding the soil and climate of the site.

- Produce sufficient seeds of various crops.

Garden as a Component of the Rural Ecosystem

The rural ecosystem consists of four subsystems: the village, rice field/upland, forest, and river (Sumarwoto, 1974). The gardening system is part of the village subsystem. From the ecological point of view, it plays an important role in the integrated approach to prevent and rehabilitate critical land. The system effectively protects the soil, improves land capability, provides settlement for people, and supports a relatively stable income.

An effective protection is one that shields the soil from excessive rainfall, sunlight, and wind. In the garden, an efficient cycling of organic matter production could be observed. The production of various plant organic material and the application of manure maintains soil fertility. The system improves land capability and family income through two phases. In the first phase it provides the daily nutritional needs of the farm family, and in the second phase it can produce enough for the market as additional source of income. Improving traditional gardening with better cultivation methods, fertilizer use, crop protection, and water management will considerably enhance family income. In the next phase, production increases quantitatively and qualitatively with better crop varieties and livestock choice.

A good gardening system can also provide a better and healthy living environment. It can be achieved through better space planning based on proper choice of crops which are ecologically adaptable, nutritious, productive, and profitable.

Problems

Current garden systems are still managed traditionally: no significant improvement has been made to intensify cropping. In the urban areas, crops are planted mainly for commercial purposes without any regard for environmental conservation, including preservation of plants' genetic resources. Any possible garden area has been crowded out by building constructions. Statistical figures (1969) showed that the total garden area in Indonesia was about 16.88% of its agricultural land or about 2.3 million hectares (Satsijati, 1980).

In the transmigration area, however, the average garden area is relatively large and usually exceeds the management capability of the farmer's family. Every transmigrant family is provided with 2 ha of land, including a 0.2 ha family garden. The newly opened land needs proper cultivation to maintain its fertility. Less attention has been paid to producing crops that provide sufficient and a well-balanced nutrition, including Vitamin A, Fe, protein, and calories.

Improving the Gardening System

Improvement of garden management can be achieved through intensification, diversification, and area extension. So far, efforts done in intensification and diversification of gardening is mainly directed towards improving daily family nutrition. More efforts should also be made to increase family income from the garden. A more diversified cropping system could also provide ecological stability, efficiently utilize sunlight and water, and spend less energy in maintaining soil structure and productivity.

Increasing the average garden area should be practiced in marginal area to make up for low productivity. Proper selection of crops adapted to the local condition should be carefully done.

Research to Improve Gardening

Research in gardening should be directed towards producing system garden models that effectively and efficiently utilize available resources to increase soil productivity, increase family income, and maintain the ecology. The long-term objective should aim at eventually enhancing agricultural development.

Research activities should, therefore, include the following:

1. Testing for crop adaptability to local conditions and the ability to produce a sufficient and a more balanced nutrition for the family;

2. Testing for crop acceptability and suitability to local conditions;

3. Testing for crop combinations suitable to local conditions and able to explore and maintain the existing soil productivity; and

4. Testing farm models which are productive and profitable in an integrated garden system.

Steps for Implementing Research

1. Collect information regarding the climate and soil of the garden site;

2. Select the site which represent the existing soil, agroclimate, and socioeconomic conditions;

3. Produce a sufficient amount of seeds of various kinds of crops to be planted;

4. Introduce or adapt various kinds of crops and their technology components;

5. Test various combinations of crops that efficiently utilize the existing resources and minimize pest and disease infestation; and

6. Evaluate various garden models to solve farmers' problems in the region.

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Strategies for Initiating Collaborative Garden Programs in the Philippines

Food Production Through Home Gardening

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Summary

Home gardening has been advocated in the Philippines for many decades. Although vegetable consumption by Filipino households has significantly improved over the years, the contribution of home gardening to this improvement is quite insignificant. Since 1974, efforts have been intensified to promote practical home garden technologies in which some breakthroughs have been achieved in some areas of the country.

The 1982 survey of the Food and Nutrition Research Institute (FNRI) showed that 76% of the households participated in food production, that only 27% of preschoolers had ideal weights, that some are afflicted by night blindness (1,8%) and Bitot's spots (1.4%), and that anemia (26.6%) was present in all age groups.

The survey also indicated an increase from 1978 in adequacy levels for energy and Vitamin A, but a decrease in protein and iron. Only about one-third of the households had adequate protein and energy levels.

Of the mean one-day per capita intake, vegetables contributed 61% of iron, 39% of calcium, and more of calcium, thiamin, and reboflavin.

Despite the relatively significant contribution of green leafy and yellow vegetables to nutrient intake, the average per capita consumption of 12.4 kg/year fell behind the recommended allowance of 32.4 kg/year. This means that about 106 t are needed to meet the national requirements.

Remedies to fill the nutritional gaps have included food sufficiency programs designed to intensify food production at the home level. The Bureau of Agricultural Extension has supplied households with seeds and seedlings.

The "magic square" garden technology is composed of vegetables and root crops which are nutritious, inexpensive, and easy

to grow in a square meter of ground. This garden is also encouraged in schools and in the homes through the school children.

Printed materials (manuals, brochures, food prescription pads, etc.), the radio (through the "Seeds for Life" program), video tapes, the NCP Nutri-bus, and the Barangay Nutrition Scholar are some of the media through which information is being disseminated.

Introduction

Home gardening has been advocated in the Philippines for many decades now. Its promotion has been part of the national food production effort. Although vegetable consumption by Filipino households has significantly improved over the years, the contribution of home gardening to this improvement is quite insignificant. There is still a wide gap between home gardening advocacy and actual practice by households in the country. This gap is attributed to lack of garden space and time, especially among urban dwellers. As early as 1974, efforts have been intensified to promote practical home garden technologies in which some breakthroughs have been achieved in some areas of the country.

The Undernutrition Problem

The significance of nutrient inadequacy can be shown in its effect which is malnutrition, as manifested by low weight, poor physical performance and growth, and slow mental development of young children.

Results of the 1982 Food and Nutrition Research Institute (FNRI) survey showed that 1.6% of preschoolers (one to six years old) were severely underweight and 15.6% moderately underweight, according to the weight-for-age standards. Twenty-seven percent of the same group had ideal weights for their age.

Findings of the same survey revealed the prevalence of night blindness (1.8%) and Bitot's spots (1.4%) among preschoolers (two to six years old). About 0.3% manifested both signs of the disorders. The extent of the anemia problem indicated by low hemoglobin level was 26.6% for all age groups, but was highest among infants (51.3%) and pregnant women (48.6%).

Nutrient Adequacy Levels

The 1982 FNRI Food Consumption survey showed an increase in the percentage of adequacy levels in 1978 for energy (from 88.6% to 89%) and Vitamin A (95.1% to 97.8%) and a decrease in protein (102.9% to 99.6%) and iron (91.7% to 91.5%).

Further, about 34% of the households had energy adequacy levels below 80%, while 30% had protein adequacy levels below 80%. It was high among common laborers (40%), fishermen (36%) and semi-skilled laborers (36%).

It is also worth noting from this survey that vegetables alone contributed 61% and 39.4% of the mean daily per capita intake for iron and calcium, respectively, and more than the daily share of calcium, thiamin, and riboflavin.

Food Adequacy Levels

Despite the relatively significant contribution of green, leafy, and yellow vegetables to nutrient intake, it is important to note that the average per capita consumption of 12.4 kg/year fell behind the recommended allowance of 32.4 kg/year. With this recommended allowance as basis, about 106 metric tons are needed to meet the national requirements. As projected in the Philippine Food and Nutrition Plan, food needs in 1984 were estimated to be 548,958 metric tons, which was 32% of the recommended dietary allowance (RDA) of 1.7 million metric tons. Six regions of the Philippines were noted to have adequacy levels lower than the national average.

In 1983, the value of vegetables in the Philippines was estimated at $0.8 billion or 3.3% of the total crop production of $1.9 billion. About $4.7 million worth of vegetables was exported in 1982. Further, it was noted that about $42 million worth of vegetable seeds is imported annually.

As shown in the 1982 FNRI survey, 76% of households reportedly participated in food production. The percentage was lower in urban (51%) than in rural (87%) households.

The mean daily per capita peso value of food bought was $0.18 and $.03 was home-produced.

Remedies to fill the nutritional gaps have included food sufficiency programs designed to intensify food production at the home level. The Bureau of Agricultural Extension has supplied households with seeds and seedlings through the Homemaker's Clubs. Support programs of the Ministries have been launched to supplement the campaign for backyard food production.

Magic Square Meter Gardens

The "magic square meter" garden is an economical method of using backyard space for growing food. This method was introduced and developed by an agriculture specialist from the

University of the Philippines at Los Banos. It is so-called because the method propagates the planting of vegetables and root crops that are of the "plant, forget, and harvest" varieties in an area as small as one square meter.

These nutritious but inexpensive food crops that families can grow in their magic square home gardens are sweet potatoes for tops and tubers; "kangkong" (upland variety) for tops; "malunggay" for leaves and young pods; "ampalaya" for leaves and fruits; "alugbati" for tops; "patani", "batao", winged bean, and other legumes for green pods or dry beans; cassava for tops and roots; peanuts; and "gabi" for leaves and tubers.

Although it is recognized that calorie and protein malnutrition cannot be solved through home gardens alone, the activity can help partially correct the estimated nutrient-intake shortage by making additional nutritious crops available to the family. A study showed that a family of eight has to plant a 400-square-meter lot to sweet potatoes, corn, and legumes to fill the protein and calorie gap. Since most urban dwellers do not have this sizeable amount of gardening space, a two-square-meter area planted to kangkong or sweet potato tops will do to supply all the Vitamin A and C requirements of a family of eight.

A square meter of sweet potato which can yield 5 kg in four months can provide the following approximate amounts of nutrients: energy - 850 cal, protein - 6.9 g, iron - 4.4 mg, Vitamin A - 5625 IU's, and ascorbic acid - 219 mg.

Productive magic square gardens have been tended by 95% of the families in Barangay Bulacao, a village in Cebu City, south of the Philippines. This concept was introduced through the organized homemaker classes where mothers are required to set up a magic square garden. More families now appreciate the value of having a little space for easily grown vegetables.

Backyard Gardens Through the School

Self-sufficiency in food at the home level is also being encouraged in school. By strengthening communication among the teacher, child, and parents, nutrition messages are effectively relayed to the home through the school child. The schools in Bulacao also served as the ideal media for the implementation of the magic square garden and in its spread and acceptance by other Cebu City barangays.

In collaboration with the Ministry of Education, Culture and Sports, the teacher-child-parent package of self-instructional manuals, which also contain lessons on food production, are provided to teachers as teaching guide.

Information, Education, and Communication (IEC) Support

In support of these food production programs, IEC print materials, such as flip charts, food prescription pads, fact sheets, and brochures are developed by various agencies, such as the Nutrition Center of the Philippines (NCP), for households and implementors.

Radio programs also serve as an effective medium in disseminating information on food production. The "Binhi sa Kinabuhi" (Seeds for Life) program launched in Cebu encourages families to tend home gardens by providing free seeds. Contests for mothers are held as part of the motivation scheme.

Video-tape recording modules on food production integrated with family planning are also developed by the Nutrition Center of the Philippines in cooperation with the Commission on Population. The dissemination of nutritional messages on food production and related nutritional health messages in video is done through the NCP nutri-bus delivery system, a comprehensive and cost-effective system of providing supervision and logistical and communication support to the village worker called the Barangay Nutrition Scholar.

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85

9

Home Gardening Research and Development Program in the Philippines

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Summary

Malnutrition is proving difficult to alleviate despite significant research breakthroughs made in food production. Fruits and vegetables are rich in vitamins, minerals, carbohydrates, and protein. They are also easy to grow in small areas. If every household grows them, families would be healthier and it would be easier to identify malnutrition problems.

Technology and systems, however, need to be developed and tested. Home gardens must be inexpensive and easy to maintain. They should appeal not only nutritionally but also financially and aesthetically. Problems, such as garden pest control, planting systems, and inadequate urban space have to be studied. Research, therefore, is of crucial importance for a successful home garden program.

The study aims to increase the supply of fruits and vegetables by developing methods of producing and utilizing them in the easiest, most economical, and effective way in backyard/home gardens.

The study specifically aims to: develop packages of technology for growing and utilizing selected vegetables; develop simple and rapid techniques for propagating fruits and vegetables and prolonging viability and vitality of seeds; determine methods of effectively and efficiently handling and utilizing the products; and to test and pilot developed package of technology for home gardens.

The study will be conducted for five years and it has two components: research and development.

The research component shall be composed of three projects which will be conducted over a period of three years, namely: cultural management of selected vegetables and fruits (4 studies); fruit crops for the home garden (2 studies); and maximization of nutritional effects (3 studies).

The development component shall be a testing of the pilot package of technology for home gardens. This portion shall

involve families or homeowners, as well as school teachers and students.

The proponent of the study is the Philippine Council for Agriculture and Resources Research and Development (PCARRD). It will be implemented by the University of the Philippines at Los Baños (UPLB). The cooperating agencies include: the Asian Vegetable Research and Development Center (AVRDC), Ministry of Agriculture and Food (MAF), Ministry of Education, Culture and Sports (MECS), and Nutrition Center of the Philippines (NCP).

Rationale

Malnutrition is one of the problems facing the developing countries today, including the Philippines. Despite significant strides in its food production program, the pressure of population growth, compounded by a troubled economy, have all but written off these gains.

Although the United States has been providing assistance in the form of food which is distributed to the needy, the distribution scheme itself has proved costly and is fraught with problems. If anything, this system may have done more harm than good in the long run in terms of its social implications and goal of attaining self-reliance.

It is common knowledge that vegetables and fruits are the richest source of vitamins and minerals, and some can also provide adequate quantities of carbohydrates and protein. These crops are easy to grow and do not require extensive farm areas since every available space is a potential production area. If every home can produce its own supply of vegetables and fruits, families will be healthier and the country could reduce its food expenditures. Admittedly, however, this is easier said than done. Technology and systems remain to be developed and tested, if they are to improve and promote home gardening significantly as an essential key to better nutrition. Research, therefore, remains a crucial issue.

For home gardens to be a continuing project, it must get the interest of some, if not all, members of the family and must be relatively easy and inexpensive to maintain. It must appeal to both nutritional and financial aspects, as well as aesthetic sense. Thus, there is a need to find ways of growing those crops the easy way and to prove that they add to savings and improve family health. It is also important to make vegetables as competitive as ornamentals in beautifying the home surroundings.

Some of the problems of a home gardener are generally like those of a large-scale crop grower, although the factors affect-

ing these problems are different. Solutions that work for the latter cannot be used by the home gardener, however. For example, different insecticides are usually recommended to control different insect pests of different crops. A home gardener, however, cannot afford to buy ten chemicals just because he has more than ten different crops.

The town or city dweller has a different problem altogether. There is usually not enough space for a garden; or if there is, the soil is usually not suitable. Growing in containers will make it possible for him to have his garden. The technology, however, is still lacking. This in itself presents an interesting area for research.

Another problem is the nature of the garden itself. The typical Philippine home garden is quite different from those set up in Western countries. There are no standard systems of planting, and likewise, there exists a tendency to produce a wide range of products for the home from a small area.

It is in this context that a seminar on home gardening and consultation with the Asian Vegetable Research and Development Center's (AVRDC) expertise, was conducted at the Philippine Council for Agriculture and Resources Research and Development (PCARRD) in Los Baños, Laguna last December 1984. The main objectives of this activity were to assess the existing home gardening program in the Philippines, evaluate the status of technology available on this area, and to determine the direction of research as it relates to the country's food and nutrition program.

Objectives

General. To increase the supply and consumption of nutritious fruits and vegetables by developing methods of producing and utilizing them in the easiest, most economical, and effective way in backyard or home gardens.

Specific.

1. To develop a package of technology for growing and utilizing selected vegetables;

2. To develop simple and rapid techniques for propagating fruits and vegetables and for prolonging the viability and vitality of seeds;

3. To determine effective methods of handling and utilizing the products fully; and

4. To test the pilot developed package of technology for home gardens.

Duration. Five years.

Project Description and Scope

The program shall comprise research and development components. Research studies on cultural management and crop protection will soon be implemented under the existing backyard gardening program in the country. A socioeconomic research has been carried out as back-up for the implementation of the technical aspects of the project.

Research Component

The research component shall be composed of the following projects which will be conducted over a period of three years.

Project 1. Cultural Management of Selected Vegetables and Fruits

Study 1. Sequencing of crops. To maximize the use of a small area and to enhance the complementation of several crops, the proper sequence of crops will be looked into. Various combinations and sequences of crops within the year for different sizes of gardens will be studied. The results obtained will be tested under different conditions. Schemes of incorporating vegetables into the overall landscape of the yard will be devised.

Study 2. Soil improvement. The use of organic materials, such as kitchen refuse or washing, plant debris, animal manure, or any farm waste, will be investigated as mulching and/or fertilizer materials. Effective methods of using these materials will be determined. These may involve techniques of composting, combining the use of several materials, best time of application, and others.

Study 3. Integrated pest management. A search for an effective, cheap, and safe chemical to control insects and diseases in a wide range of crops will be made. The properties of certain plants in relation to fungicides and insecticides will also be tested to make them less toxic. To users, especially because vegetables are continuously harvested, residue levels will be monitored. Means of controlling other pests, such as rodents and nematodes, will also be investigated.

Study 4. Container growing. The best size of pots for particular vegetables or the combination of vegetables for a particular size of pots will be determined. The amount

of soil will be measured and the optimum number of pots that can provide for the needs of families of different sizes will be determined. Appropriate soil mixtures using available resources when good soil is not easy to obtain, will be formulated.

Determination of the kind and amount of fertilizer, as well as frequency of weathering, will likewise be dwelt with. Finally, the possibility of making use of vegetable and fruits grown in containers as decorative features for the home will also be explored.

Project 2. Fruit Crops for the Home Garden

Study 1. Selection and propagation of selected fruits. Selection of fruit trees appropriate for home gardens will be done and techniques for propagating selected varieties through cuttings and other methods will be developed. Topworking techniques will also be tried and developed. Observations will also be made on the dwarfing effects of different rootstock-scion combinations. Other promising techniques will be evaluated.

Study 2. Regulating flowering and fruiting. Relatively simple cultural practices, such as bending, leaf-stripping, girdling, chemical induction, etc., that may promote early flowering or control it will be studied.

Project 3. Maximizing Nutritional Effects.

Study 1. Evaluating crop mixes. The cropping schemes in Project 1 will be evaluated with respect to their nutritional value and on the cost-and-return analysis. The recommendation will be added to the information on the studies regarding crop production technology.

Study 2. Postharvest handling. Results of the studies on postharvest handling of vegetables conducted by the Post Harvest Training and Research Center (PHTRC) at the UPLB will serve as guide for further research on other vegetable crops not yet studied by the Center. The best stage to harvest vegetables to get their fullest nutrient value will be determined. Methods of maintaining the good quality of surplus will also be investigated.

Study 3. Processing and utilization. Simple, effective, and cheap methods of processing small amounts of vegetables and fruits will be devised. Other uses of vegetables in the home will, likewise, be investigated. Recipes will be formulated and tried for acceptability.

Development Component

The development aspect calls for the testing of the pilot package of technology for home gardens. This portion shall involve families or homeowners, as well as school teachers and students. The initial phase of the pilot stage shall cover the provinces of Laguna and some portions of Metro Manila. Later on, area coverage shall be expanded to include other provinces and regions of the country. This study shall be conducted over a period of four years starting on the second year of the research component.

Management Aspect

A management committee shall oversee the program implementation. This will be chaired by the PCARRD Executive Director or his duly appointed representative. Members will come from AVRDC, UPLB, MAF, MECS, and NCP. The management committee will take charge of evaluating the soundness of the implementing plan, formulate policies and guidelines for an efficient and effective coordination and execution of the program, and define specific tasks for which each participating agency assume responsibility.

Overall coordination shall be handled by PCARRD with technical assistance from AVRDC. The proposed management and organizational set-up are shown in Figs. 1 and 2.

Foreign agencies, such as the United States Agency for International Development (USAID) and the Asian Development Bank (ADB) with the assistance of AVRDC, shall be tapped as possible sources of funds to support this program.

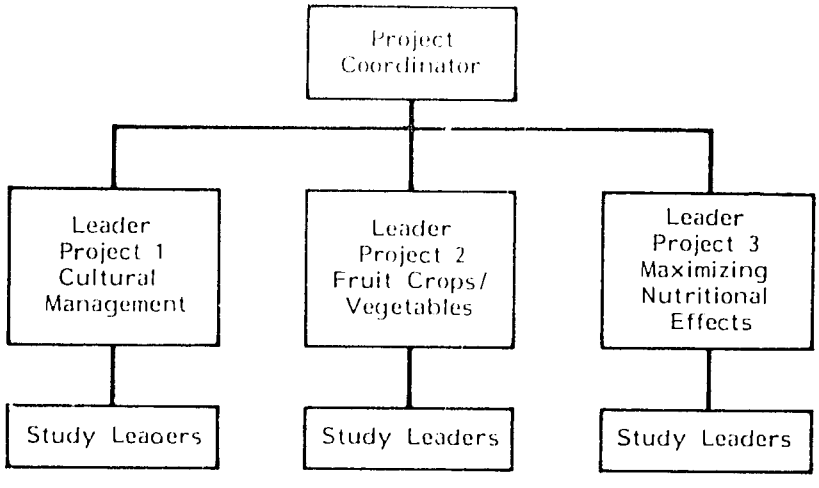
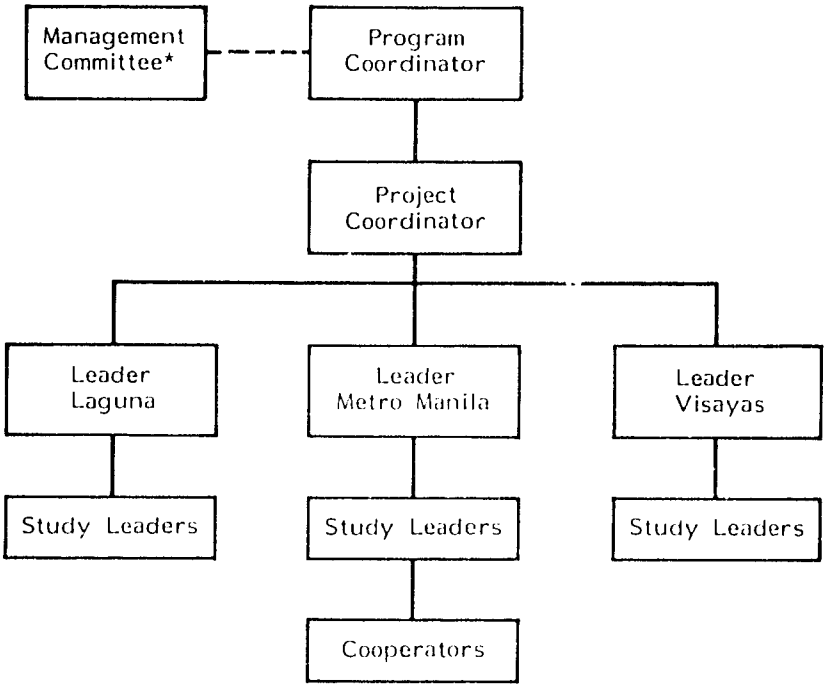


Fig. 1. Proposed organizational set-up for the research component (phase I) of the home gardening program in the Philippines.



* Composed of the PCARRD Executive Director or appointed representative as Chairman and members from AVRDC (Consultant/junior staff), UPLB, MECS, MAF, and FNA.

Fig. 2. Proposed organizational set-up for the development component (phase II) of the home gardening program in the Philippines.

Budgetary Requirements

Table 1. Budget for the proposed home garden research and development program (in thousand US dollars).

Item	Year 1	2	3	4	5	Total
I. Research Component						
A. Personal services (management costs, AVRDC consultant/junior staff and other technical staff)	15	18	20	-	-	53
B. Maintenance/operating expenses (local and international travel, supplies and materials, contingency and administrative costs, others)	20	25	28	-	-	73

Table 1. Continued.

Item	Year 1	2	3	4	5	Total
C. Trainings/seminars/ workshop	2	2	2	-	-	6
D. Equipment outlay	-	3	3	-	-	6
Subtotal	37	48	53			138
II. Development Component						
A. Personal services (management costs, AVRDC consultant/ junior staff and other technical staff)	-	30	38	40	42	150
B. Maintenance/operation expenses (local and international travel, supplies and materials, contingency, administrative costs, others)	-	28	30	33	36	127
C. Trainings/seminars/ workshops	-	5	6	7	-	18
Subtotal	-	63	74	80	78	295
Grand Total	37	111	127	80	78	433

Characteristics of the Bio-intensive Approach to Small-scale Household Food Production

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Summary

The bio-intensive approach to household food production differs from the conventionally introduced gardening systems because of its stress on deep-bed preparation, nutrient recycling, building up of the soil's biological base, diversified cropping, and its emphasis on a balanced and integrated ecosystem.

Some of the characteristics of the bio-intensive approach as developed and promoted by the author are: sustainable system, self-reliance in production inputs, space intensive, water conservation, labor-intensive rather than capital-intensive, risk-free technology, improved family nutrition, income generation, pest control, elimination of health hazards, conservation of genetic resources, and ecologically sound.

The bio-intensive approach to food production at the household level differs considerably from the conventionally introduced gardening systems because of its stress on deep-bed preparation. nutrient recycling, building up of the soil's biological base, diversified cropping, and a balanced and integrated ecosystem. Here are some of the characteristics of the approach as developed and promoted by the author.

A Sustainable System

The bio-intensive approach, as the name suggests, is a biological (as opposed to chemical) form of agriculture in which a small area of land is intensively cultivated with the use of nature's own ingredients to rebuild and then maintain the soil's productivity. At the heart of the approach is the effort to improve the soils capability to nurture and sustain plant life. What a bio-intensive gardener tries to do on his small plot is to simulate or replicate a natural forest (with the constant recycling of nutrients and maintenance of soil, moisture, and microbial conditions). Many countries of the world (and China is particularly notable) have farmed biologically for thousands of years and have been able to sustain output levels over those

years. In sharp contrast the "efficient" but short-sighted approaches being used in many Western and Third World countries have often been disruptive of the natural resource base.

Farmers in many parts of the world are experiencing the fact that they have to use steadily increasing quantities of fertilizers and pesticides to sustain previous yield levels.

In the bio-intensive approach being recommended here for small-scale plots, the soil is gradually enhanced and the composition of beneficial microbial life actually improves from season to season. The soil structure and humus content is also greatly benefited. The nutrient content of the soil is built-up, rather than depleted, after each crop. A healthy soil means a healthy stand of plants, and that means less insects and diseases. In the bio-intensive approach, yields continue to rise for the first few years and then tend to stabilize at an overall higher yield. Such systems and the outputs (i.e. yields) are easily sustained at that level for many years with unchanging or even reduced levels of material and labor inputs.

Self-Reliance in Production Inputs

The bio-intensive system is characterized by a greatly reduced dependence on expensive inputs that are generally used in conventional food production approaches. Many of these nonrenewable inputs, such as chemical fertilizers and pesticides, are produced at high energy costs (usually petroleum-based). Instead of chemicals, plant and animal wastes and natural mineral substitutes are used. In the methods being advocated here, the inputs required are bones, wood ash, egg-shells, compost, ipil-ipil leaf meal or fish meal (only in places where they are readily available).

Locally available seeds are advocated rather than hybrid and other wholly imported substitutes. Experience suggests that it is feasible to achieve a 100% self-reliance in recurring input needs. Other than hand tools, all material inputs are usually available locally or within easy access. This reduces significantly or eliminates the need for cash outlays. It also provides the producers with a sense of control over the required production resources. Finally, by emphasizing the use of local and biological resources, rather than energy-intensive, fossil-fuel-based chemical imports, a small step is being made in the direction of conserving the world's nonrenewable resources.

Recycling

Every bio-intensive gardener attempts to maximize the use of plant and animal residues and wastes. In an attempt to

return to the soil much of what came out from it, these organic materials is recycled back into it. Unfortunately, these materials are transported away from the site, dumped in the garbage, or burned.

A bio-intensive gardener usually composts such plant and animal wastes before returning it to the soil and add other materials, such as ash, bone meal etc., to replenish the soil. Soil requires food just as humans and animals do. Once again the example of a natural forest and how it regenerates itself through continuous recycling (dead trees and fallen leaves decompose on the forest floor with help from forest animals and microbial life) is helpful in understanding the need for recycling nutrients in the backyard garden.

Typically, today's soils in conventional farming are being literally mined, with little or no recycling of organic matter. In the past, various approaches to permit regeneration, such as leaving lands to fallow or abandoning swidden (slash-and-burn) plots for periods of 3 to 10 years were done to permit the regeneration of plant and animal life to rebuild organic matter. In other parts of the world in recent years, particularly in India, available chemical inputs were combined with animal manure to retain the organic matter partially in the soil.

In the bio-intensive approach organic matter is returned to the soil in the form of compost after each crop. The cultivation of a range of crops (each of different rooting lengths) tends to retain organic residues in the soil at different depths. (When plants are pulled out rootlets and root hairs invariably remain in the soil.) Organic matter builds and sustains soil life and no amount of chemicals can do that job. Such organic manure helps break up sticky and hardened clays and holds together separate soil particles of a sandy soil.

Organic matter acts like a sponge that soaks up moisture and retains it for future plant use (at a level in the soil where it is readily accessible to the plant. It can contribute to the buildup of earthworm population which in turn improves the aeration and nutrient status of the soil. John Jeavons of Ecology Action indicates that earthworm castings are five times richer in nitrogen, seven times richer in phosphorus, and eleven times richer in potassium than the soil they inhabit. When you consider that earthworms produce twice their weight in castings everyday, that's a lot of nutrients added to the soil!

Space-Intensive

Given the use of bio-intensive techniques, between 200 to 500 sq ft of land area (depending on how much land is available) is all that is needed to meet the vegetable needs of a family.

This makes the approach highly relevant to areas where there is a high population pressure on land resources or if people are landless. Landless people often have access to at least some backyard space. Also, organizations can often arrange for small community lots where each family can be allocated 200 to 300 sq ft for intensive gardening.

In many parts of the world, particularly in the continent of Africa, land may not be a limiting factor; but other inputs, such as water and fertilizers, are usually severely restricted. Since bio-intensive gardens almost always produce higher yields per unit area compared to conventional approaches, such intensive plots might be relevant even in areas where land is not limited. The bio-intensive plot is intensively used throughout the year. Plant spacings are such that leaves barely overlap when plants are fully grown. Maximum use of space is achieved through companion cropping, succession cropping, and multi-canopy cropping. Because of these techniques, yields are much higher per unit area than in most conventional systems.

Water Conservation

The bio-intensive approach described in this paper uses significantly less water than conventional garden plots. The method of deep-bed preparation and the fact that soil in the bed remains loose (only the soil in the path between beds is subject to compaction), permits the absorption of most of the water which is applied or falls (in case of natural rainfall) on the bed itself. Once in the soil, the judicious quantity of compost which was added to the soil serves to retain moisture within the rooting zone.

The closer spacing of plants recommended in the bio-intensive approach reduces the evaporation of water from the soil surface as a result of the sun's action. Mulching (a layer of grass or straw applied to the soil and between plants) serves to keep moisture loss to the minimum. Close spacing further protects moisture from the action of the wind on soil and plants.

Labor-Intensive Rather than Capital-Intensive

The bio-intensive approach is labor-intensive and, therefore, suited to small-scale, family-centered food production. It is also particularly relevant to the poorest section of society who generally lack capital but invariably have an underutilized family labor. None of the groups the author has worked with ever complained about the hard work involved. The complainants are invariably the well-to-do and the officials not used to hard manual work.

Typically, the two beds recommended for a family takes six hours to prepare (time estimates range from 3 to 10 hours per bed depending on the condition of the soil). However, in the long run, the amount of labor invested reduces from season to season. In the second season, for example, bed preparation time is usually cut by half.)

Risk-Free Technology

The use of readily available natural resources and the total reliance on family labor in the bio-intensive approach being advocated here reduces any financial risks to the family. The use of organic nutrient sources, the continuous improvement of soils, and the growing of a highly diverse selection of vegetable (usually eight to ten in two beds) tend to reduce the pest problem very significantly.

If pests do cause damage, only a portion of the crop is lost because of the diversity of crop types grown. The risks of monocropping are eliminated here. If a complete shift to traditional varieties (those that have been around for generations) is done, the pest problem and, therefore, the risks are often negligible.

Improved Family Nutrition

One of the most important reasons for raising ones own vegetables with organic methods is the high nutritional quality of the produce. The nutritional value of a vegetable is greatly affected by soil conditions. The carbohydrate, vitamin, protein, and mineral contents are linked to the soil's mineral and trace-element content. One needs a healthy soil in order to produce a healthy vegetable crop.

The emphasis on techniques that do not involve the use of costly inputs tends to provide a greater assurance that vegetables produced this way will be consumed. The emphasis on a diversity of vegetables improves the range of food typically available. By growing a diverse selection of vegetables (as opposed to monocropping) the availability of nutrition-rich vegetables is spread more widely through the season.

Also, since only small quantities of many different kinds of vegetables are being produced, the incentive to sell such produce is reduced. It is when only one or two crops are raised that peak harvests result and the products are sold to the neglect of family nutrition. Special emphasis is given to the nutritional aspect of vegetable gardening and the preparation of vegetables (e.g. amaranthus), legumes (including winged bean), the root crops, and fruits more commonly grown.

Income Generation

The dependence on home-grown vegetables usually results in a significant saving of cash resources which can be used for nonfood needs of the family. However, the bio-intensive approach can also be used as an income-generating project, through the production of vegetables for sale to nearby markets. However, such ventures must be preceded by a well-designed educational campaign to ensure that, at least, a certain percentage of the harvest is used at home.

The cultivation of a wide variety of crops tends to insulate cultivators against the risks of price slumps resulting from an over-production of a particular crop. If the bio-intensive approach is to be used for income generation, the number of beds needs to be increased from two (each 100 sq ft) to at least 10 or 12. If these are prepared during the slack period (e.g. after harvest), bed preparation can usually be accomplished over a period of time and with no cash outlay through family labor or through community help.

Pest Control

In the bio-intensive approach, the soil and not the insect is considered the source of the problem. The wide diversity of vegetables within a single bed tends to reduce insect infestation. In addition, specific plants are raised because their odor helps repel insects from other plants surrounding them. The use of indigenous and resistant varieties of vegetables also further reduces pest problems. The very fact that these indigenous varieties have been around for generations says something about their resistance to pests.

Finally, various organic (usually botanical) formulations can be prepared at home for use on small areas of land. These formulations are generally prepared from locally available material and have no adverse effects on the environment and pose no health hazard to the gardener or the consumer of the sprayed vegetables.

Elimination of Health Hazards

Every year hundreds of thousands of people are killed due to accidental poisoning by agricultural chemicals. However, what is equally concerning is the cumulative deposits of chemicals in the human body (chronic toxicity) which do not result in immediate deaths but may have long-term effects, the origins and causes of which are usually difficult to trace. The lack of "controls" in developing countries often account for the importation of banned chemicals or the use of chemicals without the required safety precautions.

Pesticide residues of vegetables in markets of the developing world are frightfully high. Adequate information is already available to suggest that the health hazards at the family level, both in the developed and developing world, are serious. The bio-intensive gardener may not be able to solve all the chemical hazard problems, but he can ensure that all his own vegetable harvests can be totally free from such dangers. Thus, the produce harvested from such a garden is worth far more than its market value in money.

Conservation of Genetic Resources

The bio-intensive approach, as developed by the author, puts a strong emphasis on the use of indigenous vegetable varieties. Ideally, a home garden should aim at 100% dependency on selected traditional seed varieties. This strategy not only provides a sigaificant insurance against pests due to diversity, inherent hardiness, and pest tolerance (through years of evolution) but also ensures that this valuable heritage of humankind is conserved for future generations. The best conservators and curators may not always be the seed banks but the farmers and gardeners themselves.

Another aspect stressed by the author is the inclusion of indigenous plants which have insect-repellant properties, as well as applications for home remedies for minor ailments. By encouraging the use of traditional medicinal plants with proven value, such plants (and knowledge) are conserved for future generations.

Ecologically Sound

The bio-intensive approach suggests that human beings must work with nature rather than attempt to dominate and control it. Renewable sources of energy are used in this system. Every attempt is made to maintain an environmental balance. The nonuse of increasing quantities of chemical-based inputs reduces environment contamination that tends to persist in the soil for many years after their use (i.e., they are not bio-degradable).

The use of animal manures (in countries where they are not already being used, as in part of the Philippines and Africa) can reduce environmental sanitation problems and related health problems in rural areas. The bio-intensive approach at the home garden level can set people thinking about the larger environmental issues. It can get people to question what they may hitherto have accepted as an inevitable consequence of modernization and development.

100

Strategies for Initiating Collaborative Garden Programs in Thailand

101

11

Strategies for Initiating Collaborative Efforts for Extending Present AVRDC/Thailand Garden Activities

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Summary

Thailand is the largest food exporter in Asia, yet malnutrition still prevails. Unless adequate food distribution, proper food habits and practices, and health protection are promoted, a healthy Thai population is unrealistic.

Thus, a multidisciplinary and comprehensive model for nutrition activities at the grass-root level is in great need. The AVRDC garden project, which has demonstrated that a suitable designed household garden is feasible and culturally acceptable, might be incorporated into existing programs.

It was in the 5th Five-Year Plan that the nationwide implementation of the food and nutrition policy materialized and gained momentum. The favorable outcome of the policy was due to the collaboration at the central and provincial levels under the Poverty Alleviation Plan. The Ministries of Health, Agriculture, Education, and Interior are involved and integrate their activities at the village level through the village committees.

The AVRDC garden model can be incorporated in the following existing programs, namely: village nutrition project; poverty alleviation plan; school lunch program; and agricultural extension activities.

Training of participating extension workers, teachers, and cadres needs to be done. Research on the following areas also deserves attention: nutrition education, dietary approach with other Vitamin A varieties, and an institutionalized tropical technology.

Introduction

As a food producing nation, Thailand is unrivalled in Asia. In fact, Thailand is the largest net food exporter in the Asian

continent. Nevertheless, it is equally well recognized that malnutrition still prevails in this resource-rich country. This undoubtedly shows that food availability or food supply is only a prerequisite not a guarantee for good nutrition. The nutritional status of an individual, family, or a community is inherently determined by food availability, food consumption, and ultimately, metabolic utilization in the human body. Unless adequate food distribution, proper food habits and practices, and health protection are well promoted, the attainment of a healthy population in this country is quite unrealistic.

Thus, multidisciplinary and comprehensive models for nutrition activities at the grass-root level are highly desirable and are in great need. The AVRDC garden project, which has demonstrated that a suitably designed household garden is feasible and culturally acceptable for nutrition intervention purposes, might be incorporated into the existing programs. Not only are Vitamin A and other vitamin deficiencies prevented, but the consumption of other macronutrients is also increased.

Relevance to the Next Five-Year Plan

In Thailand, the food and nutrition policy was first included as an entity in the 4th five-year National Plan for Economic and Social Development (1977-1981). The most significant accomplishment of this policy during that period was the creation of a strong awareness of malnutrition problems in both private and government sectors at all levels. However, it was not until the 5th five-year Plan (1982-1986) that nationwide implementation has finally materialized and gained momentum. The main thrust of the Fifth Plan's nutrition policy does not entirely lie in its nutritional program per se but in its program of poverty alleviation and development of backward areas. This is a major change from the previous plan which emphasized overall growth almost solely and expected the benefits to trickle down to the rural areas.

The favorable outcome of the food and nutrition policy implemented during the past three years was due to both intra- and inter-sectoral collaboration at both the central and provincial levels under the Poverty Alleviation Plan. The main objective of this plan is to improve the quality of life for 7.5 million rural poor residing in 37 provinces of the north, northeast, and the south by assisting them to overcome their poverty-related problems of hunger, sickness, ignorance and general deprivation. Four major Ministries i.e., Health, Agriculture, Education, and Interior are involved and integrate their activities at the village level through the village committees. Major policy instruments employed are rural job creation during the dry season; small-scale village development projects such as village fishponds, village water resources,

small-animal disease control projects etc.; together with the provisions of basic services such as health facilities, nutrition, clean water supply, etc.

It is intended that the Sixth National Development Plan will further incorporate the poverty alleviation plan by strengthening the rural, small-scale, locally and technologically appropriate development programs. The AVRDC model gardens, especially the home and school gardens, can definitely be incorporated into the program. Further innovative market and processing gardens will be the next step to be tested and assessed for future implementation. Moreover, this proposed intervention, which involves the expenditure of scarce public funds, fulfills the social investment criteria; that is, the impact can be social rather than private.

Implementation

It is quite obvious that the AVRDC garden model is suitable for a rural setting in Thailand. The model can be incorporated into the existing programs, as follows:

The innovative village nutrition project. The project was initiated on a trial basis in some 90 villages in three northeastern provinces where malnutrition was highly prevalent. The project has been expanded to cover at least one subdistrict in each district throughout the whole country through a USAID loan fund to the Ministry of Public Health (MOPH). Main activities include nutrition surveillance, food supplementation activities, and nutrition education activities. Household gardens can supply significant amounts of vegetables, and promoting them is an effective way of improving nutrition with minimum resources.

Village development projects within the Poverty Alleviation Plan. In order to measure the progress of these development programs, the Basic Minimum Need (BMN) indicators have been recently developed, tested, and refined. The gardening program can be considered a supportive activity to improve nutrition which is one of the most important BMN indicators.

School lunch program. The school garden program can be implemented in order to provide nutritious vegetables to students. Provided by school gardens, cooked and fresh vegetables added to the rice lunch box could significantly contribute to a child's daily needs for certain vitamins and minerals. Educational activities can also be easily incorporated to the program which could have a spillover effect on the parent at home.

Agricultural extension activities. At present, home gardens and somewhat bigger gardens on a cooperative basis have

been promoted through mother's and youth's groups in thousands of villages throughout the country. However, these subsistence activities are usually seasonal or temporary. Insufficient water for cultivation during the dry season and lack of technical and financial support are the main obstacles. Financial support through agricultural extension programs, together with experiences from AVRDC can definitely make a significant contribution towards improving nutrition at the household and community levels.

Training

To implement the AVRDC model in the programs above, expanded training programs are needed not only for agricultural extension workers but also for teachers and local cadres participating in the program. The main topics should cover the production requirements of many vegetable crops, the complex cropping systems involved in small-scale gardens, and basic nutrition education on the value of vegetable crops and on balanced diets.

Workshops for high and mid-level personnel should be held in order to formulate the strategies and curriculum for training as well as some managerial skills if the project would include market and processing vegetable gardens.

Research

The following areas deserve attention and further studies:

1. Effective nutrition education will be indispensable for transmitting information, changing attitudes, and eventually altering feeding and eating behavior. Once community members are convinced of the importance of improving nutritional status, the promotion of home and/or village gardening can probably be more satisfactorily accomplished.

2. Although a study from IMNU confirms previous studies in India and elsewhere that ß-carotene in various green vegetables can be adequately absorbed and also converted to Vitamin A effectively, more research is needed on the dietary approach with other varieties for the prevention of Vitamin A deficiency.

3 Institutionalized tropical technology improvement research. It is crucial to identify varieties that can be grown in the semi-arid northeast of Thailand. Varieties that mature asynchronously will be more nutritionally beneficial. In addition, pest control research is needed to ensure fresh and pesticide-free daily vegetables.

185

Summary

106

12

Evaluation of the AVRDC Garden Project in Three Asian Countries

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and

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Summary

Impressive progress has been made in the garden technology transfer in Thailand. Families have accepted amaranth and vegetable soybean showing that people can change food habits to improve their diets. Similar programs have not yet been initiated in Indonesia and the Philippines, but participants from those countries seemed enthusiastic about pushing for funding and government support.

It was decided that the two main needs of the outreach program were training and quality seed availability. Seeds are currently subsidized by private and government agencies. However, commercial seed companies have to be tapped to take over this job. It is suggested that AVRDC take an active part in the formulation of seed policies and programs.

The writer suggested research on nutrition assessment of home gardens, improvement of the food composition table, nutrient absorption, breeding and identifying adapted varieties. Research on soil fertility, water management, and pest control were also mentioned.

Introduction

The AVRDC gardening project was evaluated mainly by participating in the VIP Gardening Workshop held in Thailand and Taiwan from April 22 to 26, 1985. Following the workshop, discussions were done at AVRDC with Dr. Gershon and members of the staff. The consultant appreciated this opportunity to meet with people who focused their diverse disciplinary backgrounds in horticulture, nutrition, and economics on all aspects of the nutritional gardening project.

Progress in Technology Transfer

From observations made on representative gardens in 24 small-family farms, it can be said that impressive progress has been made in the transfer of garden technology to Thailand. The gardens were well cared for and were clearly producing substantial amounts of vegetables for the families involved. One of the most encouraging aspects of this pilot project is that the families have accepted amaranth and vegetable soybean as new components of their diets. These are both highly nutritious and productive vegetables. Questions have been raised as to whether people will change their food habits to include new items. It appears that they will do so, at least in Thailand.

Attempts have been made to initiate programs in Indonesia and the Philippines, but according to Dr. Gershon, these have not so far been successful. Efforts to obtain funding for the garden outreach program from FAO, local USAID Missions, and the Farming Systems Support Program funded by AID-Washington have not been successful despite large amounts of time and travel funds invested. The failure seems to revolve around the geopolitical location of AVRDC, delays in acting on proposals, and conflicting information about the mechanism for submitting proposals.

Nevertheless, the AVRDC garden project has generated some outside support in the form of approximately $150,000 from GTZ for its Taiwan activities and $45,000 for gardening training at the AVRDC/Thailand Outreach Program (AVRDC/TOP).

It was heartening to observe the enthusiasm of the workshop participants to extend the AVRDC gardening technologies to Indonesia and the Philippines. The nutritionists were particularly outspoken about this. Plans were discussed at length about "knocking on doors" of both government and local USAID Missions to get support funds.

Substantial work has been done at AVRDC and at Kasetsart University in Bangkok to simplify Dr. Hagan's farming systems approach and adapt it to the local situation. Even in its modified form, however, record-taking may still be too much for the LDC farm family. The socioeconomic study showed that it takes only 15 minutes more per day to grow home gardens than to shop for vegetables.

Training for Technology Transfer

The primary objectives of the AVRDC outreach program are research and demonstrations. However, some facilities have also been used for training. In fact, funding support for AVRDC/TOP has recently been extended for three more years by the Asian

Development Bank (ADB) with major emphasis on training for people who cannot come to AVRDC. Included is $15,000 per year for gardening training. Continued development of this location as a training center is a logical means of implementing the recommendations of the workshop participants for additional training in technology transfer.

The decision makers agreed on two main needs of the outreach program: (1) training for technology transfer and (2) better availability of quality vegetable seeds. Beyond these, a desire was expressed for the biochemical determination of the nutritional status of families with and without home gardens.

Most participants spoke in general terms about the need for training which the AVRDC garden program is in a unique position to provide. A few specific suggestions included: (1) to assist in the preparation of training guides, such as the one planned in Thailand; (2) to assist in the preparation of promotional materials for doctors, nurses, and clinics, all of whom need much better nutritional information than they have now; (3) to prepare materials to enrich school curricula on home gardening; and (4) to prepare educational materials for consumers regarding the nutrient content of vegetables.

Some specific needs that were voiced suggest research that might be done at AVRDC or at in-country research organizations, while others might involve adaptive research that could be done largely by national outreach programs. Some of these include:

1. Technology to maintain soil fertility for high production
2. Technology for water management in household gardens
3. Safe and effective pest control without chemicals, whenever possible
4. Identification of varieties best adapted for each country

Availability of Quality Vegetable Seeds

During the workshop the limitation most often cited as hindering a sustained vegetable gardening was the difficulty of getting viable seeds of the right varieties. In response to this need, numerous volunteer, philanthropic, and government organizations have distributed much vegetable seed to home gardeners, often without charge. All too often these seeds are low in viability or unadapted to the tropics and, therefore, low in productivity. Also, free or subsidized seeds make difficult competition for private seed companies which are needed in the long run as a sustained seed source.

The AVRDC pilot project has so far provided the necessary seeds without charge, but it is not clear how a continuing supply will be available; and this is clearly a major concern to

the workshop participants. There are some promising developments in Thailand and the Philippines. The Seeds II Project in Thailand is aimed at providing technology and encouraging private vegetable seed companies. In the Philippines, Planters Products has begun to distribute seeds of superior varieties identified or bred by the colleges of agriculture. The private seed company Hortigen Philippines has been started as a joint venture of experienced Dutch, American, and Philippine seedmen. Those companies which have started or will be started in other countries, especially in Indonesia, must be encouraged. AVRDC has a stake in the private seed companies because they are needed to capitalize on AVRDC seed-production improved varieties and reduce the Center's present activities.

I suggest that AVRDC take an active part in assisting with the formulation of seed policies and programs. This might take the form of workshops and fellowships to give policy makers an opportunity to travel to developed countries to study successful vegetable seed production and distribution programs. It is assumed too often that programs for field seeds can be applied to vegetables, but this is simply not true. In most staple field crops, such as rice, seed is the economic product. If the crop can be grown successfully, seed of some sort is automatically produced. This is not the case with many vegetables - cabbage, onions, carrots, etc. - where conditions for seed production may be entirely different from those for growing the crop itself.

Agencies which have been distributing seeds on a free or subsidized basis should be involved in planning for the eventuality of phasing out this activity. They could provide a transition for private companies which have not yet established a network of distributors. However, if these companies are to be viable in the long run, their seeds must be sold at a price that covers cost of production and a reasonable profit. Distribution costs are usually greater than production costs for seeds sold to home gardeners. Contributing to the distribution costs might be a means by which volunteer agencies could help the development of a private seed industry.

Suggestions for More Research

Assessment of home gardens on its impact on nutrition could be done by comparing food intake components of the gardening and nongardening groups, and this has been done to some extent in the Thailand pilot project. A better method would be by biochemical studies which have become feasible through recent improvements in instrumentation. Small blood samples, obtained quite easily by finger-pricking, can be analyzed to determine nutritional status. A favorable location for doing this would be in northeast Thailand where Dr. Yongyout Kachonpadunkitti,

who has both an interest in vegetable gardens and the expertise needed for the type of study, is working.

The following additional research at AVRDC is suggested to provide improved garden technology for AVRDC/TOP.

1. Improved food composition tables using present rapid and economical methods to determine the nutritional composition of foods as they vary with season, storage, cooking method, etc.

2. Absorption of nutrients and availability from different sources, similar to recent studies showing fat as essential for Vitamin A uptake and Vitamin C to enhance iron availability.

3. Breeding or identifying adapted varieties and lesser-known crops with high nutritive value and adaptability to home gardening conditions, should be studied. High salinity, low fertility, heat, drought, and flooding are all conditions which may require special crops or varieties to fit each situation.

Conclusion

The consultant found this workshop a stimulating experience because of the notable enthusiam of the participants for the AVRDC garden project in research and in the transfer of the technology to Thailand. Although they recognize that getting funds for outreach programs in their own countries will be difficult, they seem determined to make a serious effort.

13

Funding of Gardening Activities in LDCs: Thoughts and Suggestions

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Summary

Gardening as a project component has not yet attracted additional funds from donor agencies. This is partly due to lack of proper technology development and testing, poor transfer to recipients, and inadequate assessment of its impact.

In order to obtain funding for garden-related activities in less developed countries (LDCs), these activities should be promoted within the context of projects that are of interest to donor agencies. It might best attract funds if the activity is part of an international development project.

A number of constraints have contributed to this problem in funding. Among them are the lack of information, planting materials, research, training for extension workers, evaluation, impact. etc.

One funding strategy is to utilize existing AVRDC outreach programs which are linked to national programs. A second possibility is to link AVRDC garden programs directly to an in-country institution. The third is to seek funds for gardening technology development and transfer to specific projects, such as the northeast rainfed project in Thailand, transmigration project in Indonesia, homestead food production projects in Bangladesh, and cropping systems projects in the Philippines.

A collaborative effort with AVRDC might assist national programs in achieving funding goals.

Introduction

Gardening is often one of the activities of development projects in less developed countries (LDCs) generally started by national programs in response to national needs. Support for such projects often initially comes from the national programs. Once this commitment is made and a particular development project shows feasibility, additional support is often obtained from donor agencies under their international development funds.

Gardening as a project component has not yet attracted additional funds from donor agencies. This is partly due to lack of proper technology development and testing, poor transfer of the technologies to recipients, and inadequate assessment of the impact of gardening. In the past three years, AVRDC has addressed itself to these constraints, producing good gardening technologies, designing ways of transferring the technologies to LDCs, and developing methodologies for assessing impact. The AVRDC-type gardens established in Thailand, in collaboration with Kasetsart University, show good promise. Published reports on these garden activities may assist Thailand in obtaining future support. It is now time to look into that possibility, not only for Thailand, but for all LDCs.

This paper will examine some of the problems and prospects of gardening activities in LDCs and offer some suggestions. It will also attempt to address itself to one general question: can technical collaboration with AVRDC help national programs attract additional donor-agency support for development projects containing gardening components?

Prospects

In order to obtain funding for garden-related activities in LDCs, these activities should be promoted within the context of projects that are of interest to donor agencies. Garden projects alone do not readily attract donor-funding except in the case of private voluntary organizations (PVO), such as, CARE, UNICEF, and Peace Corps garden projects.

A gardening-related activity might get funding from large donor agencies if the activity is part of an international development project. Many development projects include the promotion of home gardening in their contexts to improve nutrition, increase local food production, raise health standards, etc. The following are some examples:

- Primary health care projects can include a demonstration and training center for home gardening.

- Nutrition rehabilitation projects often have clinic gardens as an education tool for mothers of malnourished preschool children.

- Rural development projects can have, as a development scheme, a gardening component for home consumption or for income generation.

- Women in development projects can include gardening as one activity for women who have the responsibility for, but not always the control over, the means for feeding their families.

- Resettlement or transmigration projects will often give new settlers a parcel of land, a small portion of which is to be reserved for home food production. These projects can have a gardening component.

- Tea or rubber plantation development projects also give workers a parcel of land and try to promote gardening on a portion of the land.

- Income-generation projects can include promotion of a combination home/market garden, where some vegetables are grown for consumption and others for sale.

- Maternity and child health projects often have, as a main activity, the monitoring of children's growth. These projects can also include a home garden component as one way of helping to promote growth.

- Food-aid projects often distribute foods which provide calories and some protein. These projects and their recipients can benefit from a home garden that can provide additional essential nutrients.

- Nutrition education projects can use gardening as a way to teach the production and consumption of culturally acceptable forms of specific nutrients.

These are just some of the agriculture-related or nutrition-related international development projects that can and often do promote gardening. They are projects that are ongoing or are in future five-year national development plans of most LDCs. Historically, they have been the type of projects large donor agencies find receptive for funding.

Constraints

In the past, some constraints reduced the positive effect a garden component would have on the success of a project. The subsequent result has been that project planners and donor agencies became hesitant to include gardening in the design and implementation of international development projects.

Information on how to grow and maintain a good garden has not always been available. The crops to select for the desired outputs have perhaps not been known. Sources of reliable planting materials may not have been readily available. Gardening may have declined during the dry season. Gardens perhaps were not initially researched to show their regional feasibility. Village-level extensionists may not have received adequate training in gardening and/or nutrition. During a project the collection of baseline data, monitoring, evaluation, and

impact assessment may not have covered the gardening component in a manner that would demonstrate its value.

Overcoming Constraints

For the past three years AVRDC has conducted gardening research and development and training, and transferred these technologies to one LDC, Thailand. Information is now available on growing and managing a garden. Crop selection and planting schedules have been developed that produce desired outputs. Sources for quality seed are determined, or the seeds grown as part of a project. AVRDC's new vegetable research project has identified heat-tolerant temperate-zone vegetables suitable for the tropics. Ongoing work on a composting garden suggests that layered composting material can result in water-retention capabilities that will need only 50% of the normal water requirements - a possible boon to dry-season gardening. The AVRDC entomology department is working on some promising biological pest-control experiments that may eliminate the use of pesticides in garden environments of some LDCs.

In addition, feasibility study methodology has been designed and tested. On-farm pilot projects have been conducted that can result in garden design for different regions. A number of young agriculturalists have been trained at AVRDC in the linkage between agriculture and nutrition; and AVRDC, in collaboration with Kasetsart University, is developing a gardening training guide for village-level extensionists. Finally, AVRDC has developed methodologies for the collection of baseline data, monitoring, and assessment of the impact of a gardening component on the overall results of a project.

Many of the constraints of gardening components in international development projects have not been alleviated. It is now time to incorporate these new technologies and methodologies into existing or planned LDC projects that are generally related to nutrition and/or agriculture. Identifying additional in-country funding possibilities would then be the next step.

Suggested Funding Strategies

National programs might first design garden activities into development projects where such activities are deemed appropriate. AVRDC can then assist in technology development and transfer, and provide methodologies to quantify the essentials and assess impact. Then the national programs can solicit additional funds from other sources.

One possibility is to utilize existing AVRDC outreach programs. These programs are now in Thailand, Philippines,

Indonesia, Korea, and Malaysia. They are extensions of AVRDC that are linked to national program and conduct research and development (R & D) on AVRDC's five mandate crops.

Funds could be solicited to support gardening technology development at these sites, the results of which could be further tested regionally on the farms. Once tested, the technologies can be phased into various development projects. Also, as new or improved gardening technologies are developed at AVRDC-Taiwan, they can be transferred to each outreach programs's gardening project, adding additional technical input.

A second possibility is to link the AVRDC garden program directly to an in-country institution, as has been the case in Thailand (though some initial gardening R and D has been conducted at the AVRDC-Thailand outreach program). This could be the type of international development project that increases institutional capabilities, and funds could be sought for that purpose. An AVRDC-Kasetsart University project of this type, involving gardening, has been successfully going on for the past two years. Its pilot-project phase is nearing completion and it will soon be ready for dissemination to national development projects.

A third possibility is to seek funds for garden technology development and transfer to specific projects. In this case the technology would be tailored to each specific project and funds would be sought for that work. Some project examples are the northeast rainfed project in Thailand, transmigration projects in Indonesia, homesite food production projects in Bangladesh, and cropping system projects in the Philippines.

The outreach program possibility is relatively long-term. Next in length of time would be the institutional capability type of project. A short-term project would be one of the specific development project examples. Some donor agencies (e.g., World Bank) may be more interested in funding long-term projects; while other agencies (e.g., Ford Foundation) might be more attracted to short-term projects.

Some donor agencies, such as the USAID Missions, have their own projects, and in the past, could not be readily approached for funding of additional activities, like gardening. Some of the Missions have now set up a way to provide quick funds for new or promising developmental work. In Thailand there is the "Emerging Problems in Development" funding source. In Indonesia it is called "The Development Studies Program." These may be sources of funding for gardening R and D in these two nations.

Whatever the strategy or the sources of funding, gardening appears to be one way of putting into the people's own hands the knowledge to regulate their own nutritional status and increase

their quality of life. A collaborative effort with AVRDC might assist national programs in achieving these goals.

Discussion

Collaborative Garden Strategies for Indonesia

Dr. Gershon: Dr. Subijanto, in your slide on the transmigration area, were those tomatoes for commercial or for home consumption?

Dr. Subijanto: Mostly for home consumption, partly commercial.

Dr. Villareal: I understand that two or three AVRDC tomatoes were released and recommended for production in Indonesia. How were the seeds produced?

Dr. Subijanto: The seed supply became a problem; the extension seed farm group was not able to produce it in sufficient amount. There was an effort to have it multiplied by private companies. This problem was crucial to the transmigration area, too.

Dr. Gershon: The Central Institute for Horticultural Crops is very new. Do you have a process set up on paper whereby you can respond to all these various seed demand in development projects?

Dr. Subijanto: Yes, there is an annual plan. We are involving the Directorate for Horticulture, foreign companies, as well as private institutions. We introduced the tissue-culture technique for producing seed potato, 10% of which is imported.

Dr. Gershon: Is the private sector already convinced of the potential of vegetable seed production? Or do they have to be convinced and shown the technology as is being done in Thailand?

Dr. Subijanto: This is still a constraint. I proposed setting up a seed project after the Thailand model to the Director General of Agriculture. We must also invite U.S. seed companies into the country, but the government regulations need to be simplified.

Dr. Gershon: Does the five-year development plan emphasize the linkage of nutrition to agriculture? Is the linkage good?

Dr. Subijanto: Yes.

Dr. Gershon: Are there indigenous seed sources available to private investors?

Dr. Subijanto: Yes, but the problem is getting the market. If we invite foreign seed companies, the problem is practically eliminated because they have the market already. A good example is banana export from the Philippines to Japan. Although foreign investors started it, now the Philippine companies are exporting it themselves.

Dr. Munger: What does the private seed business in Indonesia consist of ?

Dr. Subijanto: They are small companies first starting in the business. They use simple packaging of seeds.

Dr. Munger: Is the government encouraging these companies to expand?

Dr. Subijanto: It makes land available to them and assists them with credit facilities.

Dr. Munger: Is there no good system to distribute the seeds throughout the country?

Dr. Subijanto: Not sufficient, that is one of the bottlenecks. The price and the market of seeds is also unstable.

Dr. Tsou: Do you have a list of vegetables you want to promote and the amount of seeds you need? What commodities will be seed-produced by farmers, and which are to be imported for future development?

Dr. Subijanto: We don't have the figures for home gardens, but I can give you those for horticulture development.

Dr. Tsou: Do the two government groups (agricultural extension and public health) in the rural areas operate separately, or jointly?

Dr. Subijanto: There are at least 10 groups operating in the rural areas, but they need to synchronize their activities.

Dr. Gershon: Maybe because there is no optimum use of their time.

Dr. Subijanto: I think it is partly due to insufficient seed supply.

Dr. Gershon: If the five-year development plan call for these things and Pres. Suharto wants amaranth consumed, it seems like there is a demand. But this conflicts with what you said before, that there is no demand for these seeds.

Dr. Subijanto: There is a potential demand, but agribusiness needs consistent actual demand.

Dr. Gershon: The underlying reason behind the two seed projects in Thailand is to show private industries that the demand is there. Perhaps that would be viable in Indonesia.

Dr. Munger: The supply is concentrated in one or few places and no network distributes it to other places where there is demand.

Dr. Subijanto: Partly, but that is secondary. The primary reason is that private companies need the assurance of profit and sale and, in one instance, of monopoly.

Dr. Gershon: Regarding Thailand, it has 17 seed centers throughout the country.

Dr. Munger: I don't think 17 centers are near enough for Thailand. New York has 17 seed centers, and also hardware stores, supermarkets, and others that sell seeds.

Dr. Gershon: These centers are not only seed centers but are also used for training and other activities.

Dr. Munger: So what mechanism is used to get them out? How?

Dr. Gershon: I don't think they have gone that far yet.

Dr. Villareal: I would like to share with you one of the best things that happened to vegetable seed production in the Philippines and this would be an incentive for local seed growers. A recent administrative order came from the Ministry of Agriculture and Food that no vegetable seeds which can be efficiently produced in the Philippines should be imported. This means that only cabbage and onions may be allowed for importation since we cannot produce these seeds in the Philippines. Thus, even McDonald, an importer of white potato, is required to tie up with local institutions so that its seed potato needs can be produced within the country.

Dr. Gershon: Dr. Subijanto, Can't you use your rural organizations as a seed distribution system?

Dr. Subijanto: Yes, especially the village cooperatives. But there is not sufficient demand for private companies to participate.

Dr. Gershon: Are the people not demanding seeds because they have no home gardens? Where is the problem?

Dr. Subijanto: The demand is there, but the seeds are insufficient and relatively expensive. The high costs reduce demand.

Dr. Gershon: The Sri Lankan Department of Agriculture produces vegetable garden seeds in large amounts and private volunteer organizations such as CARE UNICEF put them into small packages and distribute them cheaply.

Dr. Munger: Doing this will only delay a self-sustaining distribution system. Is there any existing system that can add seeds to their products, such as grocery stores, supermarkets, etc? A new separate network could be too expensive.

Dr. Subijanto: Sure, the village cooperatives and PERTANI shops; there are also companies that sell herbal medicine, possessing good distribution network.

Dr. Villareal: In the Philippines, the Planters Products Inc. is handling seed distribution. Another strategy is to adapt the MASAGANA system where agricultural inputs, such as seeds, are specified in farm loans; and the banks are used as distribution points.

Dr. Gershon: It looks like private volunteer organizations could fill this seed-distribution gap. The heat and humidity of tropical countries make seed packaging a problem.

Dr. Munger: They will still undercut the private companies that might take over.

Dr. Subijanto: Private companies do need guarantees before they venture into anything. We also had the sad experience of importing mixed seeds through Singapore.

Dr. Gershon: Although unrealistic, private volunteer organizations do get seeds distributed in Sri Lanka and Bangladesh.

Dr. Tsou: If we have a priority list, we could identify commodities we can produce. If all rural institutions have a day care center or a combined center for medicine, agricultural products, etc., where housewives often go, these could be utilized as seed distribution places. Is there a seed-producing company in Indonesia?

Dr. Subijanto: Several private companies started on vegetable seed production.

Dr. Gonsalves: There may be factors other than limited seed supply which might explain why home gardens are not widely accepted. Also, maybe no effort was made to locate seed sources.

Dr. Gershon: It seems to me that governments could initially get involved in seed production and distribution. As they are involved, for example, in supporting the production and distribution of vitamin A capsules for preventing xeropthalmia. Capsule distribution can cure xeropthalmia but cannot prevent it from reoccurring. Distribution of seeds for garden crops containing sources of Vitamin A could prevent - rather than cure - xerophthalmia. If the demand for seed is there and it is supplied at affordable costs, I still think that governments could initially get involved in seed production (as they are in Thailand) and have the private sector take over when they are shown the demand potential.

Collaborative Garden Strategies for the Philippines

Dr. Gonsalves: I can say that the IIRR believes that its efforts in Cavite and Bicol must be in collaboration with the government. Our involvement is one in which we use technical advice from Los Baños. We have access to Dr. Villareal's seed collection. Maybe this is the beginning of collaboration with other agencies.

Dr. Solon: My collaboration with IIRR is on a more personal basis. There is no formal cooperation, however. I hope the agriculturists and nutritionists will

look at things realistically and collaborate with the local government in order for research to reach the people.

Dr. Villareal: I am thinking on the following strategies:

1. We in the Philippines should put our act together. The agencies involved in nutrition or home gardens complement each other but don't see eye to eye.

2. We should put up a massive compaign for home gardening and nutrition: a) we should exploit the teacher-pupil-parents relationship and the truism that children are great agents of change. b) we should involve the Ministry of Education, Culture, and Sports (MECS), for this will involve changes in the curriculum.

3. We should expand the concept of the Barangay Nutrition Scholar.

4. There should be some policies on seed supply.

5. PCARRD must be urged to give priority to research in home gardening and thus provide regular appropriation to carry out studies in home gardening.

Dr. Tsou: Is it possible to choose a few villages in the Philippines which have and don't have home gardens to get nutrition assessments? Maybe the agriculturists can design a better home garden with the help of the nutritionists.

Dr. Solon: The important thing is that there are people who can do it. It should be a joint effort between agriculturists and nutritionists. The research should include the chemical and biochemical components.

Dr. Gershon: Three and a half years ago we started day care center gardens funded by USAID, but they floundered because MECS did not support it.

Dr. Villareal: There is a little improvement now. The Deputy Minister is a man from Los Baños and I can discuss things with him.

Dr. Tsou: The involvement of MECS is important. If home gardening goes long-term, it can eventually run by itself.

Dr. Villareal: One good thing about working with Dr. Solon is his contacts with the media.

Dr. Gershon: Dr. Solon, is your prescription pad copyrighted? AVRDC would be happy to change it from Tagalog to English and make it available worldwide, if it's okay with you.

Dr. Solon: Yes, it is. We are, in fact, going around medical schools and centers promoting it. These prescriptions can be posted on walls and accomplished even in the market place.

Dr. Villareal: We have found Dr. Solon in the medical profession as our best ally in our compaign for the widest acceptance of home gardening in the Philippines.

Dr. Solon: I hope the agriculturists will design a prescription pad on home gardens. We would like to invite IIRR; we can learn a lot from Dr. Gonsalves and his group.

Collaborative Garden Strageties for Thailand

Dr. Karyadi: What is Thailand doing about rainfed and dryland gardening?

Dr Boonma: I will get together with Dr. Yongyout's boss to start a pilot project in dry and rainfed areas. The proposal will be submitted to the University and will be channeled through different agencies, studied by a working committee, and if approved by the national Committee on Planning and Policy, will become a national policy.

Dr. Yongyout: Decisions are also made by the governor's office. If a workshop is planned at this level, the program decided can be implemented also at this level.

Dr. Gershon: As regards financing of workshops, USAID Bangkok presently looks favorably on these activities, and may have a source of quick funding. As AVRDC phases out garden activities in Thailand, future activities should be set

up with Kasetsart University as the lead university, and expanded to other institutions.

Dr. Yongyout: Even if a program doesn't have the sanction of the national government, it can be decided at the local level at the governor's office which can collaborate with the four ministries at the provincial level. At the village level, the extension agents, teachers, and health workers can implement the home, school, and health gardens. In my hospital, I grew soybean for the milk and food for the patients.

Dr. Gershon: Dr. Chongrak, the Rector of Kasetsart University is planning a Thai garden workshop. The princess will sanction it during an area visit. This could get large coverage in the media which, in turn, could shape the felt need.

Dr, Arizala: How much influence do these village-level decisions have on the Ministries?

Dr. Boonma: There is no problem on that score. Home gardening has been a government policy for a long time. One constraint, however, is seeds. If this program is to be expanded, we have to get the cooperation of private seed dealers to produce and sell recommended and viable seeds. Seed distribution won't pose any problem as this can be done by the extension workers.

Dr. Gershon: These seeds must be selected and tested under local conditions.

Dr. Munger: In 1969, a graduate student developed a technology for vegetable-seed packaging which conserved their viability. Seeds were sealed in plastic bags and laminated. USAID provided some funds for the equipment. To what extent has this technology been applied?

Dr. Gershon: Very little to my knowledge. The private sector should be informed about this.

Dr. Subijanto: The technology and the facilities are available in the country, however, they are not sufficiently utilized.

Dr. Gonsalves: Has there been any move to look back at the past home gardening efforts critically to explain its failure and to determine the focus in the future?

Dr. Gershon: This workshop touched on some of the constraints.

Dr. Gonsalves: Did you know enough to plan future activities?

Dr. Gershon: We are aware of them and we are planning to develop a Thai gardening manual and training guide, including acceptable methods for assessing the impact of gardening. It is part of the reason for this workshop.

Dr. Selleck: One overriding factor in the success of the program is national commitment, the degree of enthusiasm, and resources made available. If there is no follow-up, it is doomed to fail.

Recommendations for Agriculture

Dr. Gershon: This is the culmination of one week of interaction among the participants. The feedback will be given under two categories of recommendations: agriculture and nutrition.

Dr. Subijanto (moderator for agriculture): The recommendations should start with a statement on the importance and significance of home gardens. They should be grouped into administrative, technical, and the role of AVRDC. (The following are the recommendations for the group as read by Ms. Tiamzon.)

A. Administrative

1. To encourage national programs to strengthen and develop linkages with government and private agencies in relation to solving malnutrition and disease through a home garden program.

2. To encourage the national government to establish or activate a management committee to implement programs on home gardening to combat malnutrition.

B. Technical

1. To encourage national programs to establish seed policies.

2. To encourage national programs in our home countries to intensify research and development in the following areas:

   a. Identification of appropriate varieties;
   b. Establishment of cropping sequences/systems;
   c. Integrated pest control with indigenous materials;
   d. Cultural management, including the use of organic; fertilizers and other indigenous materials, optimum use of water, etc.; and
   e. Utilization of garden products at the village level.

3. To encourage national governments to escalate compaigns on the importance of vegetables in combatting malnutrition.

4. To encourage the national government to effectively transfer or disseminate information on the proper use of pesticides and the preparation and consumption of vegetable crops.

C. Role of AVRDC

Its role is to develop the technology and to train manpower, and if possible, to assist national programs in securing funds.

Dr. Villareal: The gist is that a program will not succeed without national commitment; that is, everybody should agree that malnutrition is a problem and the government should develop a program to combat it.

DISCUSSIONS

Dr. Gershon: If the request for funding includes nutrition as a component, together with the specifics of the program, then perhaps agencies like the World Bank may be interested.

Dr. Munger: I am not clear as to who does the encouraging for national programs to do all those things in the recommendations.

Dr. Villareal: I am under the impression that this workshop will come up with recommendations and will form resolutions with the proceedings to be submitted to different national programs. Recommendations have more clout when they are formulated by a group.

Ms. Tiamzon: PCARRD has the national mandate to coordinate research and development activities in agriculture and other resources in conjunction with national policies. As it lines up priorities, we could encourage the inclusion of the home garden program.

Dr. Selleck: AVRDC can only assist national programs in looking for funds. The initiative must come from you, however. It is more effective this way.

Dr. Villareal: We recognize this and I agree wholeheartedly. In fact, the exact words in our recommendation on AVRDC's role is "...if possible to assist national programs in securing funds".

Dr. Gershon: In some cases we are prohibited. USAID and Ford foundation require that the request must come from nationals. AVRDC can be mentioned as collaborating in proposals.

Dr. Villareal: PCARRD will prioritize the funding for the garden technology to be generated by the Colleges of Agriculture in the Philippines. IIRR can participate by continuing its work now. The participation of MECS will be more meaningful if changes are done in the Ministry to encourage the nutrition program as proposed by Dr. Solon.

Dr. Gershon: Indonesia and the Philippines appear to have the same set-up regarding nutrition programs. The Colleges of Agriculture are doing gardening but the ministries lag behind. The Agency for Agricultural Research and Development in Indonesia (AARD) should have a stronger role through various research institutions, and they should encourage nutrition programs.

Dr. Subijanto: We have funding from several donors: USAID for transmigration area development and the river basin development, ADB for the seed project, and others.

Dr. Karyadi: Funding agencies, like the USAID and World Bank, might be interested if nutrition is the objective of the program.

Dr. Gershon: What strategy can you recommend to link home gardening into such existing programs as transmigration, family planning, etc., in Indonesia?

Dr. Karyadi: The first step we can do after the workshop is to convince our decision-makers that the program is very feasible and that they should make an allotment for it.

Dr. Gershon: Do you feel that what you have seen will assist you in launching general garden activities in various national projects?

Dr. Karyadi: Dr. Subijanto and I will interface with the people of the national planning agency who decide budget allocations.

Dr. Gershon: Maybe one concrete strategy is to use what you saw when workshop participants visited gardens in Thailand, and what was published to knock on doors and convince concerned people.

Dr. Subijanto: Judging from what we saw in Thailand, we are not ready. For example, we don't have the varieties we need for the project. But we will not wait; we can make adjustments as we go along. I propose that we link up with AVRDC on bilateral projects. We have a potato project funded by Australia and an improved package of technology for implementation. In the second phase, we propose to implement the transfer of potato technology with relevant activities.

Dr. Seileck: I understand that for these areas you have in mind, suitable varieties have not been identified.

It seems that your initial activity would be to identify varieties and start a testing program. Is the germplasm to be selected available in Indonesia or to be procured elsewhere?

Dr. Subijanto: We need sources of germplasm for evaluation and adaptation. Can AVRDC assist us in getting these from seed producers in Taiwan?

Dr. Tsou: The first step would be for the nutritionists and the agriculturists to meet and list down the garden commodities needed. The second step is to determine if a variety list is needed. If so, and no funds are available, a funding strategy must be proposed. I suggest that the nutrition group present their recommendations first before we continue with the discussion.

Dr. Gershon: Is the nutrition group ready? We can return to the agriculture group later.

Recommendations for Nutrition

Dr. Solon: Our first statement is that home gardening is a very important component for national growth. This is the basis for the following recommendations:

1. Improvement of the food composition tables.

2. Identification of a method to determine nutrient contents by going into geographical differences, seasonality, variety, harvesting methods.

3. Availability of research:

   a. Studies of the enhancing effect of oil on Vitamin A; and
   b. More studies on iron availability in vegetables and the enhancing effect of Vitamin C.

4. Research on dietary approach for the prevention of Vitamin A deficiency.

5. Strategies and mechanisms for technical collaboration among agriculturists, nutritionists, horticulturists on producing technologies for highly nutritious vegetables. The focus is on nutrition promoted by all concerned: teachers, doctors, agriculturists, nutritionists, etc.

6. Strengthening of the technology on:

   a. Soil fertility for the production of more vegetable nutrients;
   b. Safe pest control management; and
   c. Water management at the home level.

7. Collection of anthropological studies on beliefs/taboos, motivational forces on vegetables and transferring them into information for classrooms, clinics, media, etc.

8. State-of-the-art assessment of school curricula in all levels and disciplines to incorporate the nutrition aspect.

9. Development of a method to evaluate and monitor the actual nutritional status of people growing gardens.

10. Incorporation of home gardening into the national socio-economic and agricultural development.

11. Establishing/strengthening of institutional linkages among institutions to carry out applied research, and with

national and local implementing agencies. The private sector should be invited to participate.

12. AVRDC's recommendations of nutritious vegetables and focus on vegetables suitable for home gardening to give research credibility and prestige for these crops.

DISCUSSION

Dr. Gershon: Dr. Subijanto, have these points prompted you to link them up with your recommendations on agriculture?

Dr. Subijanto: They are complementary. In Indonesia, it is easy to incorporate nutrition into the national presidential programs and to those of the Ministry of Health.

Dr. Gershon: If President Suharto wants something done, like more amaranth consumed, is this a mandate to you to take action? If so, how?

Dr. Subijanto: The mandate resulted in a great demand for amaranth and the resulting problem of seed shortage. Luckily, we had stock of seeds that eventually solved it. We are now producing the seeds and importing germplasm from other countries.

Dr. Tsou: I suggest we identify priority action projects, such as a small international workshop of nutritionists and agriculturists to recommend the crops for home production and review the seed problem. One recommendation would be for AVRDC to collect the germplasm of these vegetables, and evaluate and distribute them for regional testing.

Dr. Subijanto: There are two things we need right now: seeds and trained manpower. We need seeds if we are to launch the program.

Dr. Solon: I shall meet with 15 people from different relevant ministries and local and international agencies to report on this trip and for us to recommend an action program on nutrition for July, the Philippine's Month of Nutrition. I think we should do something immediately upon arrival in our countries. Dr. Gershon, you might get a call from us soon.

Dr. Gershon: I am ready. I have a question for Thailand. Do you think that enough momentum has been generated by our Thailand pilot project, enough linkage initially established between Kasetsart and Mahidol Universities to really start work with national program funds to show feasibility and to gain additional outside funds?

Dr. Boonma: Yes, we agree, in principle. Our Rector also agrees, so, there is no problem.

Dr. Gershon: USAID-Bangkok might provide the initial fund for the transfer of work to the northeast with the "emerging development problem" funds that they now have.

Dr. Boonma: I plan to meet the IDRC people next month and explore the possibility of using their facilities which will reduce part of the cost specified in funding the transfer of technology.

Dr. Gershon: Do you think AID might be interested in funding the training and IDRC, the transfer?

Dr. Boonma: Pushing a request for funds from AID takes too long.

Dr. Gershon: There is a possible source of funds which can be procured quickly for sudden and promising situations. The Agriculture Development Office, USAID, Bangkok may be willing to provide $20,000 for one-year of training. This is enough to get the initial momentum going. The same goes for Indonesia. The USAID mission may be able to provide a quick way of funding.

Dr. Yongyout: If the program is expanded to the northeast, it should be done through the various organizations at the village level. They should help themselves, and it is easier to implement things this way. Ubon and the northeast are very dry and hot; an all-year cultivation might be impossible.

Dr. Selleck: Has there been any mention of small special gardens for dry areas? Some places in Africa have door gardens (gardens as big as doors) raised on limited water. The soil is dug up knee-deep and removed. Anything that will provide organic matter for fertilizer is thrown in; then the soil is returned. This system encourages root development and retains soil moisture.

Dr. Gershon: In the Philippines, they have the "magic square" garden. I don't know whether it is a success though.

Dr. Solon: It works on the principle: "Start small and succeed big." Housewives don't have time for big gardens. A "garbage" garden 1 sq. m provides the answer where one can throw his gargle water for soil moisture. By the way, I am happy to invite you to the Hyderabad International Vitamin A Consultative Group (IVACG) meeting where the focus is on nutrition and its impact on Vitamin A intervention, and gardening intervention will be discussed as an approach to resolving Vitamin A deficiency. We would like to invite people to speak on the Indonesian, Thai, and AVRDC gardens.

Dr. Gershon: Good news!

Dr. Karyadi: I am thinking of a possible annual meeting or consultative group on home gardening similar to this, of nutritionists, agriculturists, and home economists to follow up on the progress of our program. The members might be rotated. Perhaps we will include Malaysia and Brunei, a vegetable-importing country.

Dr. Gershon: Good point! AID is planning a worldwide small-scale food production workshop next year. I am on the planning committee and will make sure it is an interface of agriculturists and nutritionists. Dr. Solon is invited. This is the first of its kind and we hope it will gain momentum.*

Dr. Subijanto: Would it be possible to have a working evaluation - workshop here at AVRDC like what IRRI is doing with its international programs? We could get financial support from member countries, if AVRDC is unable to do so.

Dr. Selleck: This is an extremely important activity. I don't know where the money is coming from, but we might find some funding support for it.

Dr. Villareal: I am participating in a network that involves evaluation of crop varieties. Nine African countries participate in this network. The network is funded by IDRC through IRRI. Its budget includes money for monitoring and work-

*Workshop postponed

shops. A similar thing can be done here as an action program which we can all prepare together and submit for funding. IRRI's is funded by IDRC.

Dr. Tsou: The recommendations of the group cover a broad range, and so priorities must be set up if anything can be done at all. I suggest we get divided into small working groups with each group to work on a specific activity. It will then be easy to present our case. This is a VIP group, and a follow-up of our activities is important. Let us recommend a few names from each country with AVRDC as the coordinator.

Dr. Munger: I was asked to make an evaluation for USAID and I have two questions to ask: 1) Do the representatives of other countries agree with Dr. Subijanto that what you need from AVRDC is manpower training and help with the seed problem? 2) If so, can you be more specific about what AVRDC can do to help on the seed problem?

Dr. Villareal: Our group suggested that the role of AVRDC is to develop technology and manpower training. We refer to the development of technology on varieties, management practices, optimum use of water, continuous supply of soil nutrients (Dr. Stearn's report). Manpower development includes the different forms of training offered by AVRDC. We further suggested the role to include "if possible, to assist in getting funds."

Dr. Boonma: I agree with Dr. Subijanto on the two things we need from AVRDC. We need amaranth and vegetable soybean seeds now. We shall still decide on the other vegetables to be included. As for manpower training, I don't know yet what kind of training we need.

Dr. Gershon: There are two categories needed from AVRDC then. We have not touched on the AVRDC outreach programs. Only in Thailand did we add funds for garden research. Maybe it could be incorporated into future AVRDC outreach programs if the host government agrees.

Dr. Selleck: On the seed problem, if seeds of recognized varieties are not available for Indonesia, then Thailand would be the second choice because of the similarities in climate; and AVRDC, the third

choice. Jack has 57 varieties which he got from the local seed companies for adaptation tests. On seed production, Dr. Subijanto, there is expertise in the Philippines and Thailand on a wide-scale. AVRDC can also arrange for training on this aspect. With the cooperation of national programs, we are willing to identify, collect, and do basic testing here, or transfer testing to Indonesia.

Dr. Tsou: We can't handle everything at a time, but we are going to start with the crops on the priority list. That is why we will need these lists for research and seed production.

Dr. Selleck: Perhaps testing could be done by the Indonesian national programs where the interest and the infrastructure are. We could help them do it.

Dr. Tsou: We have to know the characteristics we need in the vegetables. This could be done by the small working groups, but perhaps this is not within the scope of this workshop.

Dr. Gershon: Perhaps there is all the more reason to include the outreach program to help. It will be easy to transfer planting material from here if needed. Dr. Tsou has a good point on priorities. A list set up on a methodology similar to that used by the AVRDC new vegetable committee is suggested.

Dr. Gonsalves: I think AVRDC could help out on the following: 1) scientific screening of indigenous varieties for home gardening; 2) conservation of water at the home level; 3) listing of rooting depths for each vegetable; 4) technical information on nonrefrigerated storage of seeds; and 5) raising of vegetables relative to other components (livestock, poultry, fish, and bees). From our side, we have 60 indigenous varieties we can share with others who are interested. We have successfully raised vegetables on waste water. There was no problem with soap water. We grow vegetables in combination with livestock (pigs, goats, rabbits, poultry, and bees).

Dr. Solon: I hope Jack can study a home garden strategy balanced with other commodities on a scale not taxing for the household.

Dr. Gershon: In our Phase 2 report for Thailand, we have included home gardening as a part of small-family farming system which includes other components. On dryland gardening, two meetings were supposed to take place this year and one next year.

Dr. Villareal: A technology of preserving seeds was developed about two years ago by a student. It has caught on in the Philippines. The seed companies have been using it.

Dr. Munger: No individual institution can do everything, hence, priorities have to be set up. Before we adjourn, I'd like to make a plea that you leave a little room in your program for opportunities and priorities. By opportunities, I mean those things which you may find out by chance and which eventually turned out to be more productive than the priorities you have set out to do. The male sterile wild carrot plant I came upon accidentally and on which I started to work, turned out to be the basis of the entire carrot hybrid seed production in the USA.

Dr. Gershon: It is similar to what happened when a Thai trainee brought some of our vegetable soybean seeds to a pilot project in her country and the result turned out successfully. There is now increased demand from AVRDC for seeds.

Well, everyone did his best and some reasonable interaction took place. The nicest thing was that both nutritionists and agriculturists were talking to each other. Such cross-fertilization can only result in something positive happening in the future.

I did not expect any definitive cookbook suggestions in this workshop, but some good focus statements did come out. If we can have your priority lists, we could start observational screening trials. If you want an updating, then we would like to have that list, too. We would also like to know how you decided on these lists, and perhaps, have this methodology distributed.

And so this first VIP gardening workshop will now come to a close. Thank you for your participation.