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VITAMIN A NUTRITION AND GARDENS

BIBLIOGRAPHY

by

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LIST OF ACRONYMS

AVRDC Asian Vegetable Research and Development Center
CI consumption index
DGLV dark green leafy vegetable
FAO Food and Agriculture Organization
FEN Food Energy Nexus

HDM hierarchical decision model
IDRC International Development Research Centre
ISRA Institut Senegalais de la Recherche Agronomique
ISTI International Science and Technology Institute, Inc.
IU international units

IVACG International Vitamin A Consultative Group
LAPIS Lesotho Agricultural Production and Institutional Support
MfM/FfHF Meals for Millions/Freedom from Hunger Foundation
MSG Mono Sodium Glutamate
NAS National Academy of Sciences

NCD National Capital District
NDpCal net dietary protein-calories
NGO non-governmental organization
NRU Nutrition Rehabilitation Unit
NV nutrient value

NY nutrient yield
ONC overall nutritional completeness
PNG Papua New Guinea
PVO private voluntary organization
RCSB Royal Commonwealth Society for the Blind

RDA recommended daily allowance
RNC relative nutrient cost
SCF Save the Children Federation
UNICEF United Nations International Children's Fund
VITAL Vitamin A Field Support Project

UPF usual pattern of food consumption index
USAID United States Agency for International Development
WHO World Health Organization

LIST OF KEY WORDS

Africa
Agroforestry
Anthropometry
Applied
Asia

Children
Country (see Index by Country, p. 64)
Drying
Europe
Evaluation
Extension

Foods-indigenous
Foods-nutrition
Foods-processing
Impact-consumption
Impact-income

Latin America
Methods
Native Americans
North America

Secondary crops
Storage
Survey
Theoretical
Urban

Vitamin A
Women
World
Yields-model
Yields-indigenous

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EXECUTIVE SUMMARY

This bibliography includes the literature concerning gardens and nutrition, dating primarily from 1984 to the present. Household gardens are defined as "a supplementary food production system which is under the management and control of household members.... A household garden can be consumption or market oriented, but at least some produce will be consumed by the household" (1A.4 Cleveland and Soleri 1987:259). Household gardens are often mixtures of annual and/or perennial crops which produce fruits, vegetables, grains, condiments, herbs, medicines, and other products. They can be found on rooftops; next to houses; as plots in fields; in strips along canals, roads, or railroad tracks; and as contiguous plots in community gardening areas. Garden production of preformed vitamin A in animal products is not addressed in this bibliography.

The purpose of the bibliography is to help researchers and program planners understand the relationship between gardens and nutrition by providing an annotated list of key literature. It builds on the discussion of gardens and nutrition in Brownrigg (1A.2 1985) and Cleveland and Soleri (1A.4 1987). Most of the entries were published after the Brownrigg review, but some published before 1985 are included because of their particular significance and/or the quality of their research.

This bibliography is divided into four sections representing key issues concerning the effectiveness of gardens as nutrition intervention. The documents in section 1, Gardens and Development, are concerned with the important role household gardens can play in development efforts with the goal of nutritional improvement. Part (1A) reviews articles that deal with the more theoretical aspects of household gardens: their relation to nutritional status; the importance of their integration into diverse, local, agroecological environments; and their relatively neglected potential in development. Part 1B focuses on documents that address problems of design, implementation, and evaluation of garden projects. In both subsections, articles specifically addressing the improvement of vitamin A nutritional status through household gardening are included.

Section 2, Garden Foods and Vitamin A, discusses indigenous sources of provitamin A, the effect of processing on the vitamin A value of foods, and the relation between food intake and nutritional status. The indigenous wild and cultivated sources of provitamin A are the subject of Part 2A; 2B includes research on the effect of food processing, especially drying, on provitamin A content; the articles in section 2C provide evidence that provitamin A in garden foods is absorbed and converted to retinol, while noting that factors such as protein energy malnutrition and consumption patterns have a significant impact on the nutritional value of available provitamin A sources.

Nutrient production, especially of provitamin A, is the subject of section 3, Garden Nutrient Yields. Part 3A contains literature on model or maximizing gardens that demonstrates their capacity for nutrient production, but raises questions about their appropriateness and long-term sustainability under developing world conditions. Local or indigenous gardens are created and maintained by gardeners and are not the direct result of a project. Some of the all too rare studies of nutrient production in these gardens are included in 3B.

Section 4, Impact of Gardens, includes literature concerned with the steps from the garden to the diets and nutritional status of individual household members as well as communities. If garden produce is consumed directly by the household, the subject of part 4A, distribution within the household and actual consumption will both affect the impact on nutritional status of household members. The economic contributions of gardens are the topic of part 4B. If garden produce is sold, then marketing and control and use of the income must be taken into account. Income can affect nutritional status directly if used for food purchases but also indirectly, for example through social status.

Key words are provided with each listing to assist researchers in quickly identifying articles relevant to their interests. When available and adequate the author's abstract or an excerpt from the author's summary or text is used. This is followed when appropriate by a brief comment relating the entry to the issues addressed in this bibliography. The text of the bibliography is followed by two indices, which cross-reference the listings by author and by country.

INTRODUCTION

This bibliography focuses on literature concerning gardens and nutrition with an emphasis on that published from 1984 to the present. It builds on the discussion of gardens and nutrition in Brownrigg (1A.2 1985) and Cleveland and Soleri (1A.4 1987). Some works predating 1984 are also included because of their particular significance and/or the quality of their research.

PURPOSE The purpose of this bibliography is to help researchers and program planners understand the relationship between gardens and nutrition by providing an annotated list of key literature.

A DEFINITION OF GARDENS Household gardens are defined as "a supplementary food production system which is under the management and control of household members.... A household garden can be consumption or market oriented, but at least some produce will be consumed by the household" (1A.4 Cleveland and Soleri 1987:259). Household gardens are mixtures of annual vegetables, fruit and tree grains, condiments, and other crops. They can be found on rooftops; next to houses; as plots in fields; in strips along canals, roads, or railroad tracks; and as contiguous plots in community gardening areas. Gardens often include domesticated animals such as honeybees, poultry, fish, guinea pigs, and even goats, and so can be excellent sources of preformed vitamin A as well as provitamin A. This bibliography, however, concerns crop production in gardens, and not animals.

ORGANIZATION The literature search and final form of this bibliography have been organized around key issues concerning the effectiveness of gardens as a nutritional intervention as identified in Brownrigg (1A.2 1985), Cleveland and Soleri (1A.4 1987, 1B.2 1990) and Brun et al. (4A.3 1989). This approach was taken for two reasons.

First, to focus the literature search as clearly as possible by providing an analytical framework for selecting, reviewing, and categorizing literature. Second, by building on previous findings, the bibliography takes readers beyond the general gardens-and-nutrition literature into more detailed analyses, enabling them to focus on the topics most relevant for garden projects whose goal is improved nutrition.

The bibliography is divided into four major sections: gardens and development, garden foods and vitamin A, garden nutrient yields, and nutritional impact of gardens. This bibliography reflects the finding that the outstanding source of failure in garden projects has been the neglect of sociocultural and ecological complexity, which affects all aspects of project activities.

Section 1, Gardens and Development, includes entries that discuss the theory of the role of gardens in development. The second part of this section includes major extension publications supporting gardens as a development strategy and also those discussing the evaluation of garden projects, particularly from the viewpoint of both general and vitamin A nutritional status.

Section 2, Garden Foods and Vitamin A, discusses indigenous crops as sources of provitamin A, the effect of processing on vitamin A value, and the relation between food intake and nutritional status. Dietary sources of vitamin A may include annuals or perennials and wild, "semi-cultivated," or domesticated plants that provide leaves, fruits, tubers, flowers, or seeds. This literature can provide insights into how garden projects can support, complement or improve these local sources, instead of ignoring or eliminating them. It also includes literature concerned with the relationship between garden projects and these traditional sources.

Food processing is an important determinant of the nutritional content of foods and their availability during the year. Food intake is a critical link in garden projects to improve nutritional status. While there is evidence that provitamin A in garden foods is absorbed and converted to retinol, the factors influencing absorption are critical.

Section 3, Garden Nutrient Yields, is divided into two parts, 1) model gardens and 2) indigenous gardens. This division is based on a finding reiterated in most garden project literature: that local sustainability, as reflected in community participation, appropriateness of technologies, and resource requirements of gardens, is critical for success.

Studies of model or maximizing gardens demonstrate the capacity for high nutrient production, but often do not consider local knowledge and resources. These gardens are often more like in situ sources of supplements for target populations who are not usually growing the gardens themselves. There are few studies of nutrient production from local or indigenous gardens; that is, gardens created and maintained by the gardeners that are not the direct result of a project. Nutrient yield from both types of gardens is often affected by crops and crop varieties, seasonality and production techniques.

Section 4, Nutritional Impact of Gardens, includes literature concerned with the steps from garden to diet and the nutritional status of individual household members and communities. If garden produce is consumed directly by the household, its distribution within the household and actual consumption must be considered. If garden produce is sold, then marketing, control, and use of the income must be taken into account. Income can affect nutritional status directly if used for food purchases, and also indirectly, for example, through social status.

BIBLIOGRAPHY FORMAT After each citation is a list of key words, including:

- *Categories from the outline (may include more than one): theoretical, applied, foods-indigenous, foods-processing, foods-nutrition, yields-model, yields-indigenous, impact-consumption, impact-income, etc.
- *Vitamin A
- *Women's issues
- *Methodological issues: survey, anthropometry, etc.
- *Geographic: country, Africa, Asia, Europe, Latin America, Near East, North America, World

When available, the author's abstract or an excerpt from the author's summary or text is used. This is followed, when appropriate, by a brief comment relating the entry to the issues addressed in this bibliography. Authors' abstracts are so indicated; where the author's abstract is not used, we provide one.

Entries are numbered consecutively throughout the bibliography, with a prefix indicating the category, e.g., 1A.1, 3B.32, ...etc. At the end of each of the nine subsections is a list of numbers of entries in other sections that also discuss the topic. At the end of the bibliography are lists of entry numbers covering vitamin A, women's issues, and geographical areas. Finally, two indices organized by author and by country are provided.

1. GARDENS AND DEVELOPMENT

This section includes documents and publications concerned with the important role household gardens can play in development efforts with the goal of nutritional improvement. Articles in part 1A deal with theoretical aspects of household gardens: their relation to nutritional status; the importance of their integration into diverse, local, agroecological environments; and their relatively neglected potential as development projects that specifically incorporate indigenous knowledge and local resources in their design and implementation.

Documents in part 1B consider more applied issues, focusing on problems of design, implementation, and evaluation of home-gardening projects. These articles suggest techniques useful to those implementing garden projects to improve household nutrition, or developing methods for monitoring and evaluating the success of home gardens in improving nutritional status and environmental sustainability.

1A. THEORETICAL [theoretical]

1A.1 **Bittenbender, H.C.**
1985 Home Gardens in Less Developed Countries. Hortscience 20(4):645-649.

Key words: theoretical, World, the Caribbean, Haiti, Mexico, Nigeria, Peru

This article briefly reviews 1) the literature on "home gardens" in Africa, the Caribbean, Peru, and Asia, and 2) garden projects to improve nutrition in Mexico, Haiti, and Nigeria. Bittenbender contrasts two current approaches that he says are being advocated to replace "the former practice which rejected local crops while encouraging western or exotic crops produced as monocrops in rows or beds" (647). The "intensive, fixed model" is characterized by the AVRDC (Asian Vegetable Research and Development Center) model gardens (see 3A.1 AVRDC 1988; 3A.2 Gershon 1985), which the author sees as inflexible and unresponsive to local conditions. The mixed garden approach, on the other hand, is based on indigenous crops and gardens with in-garden experiments and innovations evaluated by the gardeners themselves.

1A.2 **Brownrigg, Leslie**
1985 Home Gardening in International Development: What the Literature Shows. ca. 341 pp. Washington, DC: League for International Food Education.

Key words: theoretical, applied, yields-model, yields-indigenous, World

This review was written for people in international development and academia. For the first audience, the review was intended to help explain the low priority and ambiguous status of home gardening in international development despite its ancient history and proven substantial contribution to households. In Part I Brownrigg develops a working definition of gardens, which eliminates most market gardens. She then reviews information on traditional gardens in different areas of the world. Part II is a very brief review of economic and nutritional studies of home gardens. Part III treats home gardens in international development with detailed case studies of four completed projects and brief descriptions of three current projects. Part IV reviews major constraints to the success of home gardens in development, focusing on programming and implementation. Four appendices list resource organizations (30 pp.), brief descriptions of a sample of garden projects (32 pp.), annotated references to literature on gardens (118 pp.), and "how to do it" gardening guides (9 pp.).

Comment This is the major review of household garden projects and contains much valuable information for anyone involved in garden programs. It is out of print and the publisher is defunct, but it was widely distributed around the world, for example, to USAID missions. Brownrigg's review of gardening traditions is strong for the Caribbean, Mesoamerica, and the Andes, weaker for Asia and very weak for Africa; also stronger for humid than for arid areas. One of Brownrigg's most important points, based on her extensive review of research reports and project documents, is that despite the theoretical importance of gardens to households and the abundance of promising models, this does not constitute "evidence of performance." Therefore the most important next step is not technological research, but "intensive, microlevel research" on indigenous gardens around the world, "selecting samples from among gardening and nongardening households" (pp. 120-124). She also proposes a standardized procedure for implementing agencies to collect information on garden projects. Brownrigg's final comment relates the success of garden projects to government policies, which assure access of the poor to productive resources, especially in cities.

1A.3 **Cleveland, David A.**
1986 Culture and Horticulture in Mexico. Culture and Agriculture, No. 29:1-5.

Key words: theoretical, women, Latin America, Mexico

The article assesses the potential of household gardens as a development strategy in Mexico, first reviewing the food and agricultural system. It discusses the two major gardening patterns, one a part of traditional agriculture and the other based on a North American model, and concludes with an examination of the benefit to be derived from a policy fostering traditional-style household gardens. The analysis indicates that gardens may be advantageous in both rural and urban areas if they are introduced in such a way that dependencies are decreased rather than increased and resources conserved rather than squandered. The best features of both traditional and industrial gardens can serve as the basis for the creation of alternative gardens adapted to the particular social and ecological circumstances of individual sites. [CAB, formerly Commonwealth Agricultural Bureau, abstract]

1A.4 **Cleveland, David A. and Daniela Soleri**
1987 Household Gardens as a Development Strategy. Human Organization 46(3):259-270.

Key words: theoretical, impact-consumption, impact-income, yields-model, yields-indigenous, foods-indigenous, women, World

The authors review evidence for household gardens as a viable development strategy for improving food production, nutrition, and income, using a functional definition of household gardens as a food production system that is managed and controlled by the household and is supplemental to the main source of household food and income. Gardens can be consumption or market oriented, but some produce will be consumed. Gardens are often next to the house, but may be distant or in the fields. There is much variation in garden form and function between households, ethnic groups, and ecological zones.

Household gardens have been part of development strategy for a long time, but there is little evidence of their effect. There are two major models. Industrial gardens commonly promoted by development projects include exotic cultivars, expensive inputs, and planting in rows. Their popularity results in part from the production successes of high-input agriculture and the bias of development personnel. Traditionally based gardens use local

crop varieties planted in complex mixtures with minimal commercial inputs. They are environmentally sustainable and conserve genetic resources.

In general, garden yield per unit area is equal to or greater than yield in field-crop production. Labor productivity in traditional gardens may be greater than traditional field-crop production, especially when trees and other perennial crops are present. Evidence supports the potential for gardens to improve nutritional status and income, and they are most often promoted for these reasons. There is, however, little evidence of positive effects, partly because of the complex chain of events from production, distribution, and consumption, to improved household well-being. Inter- and intra-household patterns of control over resources are a key variable. For example, men may take over women's gardens when they become financially successful.

The poor record of household garden projects suggests that to be successful they must be more appropriate for the conditions of poor households and founded on the wealth of local gardening knowledge and experience. Improving and encouraging traditionally based gardens that are sustainable and accessible to low-resource households may be the best development strategy for household gardens. [Authors' abstract]

1A.5 **Cleveland, David A. and Daniela Soleri**
1988 The Development Potential of Household Gardens in Arid Lands Farming Systems. In Arid Lands Today and Tomorrow. Proceedings of an International Research and Development Conference, Emily E. Whitehead, Charles F. Hutchinson, Barbara N. Timmerman, and Robert G. Varady, editors, pp 885-898. Boulder: Westview Press, and London: Belhaven Press.

Key words: theoretical, impact-consumption, impact-income, World

This paper reviews literature on household gardens and development (See 1A.4 Cleveland and Soleri 1987) and then discusses several issues in regard to gardens in arid lands: resource distribution and system diversification, water and soil management, crop selection, and women's gardens.

1A.6 **Fernandes, E.C.M. and P.K.R. Nair**
1986 An Evaluation of the Structure and Function of Tropical Homegardens [sic]. Agricultural Systems 21:279-310.

Key words: theoretical, impact-consumption, foods-indigenous, Asia

Home gardens represent land-use systems involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and, invariably, livestock, within the compounds of individual houses. The whole crop-tree-animal unit is intensively managed by family labor. Known by different names in various places, these agroforestry systems are common in all ecological regions of the tropics and subtropics, especially in humid lowlands with high population density.

An analysis of the structural and functional aspects of ten selected home garden systems from different ecological and geographical regions shows that the average size of the home garden units is less than 0.5 ha; yet they are composed of a large number of woody and herbaceous species, carefully structured to form 3-5 vertical canopy strata, with each component having a specific place, as well as function.

Food production is the primary function of most home gardens, and the vast majority of them are subsistence production systems. While there is a remarkable similarity among the different home gardens with respect to the type and nature of the herbaceous crops, the nature of woody perennials varies, depending on environmental and ecological factors. In general, most woody components produce fruits or other types of food in addition to outputs such as fuelwood, timber, etc. These various food products provide a substantial proportion of nutritive and energy requirements of the local diet. Moreover, the species diversity and varying production cycles of the different components ensure continuous production throughout the year from the home garden unit.

Little or no research has been done to improve home garden systems. Structural complexity, species diversity, multiple output nature, [and] tremendous variability from farm to farm, are only some of the characteristics that make the home gardens extremely difficult models to work with according to the currently available research procedures. [Author's abstract]

1A.7 **Gliessman, Stephen R**

1989 Integrating Trees into Agriculture: The Homegarden Agroecosystem as an Example of Agroforestry in the Tropics. In Agroecology: Researching the Ecological Basis for Sustainable Agriculture, Stephen R. Gliessman, editor, pp. 160-168. New York: Springer-Verlag.

Key words: theoretical, Latin America

The home gardens described in this book chapter are those of the humid, Latin American tropics, characterized by proximity to the home and a multistoried profile frequently dominated by perennials. These gardens produce fuel, medicines, and food, any of which may be used for either home consumption, or market sales, or both. Their species diversity ensures year-round harvests and enables these gardens to exploit soil, air, light, and water resources more thoroughly than less diverse systems. Gleissman notes that the structure of these gardens and their role in the household food system interact and change depending on biological factors such as plant growth and maturation and socioeconomic factors such as availability of wage labor and involvement in cash cropping. Throughout this chapter the importance of diversity at many levels in these indigenous gardens is stressed. This diversity is a valuable resource that spreads risks and creates gardens that can provide nutrients, fuel, and medicine year-round.

Comment: A general theoretical review with little data.

1A.8 **Niñez, Vera K**

1984 Household Gardens: Theoretical Considerations on an Old Survival Strategy. Potatoes in Food Systems, Research Series, Report No. 1, 41 pp. Lima, Peru: International Potato Center.

Key words: theoretical, World

Although scientists, politicians and humanists have long debated the role of backyard gardens in alleviating food shortages and malnutrition, little is known about indigenous home gardening. This research report discusses the historical significance and function of home gardens, offers a definition, and develops a policy-relevant typology based on ecological and socioeconomic determinants. Finally, a cross-cultural comparative review of the literature is undertaken. Despite increasing attention given by agricultural research organizations to small-scale farmers, household gardens continue to be neglected as an

important subsistence strategy. [Author's abstract]

Comment See Niñez 1A.10 1987 for a more recent version of this document.

1A.9 **Niñez, Vera K.**
1985 Working at Half Potential: Constructive Analysis of Home Garden Programmes in the Lima Slums with Suggestions for an Alternative Approach. Food and Nutrition Bulletin 7(3):6-14.

Key words: theoretical, impact-income, Latin America, Peru

As new projects are formulated to develop urban small-scale food production systems, an understanding of traditional approaches will help pave the way for successful implementation....this article deals with traditional gardening and garden development projects in Lima, Peru. Niñez describes the socioeconomic and nutritional background of low-income target populations served by small-scale food production development projects. She then discusses on-going "native" food production at the urban household level, emphasizing household gardens, and analyzes a series of past and contemporary program. Concrete suggestions are offered to guide future program design. The species on the model cropping lists provided by applied nutrition programs tend to be relatively uniform the world over, owing to the similarity in the formal training of specialists designing programs and the transfer of programmes from one world region to another. In many world regions, however, and especially in the tropics, cultivation in home gardens of species generally associated with temperate climates is often not feasible because of the intensive care such species require under local conditions....A self-help strategy potentially invaluable for improving family nutrition thus loses its raison d'etre, which is to produce at low cost locally adapted food species for immediate family consumption. [Adapted from author's introduction and conclusion]

Niñez studied 40 gardens in Lima, Peru, over two growing seasons beginning in 1983. The gardens produced an average harvest for home consumption valued at almost 10% of household earnings over the five-month growing season (about 4% on a yearly basis). The author also analyzed two garden "campaigns" in Lima, criticizing them for operating in ignorance of local conditions, promoting temperate climate models such as French intensive gardens or raised beds which "are often maladapted or totally inapplicable to local ecology and target population socioeconomics" (p. 10), as in the cases she describes.

1A.10 **Niñez, Vera K**
1987 Household Gardens: Theoretical and Policy Considerations. Agricultural Systems 23:167-186.

Key words: theoretical, World

Comment This is a revised version of 1A.8 Niñez 1984.

1A.11 **Pacey, Arnold**
1978 Gardening for Better Nutrition. 64 pp. London, UK: Intermediate Technology Publications.

Key words: theoretical, applied, children, World

This booklet is based on a review of different PVO development projects using field reports, books, and discussions with Oxfam field-workers and others. The first half

(Chapters 1-4) discusses nutrition and gardens, and the second half (Chapters 5-7) garden production techniques. Pacey stresses that nutrition-oriented agricultural projects are structurally different than production-oriented projects (Chapter 1). Chapter 2 reviews experience with gardens for improved nutrition based on health services, emphasizing that nutrition education for mothers by itself has little impact on child nutrition, and that it must be linked with education in growing and preparing food and with help in obtaining the needed materials. Nutrition Rehabilitation Units (NRUs), residential training centers for mothers and malnourished children often connected with hospitals, were previously very popular. They have not been successful because of lack of material help to mothers for food production. Children are too malnourished by the time they are referred to the NRU, and the mothers' absence from households is difficult for the families, leading to mothers leaving before the end of the training. Pacey feels that community-based "nutrition scouts" who practice preventive health and nutrition care, including encouraging gardens, have more promise.

Chapter 3 reviews experience with gardens for improved nutrition based on community participation and control from a more integrated perspective. Community gardens have several advantages over individual gardens, including increased bargaining power with the government, for example for land, decreased individual costs such as for fencing and irrigation, and increased political and legal experience of the community. Chapter 4 covers the choice of crops for improved nutrition, stressing the study of what families with good health already eat and examining the possible negative effects of modernization on traditional diets. Therefore, Pacey concludes that the best garden program may be to encourage traditional vegetables. Pacey's review of garden projects shows that nearly all have concentrated on introduced or foreign vegetables. He also makes the points that animal foods are not necessary for adequate protein intake; cooking kills pathogens, but should be brief to save fuel and conserve vitamins.

The second half of the book discusses production techniques, including choice of crops, planting techniques for different crops, setting up a garden, composting, garden planning and care, and harvesting.

Comment: Although first published 12 years ago, this booklet, sponsored by Oxfam UK is still in print (latest printing 1984) and is still widely cited. It was the first major publication promoting gardens as a nutrition intervention in development projects. The first half of the book is much more useful than the second. The chapters on production are heavily influenced by the industrial row-garden model, advocating techniques and tools inappropriate to most poor households, e.g., "improved varieties" of seeds that "should be bought regularly every year" (p. 86), watering every day with a watering can in the dry season, and an ignorance of the role of trees in the garden. This section also shows a lack of awareness of nutrition, for example, suggesting that peppers should be picked green and that food drying should be done in the sun.

1A.12 **Soemarwoto, Otto**

1987 Homegardens: A Traditional Agroforestry System with a Promising Future. In Agroforestry: A Decade of Development, Howard A. Steppler and P.K. Ramachandran Nair, editors, pp. 158-170. Nairobi, Kenya: International Council for Research in Agroforestry.

Key words: theoretical, impact-consumption, foods-indigenous, Asia, Indonesia, Thailand.

In this chapter the author discusses the salient features of gardens based on his observations in Indonesia and Thailand and secondary data from other areas of the

world and investigates their potential as development strategies. Home gardens in Indonesia and other parts of Asia are characterized by great diversity of species, which create a forest-like multistory canopy structure. With the development of a market economy the complexity of the home garden diminishes, and its resemblance to a forest tends to disappear.

In Indonesia, home gardens vary according to wet and dry seasons, altitude, cash crops or subsistence crops, socioeconomic position of the family, and culture and tradition. In a section on the function of home gardens, the author reviews data on the economy of gardens, the relationship between productivity and cost, nutritional contribution, and sociocultural functions. In his investigation of Indonesian gardens Soemarwoto illustrates their importance in religious rituals and determination of social status and as a place for children to play and adults to congregate.

The recent introduction of high-yielding, high-input species is increasing productivity, but is doing so at the expense of stability, equity, and sustainability. Market demand influences what is grown and results in a reduction in the complexity of the home garden, degeneration of its forest-like structure, and replacement of species with little economic value. Because multistoried gardens protect the soil from erosion, commercialization causes an increase in erosion. Research needs to be directed toward achieving long-term sustainability of home gardens and linking them to other parts of the agroecosystem.

1A.13 **Soleri, Daniela and David A. Cleveland**
1989 Dryland Household Gardens in Development. Arid Lands Newsletter 29:4-10.

Key words: theoretical, applied, World

Comment: This overview of dryland gardens as a development strategy is based on 1A.4 Cleveland and Soleri 1987, and 1B.2 Cleveland and Soleri 1990.

1B. APPLIED: FIELD METHODS, EVALUATION, AND EXTENSION [applied]

1B.1 **Arroyave, Guillermo, Jane Baltazar, Jane Kusin, James M. Lepkowski, Roy C. Milton and S.G. Srikantia**
1989 Methodologies for Monitoring and Evaluating Vitamin A Deficiency Intervention Programs. 61 pp. Washington, D.C.: IVACG (International Vitamin A Consultative Group).

Key words: applied, vitamin A, monitoring, evaluation

The last few years have witnessed an increasing awareness of vitamin A deficiency as a public health problem....Extensive knowledge has accumulated on the factors that condition and precipitate vitamin A deficiency. Inadequate consumption of animal foods rich in vitamin A or plant foods rich in carotenes is a central factor....During the last two decades, attention has been paid to the development of strategies for the control and eradication of vitamin A deficiency....The published and unpublished records are plagued with examples of intervention programs that have been carried out without appropriate evaluation. This condition poses a serious limitation from both scientific and practical points of view...Without evaluation, policy-makers lack the information necessary to decide whether a program to control vitamin A deficiency should be phased out, continued as is, or modified.... This manual is meant for those persons involved in

intervention programs who are not experts in monitoring and evaluation. The purpose of evaluation in the context of this manual is to demonstrate effects or an absence of these from routinely implemented programs. Additionally, the evaluation results are important to the modification of programs in light of observed constraints. Rather than emphasizing the portion of knowledge still uncertain about a program, this manual emphasizes use of the knowledge available and its application for the evaluation of intervention programs....[From the authors' introduction]

The discussion of horticultural projects (pp. 19-21) very briefly outlines definition, objectives, indicators, criteria and targets, evaluation design, and types and sources of data. The bulk of this publication (pp. 29-63) is devoted to the design of evaluation studies that will yield statistically testable results: sample size determination and sampling design, including techniques for complex multiple-stage sampling of units of different sizes to obtain proportional samples.

Comment: This publication should be very useful for the sampling design of large-scale, complex monitoring and evaluation studies of garden and nutrition projects. It will be only marginally useful for the overall design of monitoring and evaluation studies. Examples are given of definitions, objectives, indicators, criteria, evaluation designs and types and sources of data for evaluation of nutrition education and "horticulture" interventions (17-21).

1B.2 **Cleveland, David A. and Daniela Soleri**
1991 Food from Dryland Gardens: An Ecological, Nutritional and Social Approach to Small-Scale Household Food Production. c. 387 pp. Tucson, Arizona: Center for People, Food and Environment.

Key words: applied, theoretical, methods, evaluation, World

Food from Dryland Gardens is both a beginner's guide and a reference on gardens as a development strategy for the desert and savanna regions, especially in the developing world. It is a resource for field-workers, project directors, and program planners, as well as those in industrialized countries who are looking for a low-resource, sustainable approach to household gardening.

This book is unique in addressing a widely felt need for in-depth coverage that facilitates problem solving in the great variety of developing world dryland environments. It bridges the gap between indigenous dryland gardening techniques and Western horticultural science. Wherever possible documented examples of indigenous methods are presented together with basic scientific principles. Food from Dryland Gardens increases the awareness of and respect for indigenous gardening by demonstrating that it is based on experimentation and observation just as in Western science. This provides the basis for combining the best from these two approaches in projects to support and improve existing gardens or establish new ones.

The book is divided into four parts. Part I contains chapters on nutrition, economics, and assessment of gardens and garden projects. Part II is on garden management, with chapters on plants, soils, water, pests, and diseases. Part III is about harvesting and using garden produce: saving seeds, processing, preserving, marketing, and preparation of weaning foods. Part IV is Resources, with lists of crops, resource organizations, and an annotated bibliography.

The following themes are emphasized throughout the book: understanding existing

gardens as the basis for improvements; using low-cost, local resources, including indigenous knowledge, trees, and other garden crops, to promote self reliance; control and decision-making by the local people who will be affected; the scientific principles of garden management; improving household nutritional status and income; women's roles; and ecological sustainability including the conservation of soil, water, and genetic resources.

Although many specific gardening and food preparation techniques are described in Food from Dryland Gardens, it is not a "cookbook." The authors' observations and those of many others strongly suggest that gardens and garden projects are successful only when they are uniquely adapted to the local situation and are complementary parts of the larger system. [Authors' abstract]

1B.3 **Dupriez, Hugues and P. De Leener**
1987 Jardins et Vergers D'Afrique. 354 pp. Nivelles, Belgium: Terres et Vie.

Key words: applied, foods-indigenous, yields-indigenous, extension, Africa

This book, written in French, incorporates some indigenous gardening techniques and the descriptions of these are illustrated with numerous photographs of gardens and plants. The first part of the book discusses techniques and the second is a listing of 86 domesticated and nondomesticated plants used in the region, including their name in a number of local languages and a brief description of how the plants are used and how they are propagated. [Abstract from 1B.2 Cleveland and Soleri 1991]

Comment: This is one of the most useful books for people working with household gardens in sub-Saharan Africa. Although the book addresses gardens in all regions of Africa, its emphasis is primarily on the humid tropics of West Africa. The actual effectiveness of many of the techniques described has not necessarily been proven. However, the authors' extensive experience, careful observations, and obvious respect for the skill of African gardeners makes this the best extension handbook we have seen on the subject.

1B.4 **Grün, Ingolf, Michel Beck, John S. Caldwell and Marilyn S. Prehm**
1990 Development and Testing of Integrative Methods to Assess Relationships Between Garden Production and Nutrient Consumption by Low-Income Families. Journal for Farming Systems Research-Extension 1(2): 67-80.

Key words: applied, theoretical, evaluation, North America, USA

Methods for integrating garden production and consumption were tested with low-income Appalachian households in Virginia. Multi-disciplinary pairs monitored household garden production and dietary intake for key nutrients before and during the harvest season.

Different measures and analytical techniques were used to describe the relationship of garden production and consumption. Dietary intake of vitamin A and vitamin C was significantly higher during the fall garden period. Vitamin C intake was significantly correlated with family-adjusted garden nutrient yield. The correlation of family-adjusted garden nutrient yield with dietary intake was found to best reflect the increase of dietary intake during the fall garden harvest period. Eighteen vegetable crops were ranked by a combination of nutrient and production yields using the Overall Nutrition Completeness measure. These analytical techniques appear to be useful for reducing data collection

needs in this and similar projects. [Authors' abstract]

There are two evaluation methods described in this paper. Overall nutritional completeness (ONC) "is a combined indicator of yield per m^2 and the nutrient concentration of each crop for selected nutrients" (p. 9). Linear regression is used to determine the impact of a garden on consumption, and thus "can describe the relationship of a garden intervention and dietary intake" (p. 13). The authors conclude that this method is especially useful because it does not require collection of pre- and post-project data for comparing the impact of gardens on consumption.

Comment: The diversity of subsistence strategies used by most low-resource households, especially in marginal environments, could easily complicate the relationship, which is key to the linear regression analysis. Seasonality is another factor, important in much of the developing world, that could diminish the utility of this approach. Calculation of ONC provides insights into production potentials. However, other factors such as gardener's motivation, processing and palatability of harvest, and its inclusion in local diets will also play a major role.

1B.5 **O'Brien-Place, Patricia**
1987 Evaluating Home Garden Projects. 31 pp. Washington, D.C.: U.S. Department of Agriculture, Office of International Cooperation and Development, Nutrition Economics Group, in cooperation with Agency for International Development, Bureau for Science and Technology, Office of Nutrition.

Key words: applied, impact-income, impact-consumption, evaluation

The main objective of this paper is to describe a method of determining the cost effectiveness of home garden projects. For comparative analyses, evaluations must use consistent indicators. Donors need "proof" that home gardening projects are cost-effective interventions. Implementors need better information on what works and what doesn't. By outlining the steps in evaluation and identifying specific quantifiable indicators, this paper provides an evaluation protocol that can be tested, assessed, and revised over time. [From author's summary]

This document is based on 1) literature, 2) meetings with "home garden practitioners," and 3) brief observations of home garden "research and evaluation" in Taiwan and Thailand where the AVRDC had programs using its model gardens (see 3A.1 AVRDC 1988). This was meant as a "starting point" for an evaluation protocol that can be tested by private voluntary organizations, revised (p. ii), and "eventually applied to all home garden projects" (p. iii). The author's emphasis is on economic indicators, and she presents a "largely economic and numerical approach" (p. 15). Baseline, background, garden output and input, transport cost, and project operations data are briefly discussed. The heart of this document is part IV where analysis of economic and nutritional indicators is illustrated. Direct (viz. anthropometric) and indirect (production and consumption from the garden) indicators are briefly discussed. Nutritional economics indicators receive the most attention, with discussion of the calculation of Relative Nutrient Cost (RNC), Nutrient Value (NV), and Nutrient Yield (NY) meant to provide a comparison of the cost of nutrients from the garden to their cost in the market. Finally, project evaluation indicators are listed; these are meant to provide the basis for interpreting the economic and nutritional indicators.

Comment: This document is a unique and stimulating starting point for evaluating garden projects. It was meant to be an abstract beginning, and not a ready-to-use guide, but apparently has not been tested or revised since it was published. Its strengths as well as its shortcomings stem from its narrow economic focus and its requirements for a large number of quantitative measures. This makes its methods presently unfeasible for most garden projects and likely to produce indicators that may not reflect the value of gardens to gardening households. A number of aspects of this protocol could be improved. For example, the benefit-cost ratios as constructed do not adequately address the critical need to separate project start-up costs, recurrent project costs, and maintenance costs to gardeners after the project is finished. For calculating RNC, NV, and NY the author recommends using national-level data on market prices and consumption for comparison with production and consumption from project gardens, since the former is so difficult to collect as part of a garden evaluation. It seems unlikely, however, that mixing these quite different data sets will produce any meaningful nutritional indicators. The project evaluation indicators need to be greatly elaborated, since they are critical to developing and interpreting locally appropriate evaluation protocols. Suggestions need to be given on how participants themselves will be involved in design and interpretation of the evaluation.

1B.6 **Sommers, Paul**
1984 Dry Season Gardening for Improving Child Nutrition. 49 pp. New York: UNICEF.

Key words: applied, methods, Africa, Ghana

An outline of a 4-day training course for community development workers based on a brief visit to northern Ghana. Emphasizes gardens near wells based on low-cost methods using local materials, existing gardens, and indigenous knowledge.

1B.7 **Storms, Doris and John Quinley, editors**
1989 A Field Guide for Adding Vitamin A Interventions to Child Survival Projects: Recommendations for Child Survival Project Managers. Report of a special PVO child survival task force on vitamin A, Baltimore, Maryland 1988.

Key words: applied, vitamin A, evaluation

On September 9, 1988, the Task Force on Vitamin A Components of PVO (private voluntary organization) Child Survival Projects convened in Baltimore, Maryland, at the PVO Child Survival Support Office, The Johns Hopkins University, Institute for International Programs. The purpose for calling this special task force on Vitamin A was to obtain practical, field-based suggestions to guide Child Survival project managers in the assessment of need, design, operation, management, and evaluation of vitamin A intervention activities. The meeting resulted in a broad scope of recommendations for vitamin A components that are consistent with existing standards for selecting objectives, indicators, and activities for other key Child Survival interventions. These recommendations and suggestions serve as a guide to PVO Child Survival project staff working in communities throughout the developing world. [Task force abstract]

The central part of this booklet is a brief discussion of the task force recommendations. They suggest approaches to vitamin A deficiency assessments and strongly urge reliance on secondary data sources such as WHO, UNICEF, and regional or national information bases. The difficulty of assessment is attributed, among other things, to needing a large population to accurately measure the occurrence of rare symptoms, and the difficulty of helping people recognize the early stages of those symptoms in themselves and their

children. Because the extent of vitamin A deficiency is so hard to determine, PVOs are encouraged to seek technical support if they must conduct their own assessment.

The difficulty of identifying vitamin A deficiencies means that measuring change in vitamin A nutritional status is also difficult. Because of many complicating variables the task force does not recommend reductions in morbidity or mortality as objectives for vitamin A interventions. Instead they suggest using indices directly related to delivery of the intervention itself, such as number of gardens started, number of capsules distributed, or extent of behavioral change due to education.

The task force recommends that target populations for vitamin A interventions be determined according to those groups most at risk, coordinating with existing intervention programs, and taking care not to expose vulnerable groups to the dangers of hypervitaminosis.

The five vitamin A interventions listed by the task force are "nutrition education, food production, supplementation, treatment, and fortification" (p. 17). Which intervention is chosen depends on the PVO's existing child survival program. Food production interventions are divided into purely educational support (extension) or material support (seeds, tools, etc). The performance indicators listed include "the number in the target population contacted and educated, the percentage of occurrence of targeted foods in gardens...or reported percentage of children eating garden foods containing vitamin A" (p. 20). Nutrition education is seen as an appropriate complement of garden programs and examples include projects focused on maternal and child health, health-worker training or school-based nutrition education.

It is suggested that any projects interested in community-level vitamin A deficiency interventions should, among other things, identify "locally available foods that provide vitamin A or are sources of the fats or oils necessary for vitamin A absorption" and investigate "sources and costs of garden seeds that will produce foods high in vitamin A and are appropriate for local soil conditions and local food preferences" (p. 26).

1B.8 **Underwood, Barbara, Miriam Chavez, Jean Hankin, Jane Kusin, A. Omolulu, Francesca Ronchi-Proja, Rivta Butrum and Sue Ohata**

1989 Guidelines for the Development of a Simplified Dietary Assessment to Identify Groups at Risk for Inadequate Intake of Vitamin A. 61 pp. Washington, D.C.: IVACG (International Vitamin A Consultative Group).

Key words: applied, foods-nutrition, foods-indigenous, vitamin A, women, evaluation

These guidelines were developed for dietary assessment of communities for the purpose of interventions that are affordable and locally available (p. v).

Chapter I describes the dietary approach, emphasizing the fact that in low-income populations provitamin A forms, rather than preformed vitamin A, are more available, less expensive, and provide almost all of the vitamin A in the diet. Chapter II discusses factors to consider when estimating dietary intake of vitamin A. Chapter III and Appendix II discuss food sources of vitamin A and the use of food composition tables, emphasizing the inadequacy of tables that contain data of dubious quality, do not differentiate various forms of carotenoids with widely varying physiological activities, and for the most part do not consider the important influence of food processing on vitamin A activity of foods.

Chapter IV is the heart of this booklet, laying out the authors' "simplified approach to dietary assessment of vitamin A intakes." The approach emphasizes that reliability, accuracy, and precision are necessary to obtain a useful assessment. Risk of inadequate intake of vitamin A is determined by calculating a consumption index (CI), or more often a usual pattern of food consumption index (UPF) when the CI does not reflect the usual pattern of intake. Appendix III gives an illustration of applying the approach in two sites. Chapter V discusses interventions at the national, community, and household levels.

Comment: While the focus of this publication is not gardens, the general guidelines for dietary assessment should be very useful for assessing the impact of garden projects. Gardens are discussed only at the community level, but should be components at the other levels as well. In Chapter VI the authors discuss impediments within households to improving vitamin A intakes of children. They correctly state that while "cultural" factors may impede the intake of vitamin-A-active foods, it is often the "insurmountable limitations of [mothers'] poverty-bound environment" that impede increasing intake. Therefore, any production intervention, such as gardens, should promote crops that are locally adapted and inexpensive to grow.

1B.9 **Wade, Isabel**

1986 City Food: Crop Selection in Third World Cities. 54 pp. San Francisco, California: Urban Resource Systems.

Key words: applied, urban, methods, World

Promoting opportunities for urban food production must become an integral part of project planning in cities; far more than a quaint and pleasant practice, urban agriculture is basic to increasing food security in developing nations.... This manual is an effort to show that individual city residents can produce more food for their personal consumption and earn income and that significant quantities of food can be grown in urban centers by applying thoughtful, knowledgeable food production strategies. Careful selection of crops appropriate for tough urban conditions is central to such strategies.... City Food has been designed for project organizers in developing countries--local residents or others in a position to implement or assist urban agriculture projects. [From the author's preface]

Spontaneous urban agriculture is widespread and specific examples are increasingly being documented (4A.26 Tricaud 1987; 4B.6 La Rovere 1987; 4B.9 Sanyal 1986; 4B.15 Villien 1988). This booklet is a very brief overview of urban gardening, primarily for improving household nutrition. It raises discussion topics about urban gardening that readers must then use other sources to investigate more thoroughly. The main focus is on members of categories of food crops which are predominantly grown in the tropics and sub-tropics such as fruit and nut trees, tree leaves, green leafy vegetables, roots and tubers, and legumes. Nutritional content, including vitamin A, of many of these crops is given and several production techniques are described briefly.

2. GARDEN FOODS AND VITAMIN A

The papers in section 2 focus on the relationship between household gardens and vitamin A. Part 2A deals with indigenous sources of provitamin A including wild plants and tree crops. The importance of indigenous plants and knowledge to the successful implementation of household garden projects and vitamin A improvement is stressed in many of the articles.

Part 2B discusses the impact of processing, storage, and cooking techniques on provitamin A content of garden produce. The articles in part 2C cover the relationship between consumption of provitamin A-rich foods and vitamin A nutritional status.

2A. INDIGENOUS SOURCES OF VITAMIN A [foods-indigenous]

2A.1 **Becker, Barbara**
1983 The Contribution of Wild Plants to Human Nutrition in the Ferlo (Northern Senegal). Agroforestry Systems 1:257-267

Key words: foods-indigenous, agroforestry, Africa, Senegal

One aspect of agroforestry is the integration of indigenous plants into the appropriate land-use systems. Some local trees and shrubs are particularly appreciated because of their value in human nutrition.

The Ferlo is the most arid part of Senegal, covered by open woodland. The local population uses several indigenous plants for food. Most important are Adansonia digitat, Balanites aegyptiaca, and Ziziphus mauritania, as well as Boscia senegalensis and Cassia obtusifolia. Some 20 more species are consumed to a smaller extent. Their main function is to supply the vitamins A, B_2 and C, for which seasonal shortages occur. About 50 percent of all plants growing in the Ferlo have edible parts, but only the most common ones are consumed. Further exploitation of these natural resources and their conscious integration into agroforestry systems is economically and ecologically recommendable. [Author's abstract]

Becker suggests supporting the integration of nutritionally important indigenous plant species into agricultural systems, including household gardens. This would not only make them convenient for harvesting, but would offer the plants an environment to become established in, protected from grazing animals and other stresses that may be threatening their populations in the wild.

2A.2 **Becker, Barbara**
1986 Wild Plants for Human Nutrition in the Sahelian Zone. Journal of Arid Environments 11:61-64.

Key words: foods-indigenous, Africa

Comment: This article is very similar to, though briefer than, 2A.1 Becker 1983.

2A.3 **Bompard, J.M.**
1986 Arboriculture Fruitiere en Indonesie Occidental: Traditions et perspectives. Fruits 41(9):531-551.

Key words: foods-indigenous, impact-income, agroforestry, Asia, Indonesia

The wealth of indigenous fruit trees and the originality of the cropping system are important features of fruit tree culture in western Indonesia (Borneo, Sumatra, Java), which show evidence of long-evolved traditions in the exploitation and management of local forest resources. Today most of the fruit is still produced in traditional agroforestry systems (i.e., backyard/village agroforest gardens). In 1982 between 550 and 600 thousand hectares were devoted to fruit cultivation, producing 5,136,000 tons of fruit (including bananas, citrus fruits, pawpaws, guavas, mangoes, pineapples, durians, rambutans, avocados and sapodillas). Because of changes occurring within these cropping systems under increasing demographic and economic pressures, there is concern about the future of some of the important fruit crops and the genetic reservoir. [Author's abstract; text in French]

Despite neglect by agricultural development programs focused on rice production, a wide variety of domesticated fruit trees have been maintained in western Indonesian gardens. Bompard points out that not only have these systems maintained valuable genetic resources, but they also contribute to the gardeners' diets and in areas where marketing is possible these fruit trees can provide more annual gross income than does rice cultivation, even though less land is devoted to fruit production. Bompard suggests that these indigenous mixed gardens deserve attention as genetic reservoirs for the improvement of Indonesian fruit production and as locally adapted systems for that production.

2A.4 **Bye, Robert A., Jr.**

1981 Quelites -- Ethnoecology of Edible Greens -- Past, Present, and Future. Journal of Ethnobiology 1:109-123.

Key words: foods-indigenous, foods-processing, foods-nutrition, impact-consumption, vitamin A, Latin America, Mexico

Quelites are edible greens usually derived from young, tender annual herbs but they may also include flowers, inflorescences, and stem tips of perennials. Because these plant parts are available only seasonally and do not leave recognizable macrofossils, this food resource has been difficult to detect in archaeological context. Historical references have been vague, and most recent ethnographic reports contain incomplete references due to seasonality and derogatory connotations attributed to quelite consumption. Recent studies among the Tarahumara of Chihauhau, Mexico, and experimental studies in Mexico and Africa suggest that: 1) a great richness of plants is exploited, 2) human disturbance is necessary for maintenance of this resource, 3) greens form a nutritionally important component of annual diets, 4) quelites represent products of ecologically sound agricultural practices and yields are based upon the multiple cropping model, 5) encouragement of this resource may have led to the domestication of such plants as Amaranthus, Brassica, and Chenopodium, and 6) these plants may be a valuable resource in future food production systems. [Author's abstract]

Quelites are available at the beginning of the rainy season, just when food reserves are lowest and are "critical to the survival of Tarahumara" (p. 114). Nutritional losses are minimized by traditional "preparation techniques using warm (not boiling) water" (p. 115). The inclusion of 100 g of quelites brings the vitamin A-deficient staple maize-bean-cucurbit diet to a level which meets NAS RDAs.

2A.5 **Evenson, Stacy K. and Bluebell R. Standal**

1984 Use of Tropical Vegetables to Improve Diets in the Pacific Region. Research Series 028, Hawaii Institute of Tropical Agriculture and Human Resources. 32 pp. Manoa, Hawaii: University of Hawaii.

Key words: foods-indigenous, impact-consumption, vitamin A, Asia

The content of five essential nutrients (protein, calcium, iron, ascorbic acid, and vitamin A) and the caloric value of 11 temperate-zone vegetables and 11 tropical vegetables were compiled from data reported in earlier publications. The composition of amino acids and the content of oxalic acid (an antinutrient that binds calcium) of selected tropical and temperate-zone vegetables were compared. Recipes using tropical vegetables were developed incorporating various ethnic cooking methods and were taste-tested by a multi-ethnic group of men, women, and children. Finally calculations on NDpCal (net dietary protein-calories) percent were made for each meal containing a temperate-zone vegetable and for the same meal with a tropical vegetable substituted. NDpCal percent allowed for comparisons of protein-quality change when tropical vegetable replaced temperate-zone vegetables.

The findings of this study suggested that the tropical vegetables studied could supply more of the five essential nutrients than were available from the commonly eaten temperate-zone vegetables tested. Comparisons of amino acid scores and NDpCal percent resulted in sets of values indicating higher protein quality for tropical vegetables. The problematic antinutrient oxalic acid was higher in tropical vegetables. Recipes using tropical vegetables were rated as appealing. [Author's abstract]

Comparison of the nutritional value of tropical garden vegetables and ones from temperate areas provides an overview of possible nutrient yields of gardens containing one or the other type crops. The average vitamin A production per 100g of raw food measured in international units [IU] (10 IU from beta-carotene = 1 retinol equivalent) was 5505 IU from tropical vegetables and 1672 IU from temperate-zone vegetables. An analysis of the net nutrient effect of substituting temperate-zone vegetables for tropical ones in traditional Pacific region menus showed a decrease in vitamin A content in seven of the nine menus, the exceptions being when carrots or garden peas were substituted for taro leaves and pigeon peas.

Comment: This study contributes to the literature which is bringing attention to the importance of many traditional crops, because of their high nutritional value as well as adaptation to local growing conditions and tastes.

2A.6 **FAO (Food and Agriculture Organization, United Nations)**

1983 Food and Fruit-Bearing Forest Species 1: Examples from Eastern Africa. FAO Forestry Paper 44/1. 172 pp. Rome, Italy: FAO.

Key words: foods-indigenous, Africa

Profiles of 40 food- and fruit-bearing species. See description and comment for 2A.9 FAO 1986.

2A.7 **FAO (Food and Agriculture Organization, United Nations)**
1984 Food and Fruit-Bearing Forest Species 2: Examples from Southeastern Asia. FAO Forestry Paper 44/2. 167 pp. Rome, Italy: FAO.

Key words: foods-indigenous, Asia

Profiles of 70 food- and fruit-bearing species. See description and comment for 2A.9 FAO 1986.

2A.8 **FAO (Food and Agriculture Organization, United Nations)**
1985 Report of the Expert Consultation on Broadening the Food Base with Traditional Food Plants. 45 pp. Rome, Italy: FAO.

Key words: foods-indigenous, impact-consumption, Africa

Traditional plants have been neglected or purposefully eliminated from agricultural development programs and changing diets in developing countries. However, the growing recognition that these plants, many of which are garden crops, are unique, locally appropriate agronomic and nutritional resources has inspired a reconsideration of them among development workers. A meeting held November 1985 in Harare, Zimbabwe brought together agriculture and nutrition experts from seven African countries and the FAO to discuss traditional food plants in Africa. Case studies from five countries and technical papers were presented.

The participants acknowledged the political and economic pressure on sub-Saharan countries to adopt technological packages for agriculture to rapidly boost food supplies for growing populations. They noted that the risk of investing in a narrowly based food system reliant on external inputs is becoming apparent, stimulating interest in alternative systems and crops. The failure of conventional agricultural development strategies to improve the well-being of poor, small-scale farmers was cited as another stimulus for seeking new approaches.

Overviews of the current status of research on specific traditional plants include the following garden crops: sesame, cashew, Niger seed, sweet potato, mango, guava, papaya, avocado, Brassicas, Cucurbits, pigeon pea, cow pea, bambara groundnut, and gathered fruits and vegetables. Recommendations called for information gathering and promotion of these plants, research to improve their availability and productivity, provision of marketing support for traditional crops, and improvements in storage and processing capabilities at the household and community levels. The book "Traditional Food Plants" (2A.10 FAO 1988) grew out of this initiative on traditional food plants.

Comment: This report and the case studies on which it is based are important for discussions of gardens and development because they represent the increasing recognition in the 1980s that the unique challenges of many developing country environments, coupled with limited availability of external inputs, limit solutions to nutritional and economic problems to those appropriate for conditions to be sustainable. Traditional food crops are increasingly seen as the biological resource on which to base these solutions, just as indigenous knowledge is the sociocultural resource base.

2A.9 **FAO (Food and Agriculture Organization, United Nations)**
1986 Food and Fruit-Bearing Forest Species 3: Examples from Latin America. FAO Forestry Paper 44/3. 308 pp. Rome, Italy: FAO.

Key words: foods-indigenous, agroforestry, Latin America

Profiles of 74 food- and fruit-bearing species.
This series attempts to document the wealth of local tree resources, which produce food in different regions of the world. Profiles of different species include botanical and local names, ecology and distribution, propagation methods, food use, and sometimes nutritional value.

Comment: Discussions of cultivation and use tend to emphasize potential for industrial production, not home gardens.

2A.10 **FAO (Food and Agriculture Organization, United Nations)**
1988 Traditional Food Plants. A Resource Book for Promoting the Exploitation and Consumption of Food Plants in Arid, Semi-Arid and Sub-Humid Lands of Eastern Africa. Food and Nutrition Paper 42. 593 pp. Rome, Italy: FAO.

Key words: foods-indigenous, Africa, Ethiopia, Zimbabwe

This book seeks to improve household nutrition from Ethiopia to Zimbabwe by promoting traditional food plants, many of which are now underutilized because of the predominance of introduced staple crops. A short introduction to nutrition and the role of traditional crops is followed by description of 110 species, including food value, food use, ecology, and cultivation. Species were selected on the basis of potential contribution to nutrition and income and for ease of small-scale cultivation. [Abstract from Cleveland and Soleri 1990]

2A.11 **Longhurst, Richard and Michael Lipton**
1989 The Role of Agricultural Research and Secondary Food Crops in Reducing Seasonal Food Insecurity. In Seasonal Variability in Third World Agriculture: The Consequences for Food Security. David E. Sahn, ed. Pp. 285-297. Baltimore, Maryland: Johns Hopkins University Press.

Key words: foods-indigenous, secondary crops, Africa, World

This book chapter focuses on "secondary food crops," many of which are cultivated in gardens. These secondary or minor crops are important not only because of their nutrient content and nutritional complementarity with staple foods, but also because they can be productive when other foods are in short supply, or when environmental conditions such as drought reduce or stop production of other crops. Several brief examples are given of the role of secondary food crops in reducing seasonal food supply fluctuations in Africa.

The second half of the article discusses the (potential) value of agricultural research on secondary food crops. The authors feel that the contribution of secondary food crops to household food security is justification for their support by agricultural research. The issue then becomes, What is the goal of such support and consequently what form should the support take? The complexity and diversity of secondary food crops and production systems makes them difficult to evaluate. In addition there is the risk that research and improvement efforts would occur at the expense of this complexity and diversity,

undermining the risk-spreading ability that those qualities contribute to the household food system. As Longhurst and Lipton conclude, the most important first step may be to "ensure that researchers and policy makers, even if their interest is in major crops, adequately recognize and allow for the role of secondary food crops and crop mixes within farmer's seasonal strategies, rather than that they initiate a crash program of secondary food crop yield improvement" (p. 297).

2A.12 **Martin, Franklin W. and Ruth M. Ruberte**

1975 Edible Leaves of the Tropics. 235 pp. Published jointly by the Agency for International Development, Department of State, and the Agricultural Research Service, U.S. Department of Agriculture.

Key words: foods-indigenous, World

This book is a reference on the green leafy vegetables of the tropics and subtropics. The text is organized according to plant type, such as "weeds with edible leaves, fruits, vegetables, ornamental plants with edible leaves, and tropical trees with edible leaves." Under these headings plants are grouped according to family or genus, depending on their importance as an edible green. The discussion of these groupings usually includes an overview of the plant's origin and use and sometimes information regarding nutrient content and cultivation practices. Genus and species names are given as are the common names in English and frequently in Spanish. Also included are a chapter on poisonous tropical leaves, 56 black and white photographs primarily of edible species, and a 57 page appendix organized by plant family, listing Latin name, "source and plant type" (i.e. herb, shrub, tree).

2A.13 **Meals for Millions/Freedom from Hunger Foundation (MfM/FfHF) and Save the Children Federation (SCF)**

1980 O'odham I'waki: Wild Greens of the Desert People. 25 pp. Tucson, Arizona: MfM/FfHF and SCF.

Key words: foods-indigenous, Native Americans, North America

Written for O'odham Native Americans to encourage consumption of traditional wild greens for improved nutrition. This booklet includes detailed descriptions of five plants, a list of some others, recipes, traditional stories, and a table of nutrient content.

Comment: This illustrated booklet is an example of the kind of educational publications that can be produced to encourage use of wild greens.

2A.14 **Ogle, Britta Mathilda and Louis Evan Grivetti**

1985 Legacy of the Chameleon: Edible Wild Plants in the Kingdom of Swaziland, Southern Africa. A Cultural, Ecological, Nutritional Study.

a Part I- Introduction. Objectives, Methods, Swazi Culture, Landscape and Diet. Ecology of Food and Nutrition 16:193-208.

b Part II- Demographics, Species Availability and Dietary Use, Analysis by Ecological Zone. Ecology of Food and Nutrition 17:1-30.

c Part III- Cultural and Ecological Analysis. Ecology of Food and Nutrition 17:31-40.

d Part IV- Nutritional Analysis and Conclusions. Ecology of Food and Nutrition 17:41-64.

Key words: foods-indigenous, impact-consumption, Africa, Swaziland

Research was conducted in 1981 on the use of edible wild plants in the four major

ecological zones in Swaziland. Part I provides background information relevant to the research; geographic, ecological, and sociocultural information and dietary practices, and a description of research methods used. Part II provides a demographic profile of the 211 adults and 140 school children who were interviewed. The adult population was predominantly female (86%). The population was ethnically quite homogeneous, 90% being Swazi, with 45% reporting their occupation as farming and 26% as "housework." Seventy one per cent of those interviewed grew fruit trees, 43% said they had gardens, and 100% reported collecting wild plants for food. There was a corresponding increase in the seasonality of gardening with increasing elevation, and diversity of crops grown in gardens was greatest in the lower elevations compared with the higher ones.

Adults reported an average of 48.7 edible wild plants available in their areas, and a total of over 200 species with edible leaves, fruits, roots, or resins were identified through the interviews. Leaves were the most common form of wild food used by respondents. Thirty seven per cent of adults said they consumed more cultivated foods than wild ones, 39% said wild plants contributed more to their diets than cultivated ones, and 18% said wild and cultivated foods contributed equally to their diets. Seasonality strongly affected whether cultivated or wild foods dominated in the diet.
Interviewees in all ecological zones felt that some wild edible species were becoming extinct. The highest number of species reported lost was by residents of the densely populated middleveld, center of the nation's industrial and agricultural "development." These respondents attributed the losses to the encroachment of large-scale agriculture.

Part III looks at the management, harvesting, and use of wild foods. The "mother" in the household was most frequently cited as the household member responsible for gathering these plants. The most common collecting site was agricultural fields where disturbed soil encouraged the growth of wild plants, both indigenous and introduced "agricultural weeds." It is when the agricultural practices start to include the use of herbicides that agriculture eliminates instead of encourages many of these wild plants. Thirty eight per cent of adults described protecting growing areas of wild edible plants, and 24% said they cultivate those plants in household gardens. Nevertheless, wild plant foods have low social status among some Swazis, which the authors attribute to those being considered poverty foods.

In part IV nutrient analyses of the wild foods found some of them to be good sources of protein, either directly or through complementarity with the staple food, which is maize. Other significant nutritional contributions can be in calcium, iron, ascorbic acid and a number of trace minerals.

Ogle and Grivetti state that wild foods frequently serve as buffers to seasonal food shortages in different ecological zones and the dietary diversity that the foods provide is a critical risk-management resource for Swazi households. Because of this they caution that agricultural practices such as herbicide use to maximize yields will likely have a negative impact on nutrition because it reduces the diversity and thus the risk-spreading ability of Swazi households' food systems.

Comment: The authors do not indicate if statements about proportion of wild and cultivated foods eaten refer to total diet or are comparisons of wild and cultivated fruits and vegetables only. Surprisingly there is no discussion of the provitamin A contributions of these foods, which, because of the numerous leaves consumed, could be significant. In fact, the authors give a table comparing the nutrient content of wild and cultivated plant foods in which the highest carotene content/100 grams of edible portion is found in two of the wild food sources. Overall this research raises important issues for development

projects promoting household food production to improve nutritional well being. The nutrient contribution of many wild or semiwild plant species, and how households are already protecting, cultivating and using them, give insights into how garden projects can support the use of these important local resources.

2A.15 **Oomen, H.A.P.C. and G.J.H. Grubben**
1978 Tropical Leaf Vegetables in Human Nutrition. 2nd edition, Communication 69. 140 pp. Amsterdam, The Netherlands: Department of Agricultural Research, Koninklijk Institut voor de Tropen.

Key words: foods-indigenous, impact-consumption, World

This book was written to increase awareness and thus the use of leaf vegetables in tropical diets by providing an overview of nutritional and agricultural aspects of leaf vegetables in household food systems. Leaf structure is explained, and nutrient contributions, including protein, calcium, iron, carotene, ascorbic acid and folate, production systems, and preparation and consumption of leaf vegetables are all discussed.

Comment: This easy-to-read book is a valuable resource and educational tool because of its accessibility, its recognition of the importance of these secondary foods, and its emphasis on indigenous plants, gardens, and foods.

2A.16 **Shrestha, Shushi Maya, Suzinne Pak and the Vitamin A Child Survival Project Research Team**
1989 Nutritional Behavior: A Study in Chitwan, Preliminary Findings. 19 pp. Paper presented at a meeting of the International Vitamin A Consultative Group, Kathmandu, Nepal, November 1989.

Key words: foods-indigenous, foods-nutrition, vitamin A, dietary survey, Asia, Nepal, Chitwan

Nepal contains a diversity of ethnic groups, and Chitwan, located in the Terai, offers an opportunity to study most of them. Thus, for this small-scale study, Chitwan provided an ideal location for the examination of nutrition behavior, particularly as it pertains to vitamin A-rich foods.

Thirty-two villages from seven panchayats in Chitwan were selected for this small-scale nutrition study. The purpose of this study was to gain insight into the nutrition behavior and values of the area, particularly as they pertained to children's consumption of foods with high vitamin A content. Better understanding of nutrition behavior in the study area will make possible a more appropriate formulation of nutrition messages for the nutrition education programs. The sample covered 466 households, each containing a mean of three children per household.

Some of the preliminary findings are: wild growing fruits and vegetables (jungle foods) are major sources of food. Many of these jungle foods are rich in vitamin A and other micronutrients [sic]. Another finding is that there are a substantial number of taboos against serving dark green leafy vegetables (DGLVs) during illness. Reasons for avoiding fruits and vegetables included beliefs that they would make the child sicker. [From the author's abstract]

In a 24-hour dietary recall conducted as part of this research, dark green leafy vegetables (DGLV) were listed by 43.4% of households. When asked how frequently DGLVs are

served to children in the household 29.4% said almost everyday and 53.6% said once or twice/week, for a total of 83% of the households. Several reasons were given by mothers for not feeding DGLVs to their children, including unpalatability to children, and concern that the food would cause sickness. Seventy-seven percent of respondents said they ate wild foods, including a leafy vegetable described by the authors as "a rich source of vitamin A." Among the authors' recommendations are the promotion of both wild and domesticated fruits and vegetables, support for vegetable production, nutrition education, and encouragement to mothers to "include well-cooked DGLVs in their children's diets" (p. 18).

Comment: Investigation of intrahousehold food-distribution patterns would help establish the effect of these on frequency of consumption of fruits and vegetables, such as DGLVs, by those most in need. Knowing the proportion of plant foods, especially those high in vitamin A, which were gathered and those which were cultivated would contribute much to understanding the significance of these findings for existing or potential gardening. Although mentioned in the abstract, this paper does not discuss ethnicity.

2A.17 **Shrimpton, Roger**
1989 Vitamin A Deficiency in Brazil: Perspectives for Food Production Oriented Interventions. Ecology of Food and Nutrition 23:261-271.

Key words: foods-indigenous, foods-nutrition, vitamin A, Latin America, Brazil

A vitamin A deficiency problem exists in Brazil, but it does not appear to be associated with the degree of blinding sequela found in Asia and Africa. Xerophthalmia does occur in the semiarid "sertao" region of the Northeast, but more in children under two years of age, as compared with the three to five years of age for Asia and Africa. This difference may be related to the shorter duration of breast feeding in northeastern Brazil. Many but not all northeastern states employ massive dose-capsule distributions to combat vitamin A deficiency, but all seek a more long-term solution. The Brazilian diet is both quantitatively and qualitatively deficient in vitamin A. Rural diets are poorer in vitamin A than urban diets. In southern Brazil dairy products are the principal dietary vitamin A source and responsible for most of the variability associated with income and location. In the northeast, where vitamin A intakes are lowest, plant foods are the more important sources of vitamin A. Many available or easily cultivated rich vitamin A sources, however, are not consumed. Fruits and vegetables being introduced from the south of Brazil are poor in vitamin A compared to the indigenous species, whose production and consumption are declining. Programs are needed not only to improve production of native fruits and vegetables, but also to promote their consumption. [Adapted from author's abstract]

In Table I the author compares quantitative and qualitative adequacy of the Brazilian diet by region. In Table II he classifies staple food crops and fruits according to their vitamin A quality scores. Compared with the easily grown fruits traditional in the north and northeast, the temperate-zone "fruits more commonly eaten in the South of Brazil,...such as apples, pears, oranges and lemons that are becoming culturally more "desirable" in the urban Northeast, are comparatively poor sources of vitamin A.... They are probably more easily purchased now in many urban centers of the northeast of Brazil than the superior indigenous fruits" (p. 267). Table III compares vitamin A quality scores of vegetables from southern Brazil, with indigenous herbs and vegetables of the north and northeast that are easily cultivated, but in danger of disappearing. Most indigenous crops are good sources of vitamin A. The herbs are grown in containers in and around

most dwellings in the north and northeast. The vegetables from the south are hard to grow in the northeast "without resorting to fertilizers and pesticides." Yet it is these imported crops that receive most attention in the "limited attempts made by the agricultural sector to improve the availability of vegetables in the Northeast" (p. 269). The author states that educational programs to increase vitamin A intake need to concentrate on promoting existing vitamin A food resources and breastfeeding.

2A.18 **Van Epenhuijsen, C.W.**
1978 La culture des legumes indigenes au Nigeria. FAO Vegetable Production and Plant Protection Series no. 17. 108 pp. Rome, Italy: FAO (Food and Agriculture Organization). Published in English as Growing Native Vegetables in Nigeria, 1974.

Key words: foods-indigenous, Africa, Nigeria

This book (text in French) promotes the use of indigenous plants, both wild and domesticated, in Nigeria. The first 26 pages discuss general topics of cultivation, use, cooking, and storage of these plants and plant foods. The rest of the book is devoted to illustrated descriptions of the botanical and horticultural characteristics of 38 species.

Comment: The species promoted by this book are local but the growing methods described are industrial, including a strong emphasis on pesticide use.

2B. FOOD PROCESSING AND NUTRITIONAL VALUE [foods-processing]

2B.1 **Akpapunam, Maurice A.**
1984 Effects of Wilting, Blanching and Storage Temperatures on Ascorbic Acid and Total Carotenoids Content of Some Nigerian Fresh Vegetables. Plant Foods for Human Nutrition 34:177-180.

Key words: foods-processing, foods-indigenous, vitamin A, storage, Africa

Four fresh vegetables (fluted pumpkin leaf, okra, African spinach, and water leaf) were studied. Determinations were made of the amounts of ascorbic acid and total carotenoids in fresh, wilted, and blanched vegetables as well as in fresh and blanched vegetables stored at -10 degrees centigrade and 5 degrees centigrade. Results showed that wilting accounted for the highest losses in both ascorbic acid and carotenoids in all vegetables investigated. The least losses in the two nutrients were observed in blanched vegetables. In general carotenoid was more stable to the different treatments than ascorbic acid. [Author's abstract]

2B.2 **Cameron, Margaret and Yngve Hofvander**
1983 Manual on Feeding Infants and Young Children. 3rd ed. 214 pp. Oxford, U.K.: Oxford University Press.

Key words: foods-processing, impact-consumption, women, children, World

This readable book provides background information on fetal and infant growth and development and then goes on to focus on early childhood nutrition and weaning foods. "Multi-mixes" are combinations of locally available staple, protein, energy and vitamin/mineral-rich foods, which complement breast milk during weaning. The vitamin- and mineral-rich foods are garden products and dark green leaves are advocated because of their availability and high carotenoid content.

Comment: Gardens can be the source of many food types in the multi-mix. For example, energy can be provided by oil-rich sunflower, sesame, or melon seeds. This book is an excellent reference for anyone working with child health projects. Although some of the calculations described for "designing" weaning foods are more elaborate than they should be to encourage use, the book focuses on locally available resources and solutions.

2B.3 **Gomez, M.I.**
1981 Effect of Drying on the Nutritive Value of Foods in Kenya. In Food Drying: Proceedings of a workshop held at Edmonton, Alberta, July 6-9, 1981, Gordon Yaciuk, editor. Pp 31-35. Ottawa, Canada: IDRC (International Development Research Centre).

Key words: foods-processing, foods-indigenous, vitamin A, drying, Africa

Vegetables were analyzed for vitamin C and carotene content. Four selected species were subjected to solar dehydration with and without photo-protection. Two pretreatments, steam blanching and sulfiting, were applied and carotene retention in the resulting dried products was evaluated. A control study was conducted with ambient temperature shade-dried material subjected to the same pretreatments. Mango and papaya were similarly subjected to blanching and citric acid and sucrose pretreatments, respectively, and retention of carotene and vitamin C in the dried products was observed.

Carotene retention in the ambient temperature-dried treatments was lower than in the solar-dried treatments with continued losses in storage. Light-protected drying resulted in higher retention than light-exposed drying and steam blanching improved retention significantly. Papaya showed appreciably higher retention of vitamin C with drying than did mango, while the latter showed significantly higher carotene retention. Steam blanching of mango prior to drying resulted in appreciable losses of both ascorbic acid and carotene. [Author's abstract]

2B.4 **Maeda, E.E. and D.K. Salunkhe**
1981 Retention of Ascorbic Acid and Total Carotene in Solar Dried Vegetables. Journal of Food Science 46:1288-1290.

Key words: foods-processing, foods-indigenous, vitamin A, drying, Africa

Four vegetables (African spinach, cow pea, sweet potato, and cassava leaves) were dried in the open sunshine and in enclosed convectional solar driers with and without shade provision. Total carotene and ascorbic acid content in the fresh leaves and in leaves dried under the three drying conditions were assayed. The study showed that maximum retention of the two vitamins is obtained by drying vegetables in enclosed solar drier with shade. Direct sun exposure of vegetables, as often practiced in the tropics, resulted in marginal retention of the two vitamins. [Author's abstract]

2B.5 **Rankins, Jenice, Sampson Hopkinson and Mouhamadou Diop**
1989 Palatability and Nutritional Significance of Solar Dried Mangoes for Senegal. Ecology of Food and Nutrition 23:131-140.

Key words: foods-processing, foods-indigenous, vitamin A, drying, Africa, Senegal

Three varieties of grafted mangoes were dried to a moisture content of 9-11 percent, utilizing a greenhouse model solar dryer that measured about 4.5 m^2 and had a drying

capacity of 20 kg of tray-ready mangoes. The results showed that after six months of storage, 1) retinol equivalents of beta carotene and vitamin C contents of 100 gms of dried mangoes averaged recommended dietary allowances respectively for children; 2) the Kint variety contained relatively substantial amounts of iron; and 3) acceptability ratings for dried slices and desserts were generally ok to excellent and were not influenced by the brightness and sweetness additives tested. These results have significant relevance to nutritionally at-risk populations in Tropical Africa where mangoes are seasonally plentiful and popular but go to waste in large amounts because of the lack of appropriate preservation technologies. [Authors' abstract]

Studies on food availability and dietary intake reveal that the diets of weaning age children in Senegal are often low in some essential nutrients, including iron, calcium, vitamins A and C, folic acid, and riboflavin. Mangoes, a popular fruit, are important sources of B-carotene, vitamin C, and iron, and market-garden women estimate mango waste at 50% and higher.

Comment: This study illustrates the potential for extending the availability of mangoes year-round by using low cost solar drying.

2C. FOOD INTAKE AND VITAMIN A NUTRITIONAL STATUS [foods-nutrition]

2C.1 **Charoenkiatkul, Somsri, Aree Valyasevi, and Kraisid Tontisirin**
1985 Dietary Approaches to the Prevention of Vitamin A Deficiency. Food and Nutrition Bulletin 7(3):72-76.

Key words: foods-nutrition, vitamin A, children, Asia, Thailand

The study sample consisted of two groups, numbering 15 preschool children each, whose usual diets averaged approximately 560 ug retinol equivalents. Both groups of subjects had been in an orphanage for more than six months....Their diet was rice based. The two groups of subjects were matched for sex, weight, height, and nutritional status. Group 1 subjects were tested during the wet season from late May to early October and group 2 subjects during the cool, dry season from late October to early January. Subjects in group 1 were given no supplement for a period of two weeks and then received daily supplements of cooked ivygourd containing 1,081 +/- 12 μg B-carotene....Subjects in group 2 received 1,187 +/- 10 μg B-carotene...in cooked ivygourd daily for two weeks....

The results for group 1....[show] significant increases ($P<.01$) in serum B-carotene and vitamin A levels. These findings indicate that B-carotene was not only absorbed adequately but also converted to vitamin A effectively. The results for group 2....[show] a significant increase ($P<.001$) in serum B-carotene...but no differences in serum vitamin A. [These] observations...indicated that under conditions of protein-energy malnutrition...with recurrent infections, the serum vitamin A levels of some children may drop despite daily supplementation with vegetables with high provitamin A content....

The green leafy vegetables were acceptable to these subjects; only 2 of 30 children (6.7%) would not eat them. [Excerpted from authors' article]

Comment: This study from Thailand provides evidence that traditional DGLVs can increase vitamin A nutritional status.

2C.2 **Reddy, Vinodini**

1986 Vitamin A Deficiency Control in India. In Vitamin A Deficiency and its Control. J.D. Bauernfeind, editor. Pp. 389-404. Orlando, Florida: Academic Press.

Key words: foods-nutrition, foods-indigenous, vitamin A, children, Asia, India

This book chapter includes a review of evidence from India on the efficacy of diet in reducing vitamin A deficiency (pp. 394-395). For example, mean absorption of B-carotene from leafy vegetables by undernourished children shows a mean rate of 70 percent, which is similar to that of normal adults; daily supplements of amaranth to children with marginal protein intakes significantly increased serum vitamin A; fat with spinach supplements increased serum vitamin A; and satisfactory serum vitamin A levels were maintained for six or more weeks after supplementation.

2C.3 **Tarwotjo, Ignatius, Alfred Sommer, Tito Soegiharto, Djoko Susanto, and Muhilal**

1982 Dietary Practices and Xerophthalmia among Indonesian Children. American Journal of Clinical Nutrition 35:574-581.

Key words: foods-nutrition, foods-indigenous, vitamin A, children, Asia, Indonesia

The stated frequency with which 30 Indonesian children with corneal xerophthalmia and age/sex/neighborhood matched controls who ordinarily consumed vitamin- and provitamin A-rich foods was compared. Controls were more frequent consumers of eggs ($p<0.05$), fish ($p<0.05$), dark green leafy vegetables ($p<0.05$), carrots ($p<0.01$), and carotene-containing fruits ($p<0.1$). Similar data were collected on 358 children with Bitot's spots and on normal preschool age children in a countrywide survey. Breast-feeding was more common among normals than among cases ($p<0.001$). Normals were also more frequent consumers of mango and papaya during the 2nd and 3rd year of life ($p<0.05$) and of dark green leafy vegetables and eggs during the 3rd through 6th years of life ($p<0.01$). In two separate studies, differences in carotene consumption by normals and abnormals were confirmed by differences in their serum carotene levels. Approximately 80 percent of Indonesian families, with and without xerophthalmic children, consumed dark green leafy vegetables at least once a day, and 99 percent at least once a week. Diet therefore appears to be an important factor in the genesis of xerophthalmia in Indonesia despite the availability of provitamin A-rich foods. [Author's abstract]

"The relative risk of corneal disease was inversely related to the frequency of DGLV consumption: those never consuming DGLV were at 3.7 times the risk of those consuming DGLV at least once a month but less than once a week, and at 7.3 times the risk of those consuming DGLV at least once a week" (p. 578).

Comment: This is an important article that shows a significant correlation between the consumption of vitamin A-rich foods and nutritional status in three separate samples. The finding that availability of vitamin A-rich plant foods (e.g. DGLVs), typically grown in gardens at the "family" level, is not correlated with vitamin A nutritional status emphasizes the need to look at patterns of distribution and consumption within households.

Studies like this need to be complemented by in-depth studies with a few households to understand the differences between households of children with and without vitamin A deficiency.

3. GARDEN NUTRIENT YIELDS

This section considers nutrient yields from model gardens and indigenous gardens often expressed in terms of percent of RDA provided to the household as strategies for improving household nutritional status. As the literature on indigenous gardens suggests, they may provide the best foundation for projects promoting household food production as a means to improve nutrition, including vitamin A nutrition.

3A. MODEL/MAXIMIZING GARDENS [yields-model]

3A.1 **AVRDC (Asian Vegetable Research and Development Center)**
1988 Gardening Nutritious Vegetables: Proceedings of the Vegetable Improvement Gardening Workshop, Bangkok, Thailand and Shanhua, Taiwan, ROC, 22-26 April 1985. 136 pp. Llemit, Norma V. and Pura J. Lastimosa, editors. Shanhua, Taiwan: AVRDC.

Key words: yields-model, applied, Asia, Indonesia, Philippines, Taiwan, Thailand

This book is a compilation of papers presented at a workshop organized by the AVRDC in Taiwan. Many of the papers are research and development program proposals for garden projects in southeast Asia, based on the AVRDC model.

The first section is a discussion of AVRDC research projects in Taiwan. Model school gardens, Indonesian, Thai, and Philippine home gardens, and market gardens were among those developed at the research center and their yields in weight, nutrients, or gross income were documented. "A research project developed a 10 x 18 m school garden which can provide 142 children with 1/2 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 gar- dens can supply a family of five... 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" (p.6).

The second section contains three papers on garden programs in Indonesia. The first, by Edi Guhardja, reports on one existing and one proposed garden project. The proposed research on home gardens sees them as the initial step in the creation of a household agricultural production system in new settlement areas. The existing garden project is in Cikarawang, a village in West Java where "action-oriented research" was conducted for one year on home gardens for improved vitamin A consumption. This project recruited participants, helped them establish and maintain gardens, and provided nutrition education. Constraints to "adoption of home gardens" included small or no growing areas, too much shade, damage to plants by chickens, and "local residents were not eating leafy vegetables and were unaware of the benefits of home gardens" (p. 64).

The third section is on garden programs in the Philippines and starts with a description by Florentino S. Solon of the gardening intervention used in the Cebu City vitamin A project [see 4A.12 Latham and Solon 1986 and 4A.21 Solon et al. 1979]. For this project "magic square gardens" were designed by an agriculturalist and introduced through "organized homemaker classes." This design emphasized small size and a repertoire of easy-to-grow, nutritious crops. The result was that "more families now appreciate the value of having a little space for easily grown vegetables" (p. 82). These gardens were also promoted through schools and nutrition education programs including distribution of free seeds to encourage gardening. Other chapters discuss garden project proposals. Chapter 11 describes a proposal for a five-year research and development project to

promote AVRDC gardens in Thailand, including a focus on "vitamin A (crop) varieties."

Summary chapters include an evaluation of AVRDC projects by horticulturalist Henry Munger who recommends improved training and training materials and encouraging private seed companies as a "sustained seed source."
Comment: This research confirms the capacity of model gardens to produce significant quantities of nutrients, including vitamin A. For example, the home garden models produced between 82 and 125% of vitamin A RDAs for a family of five (Table 25, p. 37). How this capacity will be affected by local conditions and if this production will ultimately improve nutrition remain unanswered questions. Consideration of existing gardening practices and indigenous knowledge about gardening is not apparent, nor is local participation in project planning or implementation. While self-reliance appeared to be the goal, it seems the assumption was that self-reliance and local problem solving should not extend to all aspects of the project, because the project "trained them to make full use of their own resources and not to depend on others, except on the new garden technology" (p. 64). Overall, AVRDC activities are important because they represent one if not the largest recent investment in gardens for development. Given their prominence in terms of development investment it is essential that the AVRDC programs be analyzed carefully to understand how the assumptions of the AVRDC approach have affected their research and development projects. Issues such as local participation and self-reliance are some of those which merit inclusion in this analysis.

3A.2 **Gershon, Jack**
1985 Alleviating Vitamin A Problems with Home Gardens. Journal of Plant Foods 6:117-124.

Key words: yields-model, vitamin A, Asia, Taiwan

A demonstration garden was developed to produce vegetables that contain significant amounts of provitamin A. The objective was to provide 80 percent of a family of five's recommended daily allowance (RDA) of vitamin A, based on FAO standards.

A culturally acceptable intercrop of vegetables was planted in a 4 X 4.5 m plot, consisting of three raised beds, and observed for a one-year period. Low-input agricultural practices were utilized throughout. Data were collected on the yield from each crop. Weighed samples were analyzed for their retinol equivalents of provitamin A, for calcium, iron, protein, and vitamin C.

Results showed that the vitamin A garden produced a calculated daily yield of 1.5 kg (edible portion) of nutritious vegetables during the year. For a family of five, this represents over 200 percent of their vitamin A requirements (plus 31 percent calcium, 110 percent iron, 21 percent protein, and over 400 percent vitamin C).

The gardens proved to be feasible under AVRDC's tropical conditions. The technology can now be transferred to developing countries where local, culturally acceptable vegetables can be grown in small home garden plots, and the outputs weighed and measured for their contribution to the diets of people deficient in vitamin A or other selected nutrients. These data should be useful to planners and policy-makers in developing countries who seek to link agriculture and nutrition by developing simple programs that can easily evaluated in a one-year period. [Author's abstract]
This article reports on garden research conducted by the Asian Vegetable Research and Development Center (AVRDC) in Taiwan. Four model "vitamin A gardens," each containing three raised beds, were planted with a different mixture of "culturally appropriate", predominantly southeast Asian crops including spoon cabbage, amaranth,

water convolvulus, mustards, shallots, garlic, tomatoes, kale, and spinach. Edible yields/crop/garden were recorded and samples of each were analyzed for nutrient content. Garden nutrient yield was calculated by multiplying yield x nutrient content.

Comment: This research shows that high vitamin A production can be achieved in vegetable plots. Whether that will result in improved vitamin A nutrition among households with gardens will depend on many factors, especially human factors. Even though "low-input methods were practiced to simulate local conditions" the most essential element of "local conditions", local people, was completely absent. The emphasis on models and technology transfer in this research overlooks the importance of local participation and the adaptation of strategies to meet local needs.

3A.3 **Kailasapathy, Kasipathy**
1988 Studies of the Role of School Gardens in Combating Malnutrition in Sri Lankan Children. Ecology of Food and Nutrition 21:131-141.

Key words: yields-model, children, Asia, Sri Lanka

The objective of this study was to develop a model school garden to provide part of the nutritional requirements of school-going children in Sri Lanka. The garden (crop area 28 square-meters) consisted of capsicum, eggplant, lettuce, tomato, carrot, dwarf beans, okra, winged bean (Psophocarpus tetragonolbus L.DC) and sesbania (Sesbania grandiflora), and produced an average daily yield of 813 g vegetables, which could supply 1491 KJ (310 Cals), 18 g protein, 15 mg iron, 751 mg calcium, 3201 mcg vitamin A, 669 mcg riboflavin, 4 mg niacin, and 224 mg vitamin C. The output of nutrients from this experimental garden was calculated as a percent contribution towards the (Sri Lankan) recommended dietary allowance for school-going children. The garden would provide the following percentages of a 10-12 year old child's daily recommended intakes: 13 percent of energy, 40 percent of protein, 115 percent of calcium, 151 percent of iron, 557 percent of vitamin A, 42 percent of riboflavin, 25 percent of niacin and 1222 percent of vitamin C. [Author's abstract]

Comment: This article reports on work similar to that done by the AVRDC in Taiwan (see 3A.1 AVRDC 1988; and 3A.2 Gershon 1985). The purpose was to create a model institutional garden for the production of nutritional supplements for Sri Lankan school children. The distinction should be maintained between institutional, maximizing gardens and ones appropriate for households. In addition, further efforts may still be required to reach those populations most in need because often they cannot take advantage of institutional programs such as schools and health clinics.

3B. INDIGENOUS GARDENS [yields-indigenous]

3B.1 **Kleer, Jerzy and Augustyn Wos, editors**
1988 Small-Scale Food Production in Polish Urban Agglomerations. FEN Research Report No. 26. 63 pp. Paris, France: The Food Energy Nexus Program, United Nations University.

Key words: yields-indigenous, impact-income, vitamin A, urban, Europe, Poland

"All units producing food on a small scale in Poland, except for the recreational plots outside urban areas, comprised 402,000 ha or 2.1% of the total area of the country's farmland in the mid 1980s....they engaged 2.8 million families,...about 28% of the

country's total population....production...from these...gardens is assessed at 6.2% of the total agricultural output....Thus we are concerned with an important sector of the Polish food economy" (p. 11). The authors believe that the removal of the food production function from the household and its relegation to the industrial, energy-intensive food system is not a realistic alternative for "developing" countries.

Allotment gardens in Poland are very important economically, socially, and nutritionally. Production from the average garden in 1985 valued at retail food prices, showed revenues that yielded hourly returns equal to 113% of the average wage. The gardens provided the following percentages of RDA for vitamin A (principally in provitamin form): 15-22% in worker households, 21-34% in retired and pensioned households (p. 38).

Urban gardens are promoted also for ecological reasons to reduce energy consumption by using organic inputs rather than energy intensive chemical inputs. The authors emphasize that small-scale food production is a complex issue that cannot be solved solely by individual households and that therefore "a complex legal and economic system as well as an agrotechnical and production system" is needed (pp. 47, 52).

3B.2 **Marten, Gerald G. and Oekan S. Abdoellah**
1988 Crop Diversity and Nutrition in West Java. Ecology of Food and Nutrition 21:17-43.

Key words: Yields-indigenous, foods-indigenous, Asia, Java

Small-scale, subsistence agriculture in Java has an exceptional diversity of interplanted crops -- a diversity that is declining as farm sizes decrease due to population growth and as greater emphasis is placed on the most profitable crops for an expanding market economy. The nutritional consequences of these changes can be examined by examining interrelationships between household economic status, market involvement, dietary preferences, crops employed, crop yields, and food consumption.

The large quantity of rice in the Javanese diet frequently leads to deficiencies in the production and consumption of calcium, iron, riboflavin, and vitamin A. Mixed-cropping fields and home gardens are the major sources of these critical vitamins and minerals. The production of these vitamins and minerals is greater in fields and gardens with a greater diversity of interplanted crops.

Some Javanese families do not have sufficient land to produce all the food they need. In addition to the vitamins and minerals mentioned above, calories and methionine are in particularly short supply for these families. Data obtained indicated that a mix of starchy root crops, legumes, and green leafy vegetables can satisfy nutritional needs with the least amount of land. This is the cropping strategy generally followed by families with insufficient land, but they could improve their nutrition by placing greater emphasis on specific green leafy vegetables that produce larger quantities of critical vitamins and minerals. An increase in the market economy itself does not appear to have undesirable nutritional consequences, since families are not losing critical nutrients in the process of selling their produce and buying other foods for home consumption. [Author's abstract]

Comment: Similar to and based on the same research as 4A.1 Abdoellah and Marten 1986.

3B.3 **Omohundro, John**

1985 Efficiency, Sufficiency, and Recent Change in Newfoundland Subsistence Horticulture. Human Ecology 13:291-308.

Key words: yields-indigenous, impact-income, vitamin A, North America, Newfoundland

Traditional Newfoundland horticulture has been a subordinate and compensatory element of the subsistence sphere in a plural economy centered on fishing. Criticized as inefficient and ruinous to the land, this tuber-root-brassica gardening has in fact been a valuable contribution to diet, is relatively efficient, and compensates for the inadequacies of land and weather. Field data from the Great Northern Peninsula, where some traditional practices persist, demonstrate that the practices conserve time and labor and substitute massive applications of materials to assure a yield sufficient for household needs. The inefficiency in the tradition may be understood as a response to the constraints upon household labor and follows a kind of Leibig's law of the minimum. Recent changes in gardening practices reveal the dynamics of horticulture in the household's mixed economic strategy. As cash and land have become more common, they have been used to further reduce time while maintaining sufficiency. [Author's abstract]

The study sample was about one-half of the gardening households in two communities, 24 households in Main Brook and 23 in Conche, with 48 m^2 per capita cultivated (pp. 294, 299). Data included gardening histories, input/output studies of 10 households, work diaries, weights of sample harvests, and soil tests. Potatoes were 90% of garden production by weight, but cabbage, rutabaga, and a small quantity of carrots, beets, and lettuce were also grown. The traditional meal plan, still widely followed, includes cabbage with rutabaga roots and leaves eaten fresh three to five times a week and cabbage and rutabaga also eaten boiled. Based on food composition tables Omohundro calculated that this provided the following percentages of Canadian RDAs: 42% vitamin A, 43-128% ascorbic acid, 12% calcium, 5% thiamin, 1-10% riboflavin, and 3-8% vitamin K (p. 300).

Omohundro notes that there is a lot of variation, but that the average investment of time and other resources, especially locally abundant organic fertilizer from the sea, is at higher levels than what would conventionally be considered efficient, because gardeners are inspired by the high status of a successful garden and the abundance of fertilizers. According to Omohundro, they appear to be ignorant that they are following a "horticultural version of Leibig's law of the minimum," in the face of uncontrollable external factors, in order to minimize risk of no production in worst years. The increase in wage labor and access to better garden plots with new roads has also encouraged households to increase inputs of cash and land (more extensive) and reduced inputs of time and labor.

4. IMPACT OF GARDENS

The articles in the first part of this section (4A) consider the effect of household gardens on household consumption, and in some cases the nutritional status of household members. It is found that gardens provide important supplements to agricultural diets, often supplying nutrients that grain-based diets typically lack. Several studies reveal that increased garden production does not necessarily result in a decrease of food purchases, suggesting an overall increase in food consumption. Throughout, the intrahousehold distribution of resources and the availability of garden land are important considerations. The need for nutrition education in conjunction with garden projects also is apparent.

Part 4B considers the effects of household gardens on income levels. In situations where households market garden produce, control over distribution and use of income are major determinants of the nutritional impact of gardens.

4A. CONSUMPTION [impact-consumption]

4A1. **Abdoellah, Oekan S. and Gerald G. Marten**
1986 The Complementary Roles of Homegardens, Upland Fields, and Rice Fields for Meeting Nutritional Needs in West Java. In Traditional Agriculture in Southeast Asia; A Human Ecology Perspective. Gerald G. Marten, editor. Pp. 293-325. Boulder, Colorado and London, U.K.: Westview Press.

Key words: impact-consumption, foods-indigenous, vitamin A, Asia, Java

To determine the nutritional consequences of changes from subsistence to a market oriented economy, the authors analyzed the agroecosystem of gardens in Southeast Asia from a human ecology perspective. Data were analyzed from a field survey of 148 village households in the Jatigede area of west Java. Food production primarily occurs in three agricultural systems; 1) homegardens, 2) upland fields, and 3) rice fields. Researchers divided households into poor and well-off, and each of these groups was divided into two subgroups, those near and those far from markets. An analysis of food produced revealed that aside from vitamin C, adequately supplied by homegarden fruits, "some nutrients (calcium and vitamin A) are produced in short supply by nearly everyone....but the production of calories, protein, riboflavin, iron and methionine is deficient primarily among the poor 25 percent of the population" (p. 313). Well-off households consumed more of all nutrients than did poorer households, except for vitamin A and calcium. Well-off households consumed sufficient calories and animal products while poor household diets were deficient in calories and consumed few animal products.

The three agricultural systems complemented each other in the nutrients they produced. Although rice dominated the diet, the majority of the nutrients, particularly vitamin C, vitamin A, and calcium, were provided by the homegardens and upland fields. The authors believe that inavailability of land is the reason that many households cannot be self-sufficient in nutrient production. For example, while nearly all households had homegardens, the poor frequently lacked upland and rice fields.

The authors conclude that nutritional deficiencies in Java are caused by a rice-based diet and insufficient household production due to land shortages. According to Abdoellah and Marten, proximity to markets exacerbated the nutritional problems of the poor because of particularly acute land shortages in these areas, not because of "market pressures" to sell their produce. Higher crop diversity is associated with the production of more nutrients, and the authors believe that the main possibility for improving

nutritional status in Java lies in adjusting the crop mixtures in upland fields, which already supply the majority of the nutrients. Increasing the amount of green leafy vegetables in upland fields would increase supplies of provitamin A, calcium, and riboflavin.

Comment: The finding that "poor" households consumed more vitamin A than "well-off" ones supports the results of Stoler's research in Java (4A.22 and 4A.23 Stoler 1978, 1979). This suggests that the dietary importance of home gardens and the fast-growing dark green leafy vegetables grown in them increases along with household poverty.

4A.2 **Bindon, James R.**
1986 Dietary Patterns of Children in American Samoa: Multivariate Analysis of Food Groups and Household Associations. Ecology of Food and Nutrition 18:331-338

Key words: impact-consumption, foods-indigenous, dietary survey, children, Asia, American Samoa

This report presents the findings of a dietary survey among 63 children, aged five to seven years, on the island of Tutuila, American Samoa. Twenty-four hour recall interviews were conducted with the children and household food preparers to estimate kinds and frequencies of food consumed. The foods were aggregated into 19 groups, and a principal component analysis was performed to determine patterning among the groups. Four factors, accounting for two thirds of the variability in frequency of food group usage, are reported on. The first two factors focused on introduced foods that are primarily purchased in the markets: breakfasts of milk, eggs, and cereal or bread and butter; lunches and dinners with sandwiches, chicken, and nontraditional vegetables, as well as snacks (cookies, candy, sodas, chips and similar foods). The next two factors focused mainly on traditional Samoan foods that have been combined in prestige meals for centuries (meat, fish, taro, breadfruit and bananas). Analyses of covariance on the diet factor scores indicated that per capita income was not associated with any of the dietary factors, but maintenance of a plantation was related to high scores on the two traditional food factors. On the basis of previous dietary work on Samoan adults, it is suggested that, since gardening is associated with higher frequency of use of traditional foods, it may also be associated with improved nutritional quality of a diet. [Author's abstract]

This survey shows that having a "plantation" ("family garden") has a major influence on children's diet on Tutuila. As Bindon concludes, "By increasing the use of traditional foods (taro, breadfruit, banana, coconut and fish), gardening may be improving the nutritional quality of the diet of Tutilian children" (p. 338).

4A.3 **Brun, Thierry, Jacqueline Reynaud and Simon Chevassus-Agnes**
1989 Food and Nutritional Impact of One Home Garden Project in Senegal. Ecology of Food and Nutrition 23:91-108.

Key words: impact-consumption, impact-income, foods-indigenous, women, evaluation, survey, Africa, Senegal

An evaluation of the nutritional impact of a vegetable production project at household level which was initiated in 1969, in Kumbija, a village in West Senegal. This was part of a larger scheme implemented in Experimental Agriculture Units by the Institut Senegalais de la Recherche Agronomique (ISRA).

The production and sale of vegetables was first demonstrated to male farmers by extension agents. It required drawing water from wells, which is typically a female activity. The vegetable production quickly was taken over by female farmers, mostly from the Soce ethnic groups. In 1980, sixty-four women had plots of land dedicated to dry-season vegetable production. Very few projects of this kind have been carefully evaluated for their nutritional impact. In the present study an attempt was made to assess to what extent this project had achieved, after almost twenty years, part of its stated goals.

Results from seven food consumption surveys conducted between 1970 and 1981 were compared. Mean-per-capita energy intake was 2200 Kcal in 1970-71 and 2400 Kcal in 1981-82. Mean protein intake per capita was close to 75 g/capita both in 1970-71 and 1980-81. There was no significant difference either in energy, protein, vitamin, or mineral average intake between the earlier study (1970-71) and the latter one (1981). Iron, retinol equivalent, and ascorbic acid intakes in particular did not appear higher after several years of vegetable gardening than at the beginning of the project. The major reason seems to be that only a small fraction of the vegetables produced is consumed by the family and that the income generated by the sale of the vegetables is almost never used for food purchases. The vegetable gardening project, however, had a marked impact on women's income. It affected their social status and their awareness of urban social and food habits. [Adapted from authors' abstract]

Comment: This article is a rare attempt at garden project evaluation. It suggests the difficulty of assessing the nutritional impact of gardens due to the many interacting variables present in the household food system, both in production and consumption and in the economic environment external to the household. Even though garden projects are initiated to address nutritional needs, often increasing income is the gardeners' primary motivation for gardening. This can be especially true for women who frequently do not have other sources of income. Two other findings have significance for household gardens in development:

1) Wild foods are important sources of vitamins, minerals, and energy, and the use of those foods changes in relationship to garden activities. "It appears that among vegetable growers, to a large extent, home-grown vegetables have replaced the picked leaves and fruits previously used in sauces" (p. 98). These observations suggest the value of recognizing and incorporating wild plant foods in projects supporting secondary household food production.

2) It is possible that the failure of gardens to improve the diets of the most at-risk populations, weaning infants and small children, could have been avoided had nutrition education been included in the garden extension program. The authors state that, "Good training in gardening and nutritional education is required for mothers....in Kumbija mothers did not seem to understand that vegetables were good for their children; most of them stopped growing carrots because children, who liked them, would sneak through the fences into the gardens and eat them raw" (pp. 106-107).

3) Although only 7% of garden income was spent on food, it may have contributed indirectly to improved household nutrition. Women "might have saved part of their main income from groundnuts and cereals thanks to winter vegetable sales" (p. 106). And garden income "allows women to purchase items that are specifically important to the improvement of their social status in a society where men have a dominant social position" (p. 107).

4A.4 **Cohen N., M.A. Jalil, H. Rahman, M.A. Matin, J. Sprague, J. Islam, J. Davison, E. Leemhuis de Regt and M. Mitra**

1985 Landholding, Wealth and Risk of Blinding Malnutrition in Rural Bangladeshi Households. Social Science and Medicine 21(11):1269-1272

Key words: impact-consumption, impact-income, vitamin A, children, socioeconomic survey, Asia, Bangladesh

The 1982-1983 Bangladesh nutritional blindness study visited 11,618 rural households and examined 18,660 preschool-age children in an effort to determine the prevalence and determinants of eye lesions and loss of sight due to Vitamin A deficiency (xerophthalmia). Risk of xerophthalmia was significantly higher for children from households without any of the indicators of relative wealth used. Almost 80 percent of blind children came from landless households, and even a very small garden reduced considerably the chances of a household having a xerophthalmic child. Poorer households with access to less than 0.3 acres of land or no garden or without a tin roof, wristwatch, radio or cycle were at least twice as likely as their more fortunate neighbors to have a young child with any type of xerophthalmia. Taking account of such socioenvironmental risk factor weightings would direct the scarce resources of intervention programs to households and children who most need them. [Author's abstract]

This survey found a positive correlation between household wealth and decreasing risk of vitamin A deficiency symptoms in children. Risk of those symptoms was at least twice as high among nongardening households as among those with gardens.

Comment: The functional relationship between the wealth indicators considered and children's vitamin A status is not discussed. Some indicators (house construction materials, radio, wristwatch and cycle ownership) represent assets that do not have a direct impact on children's vitamin A status. Access to land and the presence of a garden can have direct implications for nutrition and so must be considered differently than simply proxies for wealth. This is especially true for gardens because of the type of foods grown and because access to land includes land ownership as an asset and not just the ability to produce food for consumption. This stimulates the following question for future research: To what extent is the relationship between gardens and decreased incidence of vitamin A deficiency due to the contribution of gardens to improved consumption of provitamin A and to what extent is it the result of gardens being an indicator of wealth?

4A.5 **Dewey, Kathryn G.**

1981 Nutritional Consequences of the Transformation From Subsistence to Commercial Agriculture in Tabasco, Mexico. Human Ecology 9:151-187.

Key words: impact-consumption, dietary survey, children, Latin America, Mexico

Recent changes in the area of the Plan Chontalpa in Tabasco have greatly reduced the production of subsistence crops by rural families, resulting in decreased crop diversity and a concomitant increase in the degree of dependence on outside sources of food. Results from a nutrition survey of 149 families demonstrate that the dietary diversity, dietary quality, and nutritional status of preschool children are negatively associated with lower crop diversity and increased dependence on purchased foods. Dietary deterioration is illustrated by the negative relationship found between nutritional status and increased sugar consumption. The assumption that a rise in income accompanying the adoption of

commercial production will automatically lead to improved nutrition is challenged: income levels were not found to be consistently related to nutritional status. Children of families that have converted to cattle production, despite greater land availability and family incomes, do not have improved nutritional status. In the study area, where wages are low and food prices are very high, the value of a higher degree of self-sufficiency in food is recognized, yet families continue to switch to cash crops due to the environmental, economic and time constraints imposed by the system of commercial agriculture in which they participate. The solution is not to return to traditional subsistence farming, however, but to determine under what conditions a more progressive form of agricultural change can occur. [Author's abstract]

"Fruits and vegetables...are not often consumed at all unless they are grown in the family garden, partly because they are not readily available but also because they cost more than even the wealthier families are willing to spend. Children of families who produce some or all of their own fruit in the 'solar' [garden] consume fruit more often than children of families who buy all their fruit (3.4 vs. 2.4 times per week, Student t test, $p<0.05$). These results indicate that merely replacing food with cash does not guarantee that dietary quality will remain the same" (p. 177).

4A.6 **Ensing, Bart and Sandrina Sangers**
1986 Home Gardening in a Sri Lankan Wet Zone Village: Can it contribute to improved nutrition? Manuscript, 41 pp. The Netherlands: Wageningen.

Key words: impact-consumption, yields-indigenous, vitamin A, survey, women, children, Asia, Sri Lanka

The goal of this paper was to understand the role of "home gardens" in diet and nutrition in a coastal village of Matara district, Sri Lanka. During field work from March to July 1984, observations, interviews, and a food frequency survey were all used to investigate this relationship. Special attention was given to existing and potential home garden contributions to the major nutritional problems of the area: protein-energy malnutrition and vitamin A and iron deficiencies, especially among weaning children and pregnant and lactating women.

Home gardens were a common component of the local farming system. They typically contained a mixture of annual and perennial crops as well as many "naturally growing green leafy vegetables." Produce from these gardens was found to be an important supplement to protein and energy intake during the hungry seasons and at times even replaced the depleted staple food. Seeds, green leafy vegetables, and limited animal products contributed protein to the diet. Green leafy vegetables, orange and yellow fruits, and betel nuts were the sources of vitamin A provided by the garden. Fruits were often shared between households and children were allowed to pick them freely. Gardens provided most of the coconuts, which are the main source of fat in the plant-based Sri Lankan diet, and thus important for provitamin A absorption. Some fruits, green leaves, and other vegetables contributed iron to local diets.

Although gardens have the potential to make greater contributions to improved nutrition of vulnerable populations, Ensing and Sangers suggest that dietary habit influenced by Ayurvedic medicine, intrahousehold food distribution patterns, and the low priority of gardening compared with other activities, are the reasons why that potential is not realized. However, despite constraints on local resources, including labor, these indigenous Sri Lankan home gardens still appear to produce enough fruits and vegetables to improve household nutritional status. The immediate need therefore, is not

for agronomic support but for nutrition education regarding the use of the garden harvest and its effect on health.

4A.7 **Frankenberger, Timothy R., M. Pricilla Stone and Sandra Saenz de Tejada**
1989 Household Vegetable Gardens in Africa: Case Studies from Mauritania and Lesotho. Arid Lands Newsletter 29:21-24.

Key words: impact-consumption, impact-income, urban, women, Africa, Mauritania, Lesotho

Comment: This article summarizes the results of 4A.18 Saenz de Tejada 1989, and 4A.24 Stone et al. 1987.

4A.8 **Gutman, Pablo**
1987 Urban Agriculture: The Potential and Limitations of an Urban Self-Reliance Strategy. Food and Nutrition Bulletin 9:37-42.

Key words: impact-consumption, impact-income, urban, Latin America, Argentina

Growth in Latin American cities has been accompanied by increasing urban poverty. By the year 2000, Mexico City and Sao Paulo will reach 26 million and 24 million respectively. Urban and peri-urban food production has been suggested as a strategy for food self-reliance in cities of the developing countries. The author studied Greater Buenos Aires, Argentina, to understand the potential of urban agriculture for home consumption in order to improve the nutrition of the poor. Urban gardens for home consumption require few resources and are low cost. Gutman and his colleagues calculated that these gardens "could replace between 20 and 25% of the cost of an adequate [Latin American] family diet" (p. 39). After reviewing strategies proposed to encourage urban gardens in Buenos Aires in relation to other urban food programs (price subsidies, rations distribution, and coupons), Gutman and his colleagues "concluded that, although urban gardens cannot replace other strategies, they surpass other programs of income redistribution because they generate independence rather than dependency" (p. 40).

The shortcomings of urban gardens identified by this research were: "the rate of growth in number of gardens was slow and the levels of abandonment were high.... [and] in Greater Buenos Aires...urban gardens do not benefit the poorest groups (unemployed, squatters) so much, but do assist the groups that are somewhat better off (working class, etc.)" (p. 41).

Comment: This discussion of gardens is valuable and unique because it emphasizes the necessity of considering the role of gardens within a broader development context. Gutman describes the capacity of gardens to provide nutritional, economic, environmental, and social benefits to the urban poor. However, he also points out that a focus on self-reliance strategies (such as gardening) overlooks the need for structural changes such as income redistribution and support services. His recommendation is for development that combines both of these approaches as complementary and necessary for long-lasting positive changes.

4A.9 **Immink, Maarten D.C., Diva Sanjur and Mirta Colon**
1981 Home Gardens and the Energy and Nutrient Intakes of Women and Preschoolers in Rural Puerto Rico. Ecology of Food and Nutrition 11:191-199.

Key words: impact-consumption, vitamin A, women, children, Latin America, Puerto Rico

The study investigated how the increased availability of self-grown foods was related to the adequacy of the energy and nutrient intake of rural women and preschoolers in rural Puerto Rico. The 109 women included in the study were found to be most seriously deficient in iron and calcium and tended to suffer from obesity. The 50 preschoolers demonstrated no serious chronic/acute undernutrition or growth retardation and were most seriously deficient in iron and vitamin C. Results indicated that per capita food expenditures did not decrease with increased availability of self-grown foods. Home gardens had the effect of increasing the total food supply of the household during certain seasons. Preschoolers appeared to benefit nutritionally more from horticultural production than adult women. With the exception of iron intake, more adequate energy and nutrient intakes of preschoolers were associated with the availability of different self-grown foods. This was only true for the vitamin A intake of the women. [Author's abstract]

The authors divided the foods grown by households into four different categories: fruits, starchy vegetables (including sweet potatoes), legumes and vegetables, and households categorized by the number of each category grown for home consumption. Least squares analysis from regression equations with percent RDA as the dependent variable (and holding per capita food expenditures constant) showed significant increases in vitamin A intake as percent RDA for mothers ("homemakers") for all groups except vegetables, and for children 1-5 for all four groups of garden produce.

Comment: This article is one of the few that quantifies the relationship between household gardens and nutrient intake.

4A.10 **Indirabai, K.**
1986 Prevention of Blinding Malnutrition in India. Newsletter from India. Journal of Tropical Pediatrics 32:317-318.

Key words: impact-consumption, foods-indigenous, vitamin A, women, children, Asia, India

Xerophthalmia, or blinding malnutrition, is a major problem in India, where nearly 40,000 children lose their sight every year. Twice this number become partially blind, and approximately 20,000 children die. The British-based Royal Commonwealth Society for the Blind (RCSB) initiated intervention projects in several Indian states in 1981. Rates of xerophthalmia decreased and the program was terminated. A new intervention program began in 1985 and is presently operating 14 projects in nine states. The program includes immunization, vitamin A administration, and treatment for minor ailments, as well as health and nutrition education for mothers. The education component includes 1) promotion of breastfeeding, 2) personal hygiene, 3) oral rehydration for diarrhea, and 4) training mothers to prepare weaning foods that include dark green leafy vegetables. "The RCSB is attempting to promote kitchen gardens in its project areas," and the author claims that, "as a result of this programme many houses, even in desert areas, now boast of a home kitchen garden" (p. 317). No new cases of corneal involvement have been reported in any of the projects. Another outcome of this

program has been a "sharp decline in the percentage of marasmic children" (p. 317).

Comment: The intervention program described in this brief article is based on recognition of the relationship between vitamin A deficiency and other diseases and how malnutrition, poor hygiene, and premature cessation of breastfeeding all contribute to debilitating and even deadly consequences. This program appears to be an example of using several complementary strategies with good results.

4A.11 **Kumar, Shubh K.**
1978 Role of the Household Economy in Child Nutrition at Low-Incomes: Case Study in Kerala. Occasional Paper No. 95, 78 pp. Ithaca, New York: Department of Agricultural Economics, Cornell University.

Key words: impact-consumption, impact-income, women, children, survey, Asia, India

The purpose of this study was to determine the effect of maternal wage-labor-force participation on weaning child nutritional status. Field work was carried out from February to September 1974 in three sites, chosen to cover the breadth of agricultural economy in midland Kerala State in southern India. A baseline survey of 120 households selected by random stratified sampling was followed by more intensive work with a subsample of 48 households chosen in the lower 50-60% income bracket and having a child of weaning age (6-36 months). Nutritional status (weight/age based on the Harvard standards) was determined for the three-month period during harvest, and the three-month period with least food available.

"The component of household income flows that has the most consistently positive effect on child nutrition is own-'farm' [garden] income, that is, the value of home garden production. During the slack employment season, it becomes an even stronger predictor of child nutrition. Significantly, but perhaps not surprisingly, it is also a more important predictor in households where mothers are not in the wage labor force....There are several possible reasons for the observed effect of own-'farm' [garden] income on child nutrition: (a) pattern of land distribution in which the incidence of absolute landlessness is small; (b) ecological conditions that permit year-round dry-land cultivation; and (c) the woman's role in the production of own-'farm' [garden] income and in the allocation of its output. In Kerala, agro-climatic conditions are very favorable for an intensive pattern of cultivation....Moreover, the stability of land tenure has been crucial in encouraging horticulture, especially the planting of perennial fruit trees and vegetables....it is also likely that women may get higher net returns from labor allocation to household production and the cultivation of their own small plots than from participation in the wage market. Furthermore, the prevalence of matrilocal traditions, an ostensible surplus labor supply in the wage market, and low wage rates for women are also contributing factors in the decision of women to try to optimize returns from home production. These conditions suggest that it is (a) the buffering effect that home-garden produce has on consumption when short-falls in wage income occur and (b) the larger role of women in its production and allocation of output, also permitting easier and better child care, that produce the observed own-'farm' [garden] income effect on child nutrition" (pp. 44-45).

"In summary, it was found that overall income effects on child nutrition reflect a combination of effects deriving from the wages income and family own-"farm" [garden] income. The effect of these income components on child nutrition is conditioned by maternal labor-force participation. The family farm product appears to save labor product for lean employment and income periods and prevents the decline in the

nutritional status of children during such periods. The positive wage income effect on child nutrition was found to be present only when mothers were in the labor force" (pp. 66-67).

Comment: This is one of the very few studies to quantify the effect of indigenous household gardens on nutritional status.

4A.12 **Latham, Michael C. and Florentino S. Solon**
1986 Vitamin A Deficiency Control in the Philippines. In Vitamin A Deficiency and its Control. J. Christopher Bauernfeind, editor. Pp. 425-443. Orlando, Florida: Academic Press.

Key words: impact-consumption, vitamin A, evaluation, Asia, Philippines

This chapter consists primarily of the analysis of three interventions that has been previously reported (see 4A.21 Solon et al. 1979). The conclusion is again repeated that nutrification (initially of MSG) is the best hope of reducing vitamin A deficiency. However, they "certainly do not recommend nutrification alone" (p. 440), but rather simultaneously with the other two interventions, capsule distribution and public health/home gardens. The authors state that two years was "too short a period of time to evaluate the effectiveness" of increased garden production and consumption of carotene-rich fruits and vegetables, although 49% of the households established home gardens. Another problem with gardens for reducing vitamin A deficiency is that "nutritionists and horticulturalists often work separately" and "Much of the activity in horticulture has been aimed at increasing the yields of vegetables for the market. Less attention is given to home consumption and very little to the nutrient content of the vegetables produced" (p. 439). The authors conclude that for long term control of vitamin A deficiency in The Philippines a number of measures need to be implemented, including 1) reducing the extent of poverty, 2) improvement of health services, 3) increasing the availability and consumption of vitamin A and especially carotene-containing foods.

4A.13 **McKigney, John I.**
1983 Interventions for the Prevention of Vitamin A Deficiency: A Summary of Experiences. In Nutrition Intervention Strategies in National Development, Barbara A. Underwood, editor. Pp. 363-384. New York, New York: Academic Press.

Key words: impact-consumption, vitamin A, Asia

Only within the past two decades has the public health sector addressed vitamin A deficiency leading to xerophthalmia. In the first section of this article, McKigney reviews events that led to coordinated intervention strategies. In section two he summarizes experiences with vitamin A deficiency interventions including 1) high-level dosing, 2) nutrification or fortification of food, 3) horticultural approaches, 4) nutrition education, 5) socioeconomic approaches that involve governmental policies and/or actions, 6) public health, and 7) combined interventions.

In areas where vitamin A deficiencies are prevalent, vegetable products are the primary dietary source of the vitamin. Therefore "promotion of production and consumption of low-cost, carotene-rich vegetables and fruits should therefore be an important strategy in these countries" (p. 373). However, McKigney lists a number of obstacles to the success of "the horticultural approach." Horticultural research has tended to be directed toward cash crops and features such as increasing yield and standardizing color and shape for

market potential, rather than nutritional content; imported seeds, poorly adapted to local conditions, have been used in promotion efforts focused on vitamin A-rich crops from industrial countries instead of traditional sources, overlooking the "sociocultural setting of food preferences"; and not much is known about food production and inter- and intra-household food distribution.

And yet McKigney concludes that there is wide support for the horticultural approach and it is a part of intervention programs being planned for the future, for example, in Africa.

4A.14 **Nankumba, J. Sinoya**
1979 The Socio-Economic Aspects of Small Gardens Near Smallholder Farmers' Houses in Malawi -- A Case Study. Manuscript 9 pp. Research Bulletin, Bunda College of Agriculture, University of Malawi.

Key words: impact-consumption, impact-income, foods-indigenous, socioeconomic survey, children, Africa, Malawi

A socioeconomic survey was conducted in Mkwinda and Mazinga (Unit 23), Chadula (Unit 5), and Chalendawa (Unit 1) villages within the Lilongwe Land Development Program in Malawi during December, 1979, to carry out preliminary investigations into the social and economic factors of small gardens near farmers' homes as they affect the life of farming families. The single visit survey method of data collection was used. A sample of four randomly chosen farming families from each sample was used. Small gardens near farmers' houses may be regarded both as holding places for crops new to the area and as demonstration plots for recommended farming practices. In addition, small gardens may be equated with training fields (at household or village levels) for the youth in practical farming and as handy socioeconomic units providing the food (relish) requirements to the family. Thus, serious consideration needs to be given to small gardens near farmers' houses when dealing with agricultural technology, farming systems, food, and nutrition for smallholder farmers in Malawi. [Adapted from author's abstract]

This report discusses research based on the collection of information about household gardens in Malawi from different members of the household, including children. Nankumba describes the gardens as providing agricultural training and socialization for the children. Gardens were said to contribute directly to children's diets as a readily available food source when their parents are busy with work in the fields, and children may sell produce from these gardens for cash income.

Comment: This article is unique in giving insights into the role of gardens from different perspectives. While the gardens are sources of sauce or relish ingredients for the household meals, their contributions to children seem especially important. These insights are suggestive of how intrahousehold control and use of the garden and its harvest affect its impact on the well being of different people in the household.

4A.15 **Ohtsuka, Ryutaro, Tsukasa Inaoka, Toshio Kawabe, Tsuguyoshi Suzuki, Tetsuro Hongo and Tomoya Akimichi**
1985 Diversity and Change of Food Consumption and Nutrient Intake Among the Gidra in Lowland Papua. Ecology of Food and Nutrition 16:339-350.

Key words: impact-consumption, vitamin A, Asia, Papua New Guinea

Food consumption and nutrient intake of the Gidra in lowland Papua, who number 1,850 and inhabit 13 villages, were analyzed by compilation of five two-week (or twelve day) records, in a single village in 1971 and in four different villages (including the above village) in 1981.

The nutrient intake of the Gidra varied both over time and among the villages. Difference in food consumption patterns included different proportions of plant staples such as sago flour, garden crops, and purchased cereals. The animal protein sources, mainly game and fish, also markedly varied among the villages. These differences in food consumption were related to environmental conditions such as the fauna and flora in the environment of each village and to the degree of modernization as reflected in ability to purchase foods not locally grown.

The causal relationship between ecological (environmental and cultural) conditions and food and nutrition is discussed and a schematic model for this relationship is presented. [Author's abstract]

In the Gidra's traditionally mixed subsistence strategy, coconuts, garden crops (taro, bananas, plantain and yams), wild plants and animals, and domesticated animals supplemented the staple, sago flour. In 1981 garden crops contributed 27% and 45% of the calories and 11% and 16% of the protein in the diets of the two upland Gidra villages, and 38% of the calories and 12% of the protein in the coastal village [calculated from Table IV, p. 346]. In Wonie, an upland village, sweet potatoes contributed 25% of the protein and energy from garden crops in the diet. In the other villages sweet potatoes supplied only 10% of energy from garden foods; protein contribution is not given. This high-energy contribution of sweet potatoes to diets in Wonie is attributed to the introduction of new varieties in 1979, although informants in other villages reported that the high yields of new varieties decrease two years after introduction.

Comment: Overall the specific quantity of energy and protein contributions made by the gardens varied according to the availability of other sources of those nutrients, which in turn depended on the local ecological conditions and availability of purchased foods. However, gardens made significant contributions to diets in all the villages surveyed and the importance of sweet potatoes in those gardens implies that they may also have been useful as sources of vitamin A, both from leaves and tubers.

4A.16 **Patil, J.S.**
1987 Nutrition Gardens. Proceedings of the Nutrition Society of India 33:108-110.

Key words: impact-consumption, women, children, Asia, India

A project to establish gardens for improved nutrition among indigenous people in Maharashtra State, India, is briefly described. Malnutrition due to seasonal food shortages and a lack of dietary diversity is especially serious among weaning children and pregnant and lactating women. Because of the long dry season the project focus was drought-adapted edible tree crops. Propagation materials and information were supplied as was nutrition education. "Model farmers," those with access to "irrigation facilities with small wells," were used to train and demonstrate project techniques.

Comment: Although the villagers were said to be involved with project training and implementation this is not explained and there is no mention of their participation in project planning. No details of project impact are given beyond that it was positive because it added fruits and vegetables to the "diets of tribal families which (formerly)

consisted of only cereals."

4A.17 **Reynaud, Jacqueline, Thierry Brun and Tonia Marek**
1989 Impact of a Women's Garden Project on Nutrition and Income in Senegal. Arid Lands Newsletter 29:15-20.

Key words: impact-consumption, impact-income, women, Africa, Senegal

Comment: This is another version of 4A.3 Brun et al. 1989.

4A.18 **Saenz de Tejada, Sandra**
1989 Food Consumption and Its Relation to Production: A survey in Lesotho. Tucson, Arizona: Women in Development, Department of Anthropology, University of Arizona.

Key words: impact-consumption, foods-indigenous, women, children, survey, Africa, Lesotho

The purpose of the USAID-supported Lesotho Agricultural Production and Institutional Support (LAPIS) was to increase income and employment opportunities of the rural population by increasing production of vegetables and fruits by labor intensive technologies. A food consumption survey was conducted after harvest in four areas of Lesotho among 141 Basotho households to assess the impact of a LAPIS irrigated horticultural project on the diet of 34 participating farmers and document dietary differences between household types. A national nutrition survey in 1976 showed 20% of the children under five were chronically undernourished and up to 25% were anemic. Child malnutrition relates primarily to inappropriate child feeding practices during the weaning period.

The basic Basotho diet consists of a thick maize porridge served with some kind of relish of wild or cultivated green leaves and thin sorghum and maize porridges. Wild greens were consumed on average seven times a week by all groups and were a source of income when sold in local markets. Greens grow best in disturbed soils such as cultivated fields, and introduced agricultural technology has limited this source through monocropping and intensive cultivation. Household gardens have become increasingly important in recent years because of landlessness and land shortages.

This study found that LAPIS participants have an overall higher frequency of consumption and a "rich" diet. "Rich" is not defined by the author. Farmers in the LAPIS project produced vegetables for a time period three times as long as the control group, and they produced over twice as many crops. However, when controlling for wealth, only those rich participants had higher consumption figures than their counterparts in the control group. Seventeen members of a cooperative food association group, who worked part time on a jointly held three hectare plot, had the lowest rates of consumption of all food items. Participation in the project has had no clear benefits in their diet and, controlling for wealth and regional differences, participation in the projects seems to have affected diet negatively.

Among the LAPIS gardeners, weekly vegetable consumption, as distinct from wild greens, was higher, ranging from 7.16 times a week among the individual project members to 4.61% in the control group. On the other hand, LAPIS gardeners had a lower weekly consumption of wild greens. LAPIS gardeners ate wild greens 4.3 times a week as compared with 7.6 times a week in the control group. Home production among the gardeners is not sufficient and must be supplemented by market purchases.

Socioeconomic differentiation was most highly correlated to dietary diversity and nutritional status. However, higher incomes did not necessarily correlate with better diet because income was sometimes spent on nonfood purchases and foods that were less nutritious. Dietary diversity was less among the food association members, "suggesting a case of 'transitional malnutrition'" (p. i). The increased availability of leafy vegetables might be substituting for previously consumed foods, rather than adding to them, and the cash from daily wages earned in the garden was too little to purchase anything in addition to necessary nonfood items. The author suggests that transition from subsistence to cash cropping is a vulnerable time. Attempts to maximize nutritional benefits through agricultural change will fail if not targeted toward the most nutritionally vulnerable groups, namely resource-poor farmers and landless and near-landless laborers.

4A.19 **Shack, Kathryn Wetherell**
1988 Effects of Agricultural Development and Resettlement on Nutritional Status and Dietary Intakes of Mothers and Children: A Study of Three Ethnic Groups in Lowland Papua New Guinea. Unpublished dissertation, University of California, Davis.

Key words: impact-consumption, foods-indigenous, women, children, anthropometry, Asia, Papua New Guinea

Nutritional status and dietary intakes of three ethnic groups in Gavien, a rubber resettlement project in lowland Papua New Guinea (PNG), were compared with those of people living in the home areas. The three groups were Grass Country (hunter-gatherers); Wosera (agriculturalists); and Middle Sepik (hunter-gatherers with limited agriculture).

Information was collected on community and household characteristics, food intake patterns, nutritional status, anemia, and malarial infection. Grass Country children in Gavien were higher in weight-for-age and weight-for-height than their home area counterparts. Wosera children in Gavien were taller than their counterparts. In contrast, Middle Sepik children showed no improvement in Gavien.

Sago and fresh fish consumption decreased for hunter-gatherers in Gavien, but garden crop consumption increased. Purchased foods, such as rice and tinned fish, became important energy and protein sources for all groups in Gavien. In comparison with intakes in home areas, mothers and children from Wosera and Middle Sepik had higher intakes of most nutrients in Gavien. Grass Country mothers and children had lower protein and niacin intakes in Gavien while intakes of other nutrients were generally higher.

Among resettlement children, cash-crop income was positively associated with anthropometric status and energy intake. Neither the amount of food planted nor food expenditures were related to nutritional status. In contrast, amount of food planted was positively associated with body mass index of mothers. Cash-crop income was related to dietary quality but not other maternal nutritional status variables. Consumption of rice and fish was related to food expenditures.

The group that benefitted most from resettlement was agriculturalists, who were crowded at home and already had the cultivation skills necessary for growing food and cash crops. Dietary quality improved with resettlement because traditional diets in lowland PNG are monotonous and lack cereals. Therefore, the addition of purchased foods had a beneficial, rather than detrimental effect. Resettlement and cash cropping

need not decrease nutritional status if dietary quality is enhanced by good quality purchased foods and home gardens are maintained. [Adapted from author's abstract]

4A.20 **Shack, Kathryn W., Louis E. Grivetti and Kathryn G. Dewey**
1990 Effects of Resettlement on Nutritional Status of Mothers and Children in Lowland Papua New Guinea. Ecology of Food and Nutrition 24:37-54.

Key words: impact-consumption, women, children, anthropometry, Asia, Papua New Guinea

Nutritional status of three ethnic groups living at Gavien, a rubber resettlement project in lowland Papua New Guinea, was compared with that of people living in the home areas: Grass Country (hunter-gatherers); Wosera (agriculturalists); Middle Sepik (hunter-gatherers with limited agriculture). Anthropometry of mothers (n=115) and children (n=115) was completed during wet and dry seasons. Blood samples were collected to identify anemia and malarial infection. Grass Country children in Gavien were higher in weight-for-age and weight-for-height than their home area counterparts. Wosera children at Gavien were taller than their counterparts. In contrast, Middle Sepik children showed no improvement in Gavien. Hemoglobin and hematocrit were generally lower among mothers and children in the home areas and malarial parasite rates were higher. The group that benefitted most from resettlement was the agriculturalists, who were crowded at home and had cultivation skills necessary for growing food and cash crops. Resettlement was less beneficial for hunter-gatherer groups unaccustomed to agriculture. [Authors' abstract]

Wosera families had gardens in both Gavien and in their home villages. Nutritional status was lowered in home villages because population pressure necessitated sharing food with large numbers of people. In addition, insufficient fallow periods resulted in decreased land fertility. Shortened fallow periods may be a problem in Gavien because leases require settlers to plant rubber on the majority of the land and food gardens may have to be rotated more often. Food crops from gardens were important sources of income, particularly as settlers waited for rubber trees to mature (7 years). If relocation is to continue, efforts need to be made to teach gardening for food to nonagriculturalists. The government currently places no interest in food crops, which the authors attribute to the prominent role women play in food crop production and marketing. This research demonstrates that agricultural development projects which are based on cash cropping do not necessarily result in decreased nutritional status.

Comment: Similar to and based on the same research as 4A.19 Shack 1988. It is important to note that: 1) these households resettled voluntarily (according to the authors) and 2) food gardens may be important subsidies of cash-crop systems. No definition or description is given of "gardens" and so it is unclear if the food production systems are actually secondary, or if they have simply been labeled gardens due to the crops produced or their size.

4A.21 **Solon, Florentino, Tomas L. Fernandez, Michael C. Latham and Barry M. Popkin**
1979 An Evaluation of Strategies to Control Vitamin A Deficiency in the Philippines. American Journal of Clinical Nutrition 32:1445-1453.

Key words: impact-consumption, vitamin A, children, survey, Asia, Philippines

Xerophthalmia has been found to be an important cause of blindness in the Philippines. An earlier study had investigated its prevalence and epidemiology on the island of Cebu.

The research now presented consists of an evaluation of the relative effectiveness of three different intervention strategies to control Vitamin A deficiency in Cebu. These interventions were 1) a public health and horticulture intervention, 2) the provision of 200,000 IU of vitamin A to children every six months (the "capsule intervention"), and 3) the fortification of monosodium glutamate with vitamin A. A total of 12 areas or barangays were included. Each intervention was monitored in four different barangays, two urban and two rural, for almost two years. Similar examinations were performed before and after the interventions. The monosodium glutamate fortification was the only intervention which resulted both in a significant reduction in clinical signs of xerophthalmia and in a significant rise in serum vitamin A levels. Fortification is now being planned in three Philippine provinces. [Author's abstract]

A total of 1715 children in 626 households were surveyed. "The base-line study in Cebu indicated a very high prevalence of deficient and low-serum vitamin A levels, and the presence of significant numbers of children with clinical signs of xerophthalmia" (p. 1452). The public health and horticulture intervention included medical treatment, sanitation and health, nutrition education, and assistance with growing high-vitamin A vegetables. The base-line study showed drumstick, malabar nightshade, and water convolvulus leaves commonly eaten and rich in carotene. A mean size urban garden (18.5 m^2) could yield as much as 15,000 IU of vitamin A/person/day. Comparison of the interventions was based solely on clinical eye signs and serum vitamin A levels for the 1407 children examined in the base-line study of 1973 and again after completion of the 18-month study in 1975.

The public health and horticulture intervention resulted in a small but nonsignificant decrease in clinical eye signs, while there was a significant decrease for the other two interventions; it was the only intervention which did not result in a significant increase in serum vitamin A levels for all groups combined. However, the public health and horticulture intervention did show a statistically significant increase in serum vitamin A levels for the group most deficient prior to the intervention. In addition, the public health and horticulture intervention had benefits that the others did not have, including an increase in children's vitamin A intake, increase in weight/height compared with the Harvard standards, and a decrease in third-degree malnutrition.

The public health and horticulture intervention cost $2840/year/barrio of 300 households, much higher than the other two interventions. This makes the results regarding nutritional status difficult to interpret. The authors state that "it must be stressed that field intervention studies of the kind reported here are challenging but are also fraught with difficulties of design, implementation, and analysis. They should not be entered into lightly" (p. 1452).

Comment: This article is one of the few analyses of the effect of gardens on vitamin A nutritional status. It is important to note that the authors do not attempt to attribute changes in nutritional status among gardens and the other components of the public health and horticulture intervention. There is no discussion of the state of gardening or diet before the study, nor of the possibility of evaluating the effect of a long-term strategy such as gardening over such a short (18 month) period.

4A.22 **Stoler, Ann**

1978 Garden Use and Household Economy in Rural Java. Bulletin of Indonesian Economic Studies 14(2):85-101.

Key words: impact-consumption, yields-indigenous, vitamin A, Asia, Java

"This paper is a preliminary attempt to investigate the nature and uses of home gardens in the central Javanese village of Kali Loro. Using data collected in ...1973 (p. 86). Six hamlets (with a total of 478 households) were chosen for a general household survey from which a smaller sample was selected for more intensive studies (60 visits per household, every 6 days throughout the year)....For the analysis below, the full sample of 90 households was reduced to 21 households (p. 91). The fact that production intensity increases with smaller gardens suggests that even the smallest gardens can respond favorably to intensification efforts. In fact, labor inputs in gardens are also inversely related to garden size....(p. 96) Low income households employ other low-risk cropping strategies. They produce and consume more leafy vegetables in general...than higher income households. Since spinach..., the leaves of long beans..., cassava leaves..., and other leaves from fruit trees...can be harvested within two months after planting or throughout the year, they are relatively reliable cultigens that serve as low-risk foods sources. On the other hand they do not offer the high cash returns of other less certain or longer-term crops that are more intensively cultivated by wealthier households. Although Vitamin A has been identified by some studies as a more pressing nutritional deficiency in rural Javanese diets than caloric and protein deficiencies, it is interesting that in agriculturally poor areas, Vitamin A deficiencies were found to be less common since basic foods were in low supply and the diet was supplemented by low-cost supplementary greens and pulses. This observation is paralleled on an inter-household level in Kali Loro, where the low-income households consume the least amount of rice and the highest amounts of leafy vegetables per consumer-unit" (p. 97). Development agencies and agricultural specialists concerned with reaching the 'poorest of the poor' have hit on home-gardens as a natural target. Unfortunately most of their interests (and funds) have focused on possible garden improvements without sufficient investigation of existing patterns of garden use" (p. 100). [Extracted from the author's article]

Comment: In their paper on Jatigede, West Java, Abdoellah and Marten (4A.1 1986) describe the same relationship between increasing vitamin A consumption, in the form of green leafy vegetables, with increasing household poverty.

4A.23 **Stoler, Ann**
1979 Garden Use and Household Economy in Java. In Agriculture and Rural Development in Indonesia, Gary E. Hansen, editor. Pp. 243-254. Boulder, Colorado: Westview Press.

Key words: impact-consumption, yields-indigenous, vitamin A, Asia, Java

Comment: Similar to and based on the same research as 4A.22.

4A.24 **Stone, M. Priscilla, Barbara Perquin and Sarr Hamidou**
1987 Vegetable Production Along the Senegal River. A Reconnaissance Survey of Gardens in the Brakna and Gorgol Regions. 103 pp. Tucson, Arizona: Mauritania Agricultural Research Project II, College of Agriculture, University of Arizona.

Key words: impact-consumption, impact-income, women, survey, Africa, Mauritania

This report presents the findings of a three-week survey of vegetable gardening and marketing along the Senegal River Valley undertaken in April of 1986....Thirteen vegetable gardens were visited, as well as interviews conducted with merchants and customers in the various villages and in the Kaedi market. A brief history of vegetable production in this part of Mauritania is sketched. The survey information...includes descriptions of the vegetable gardens themselves as well as their histories, use of inputs, organization, products, and marketing....constraints to production and...recommendations

for further research and extension. [From authors' summary]

All gardens received some help from outside agencies and are predominantly cool, dry-season gardens growing mostly European annual vegetables. Most gardens are cooperatively organized, most gardeners are women, and vegetables are both sold and consumed. Estimates of yields and incomes from figures reported by gardeners may not be very accurate. The important points are that 1) most gardeners surveyed said that consumption is a primary objective of gardening, with some even stating a desire to improve nutrition (pp. 22-23), and 2) they believe that "they turn a small profit, especially when any inputs are kept to a minimum" (p. 20).

4A.25 **Teply, Les J.**
1986 Control of Vitamin A Deficiency by the Agricultural Crop and Household Food Approach. In Vitamin A Deficiency and Its Control. J. Christopher Bauernfeind, editor. Pp.329-324. Gainesville, Florida: Academic Press.

Key words: impact-consumption, vitamin A, Asia, World

While the usefulness of synthetic vitamin A administered as a supplement and in food nutrification programs is not denied, the author states that the preferred source of vitamin A is in the "regular food supply." Dark green leafy vegetables and orange and yellow fruits provide not only provitamin A, but have the added benefit of supplying other essential vitamins and minerals as well. More data is needed on vitamin A potency in local food sources and how this varies with environmental conditions, plant variety, stage of maturity, and post harvest handling. More data on consumption is also needed, particularly for young children. Progress in the promotion, production, distribution, and consumption of nutritious foods has been limited in international development because nutrition has not been taken into account. Some progress has been made since 1974 when the World Food Conference in Rome called attention to this deficiency, and Teply reviews some of the efforts of FAO, UNICEF, WHO, and UNESCO in promoting nutritious foods. The author briefly mentions a number of successful programs. While agricultural and economic authorities worldwide have ignored the contribution of small plot production, there are indications that this is changing and the future may bring more use of gardening and horticultural approaches.

4A.26 **Tricaud, Pierre-Marie**
1987 Urban Agriculture in Ibadan and Freetown. FEN Research Report No. 23. 45 pp. Paris, France: The Food Energy Nexus Program, United Nations University.

Key words: impact-consumption, impact-income, applied, urban, Africa, Nigeria, Sierra Leone

In part I Tricaud reports results of a survey in 1987 of 60 gardeners in 10 cultivated areas of Freetown, Sierra Leone, and 40 gardeners in 11 cultivated areas of Ibadan, Nigeria. Most gardeners were low income, and all of these said that they garden to feed their family or because their income is too low. A total of 60 different crops were identified in both cities, but, according to Tricaud, this is probably a large underestimate since many tree crops were not counted. One garden in Freetown with less than 1000 m^2 had more than 30 species. Three main cropping patterns were identified: short cycle (e.g. leaf vegetables), annual cycle (e.g. maize, yams) and semi-perennial and perennial (trees). Tricaud claims that in Freetown gardeners grow leaf vegetables on small plots because this always provides them some income from sales year-round after consumption (even on plots only 30 m^2). They want this income to purchase rice, which

they prefer over other staples. In Ibadan in contrast, people plant maize, cassava, and other staples in their gardens. If more land were available, most people said that they would begin a garden or expand an existing one.

Part II discusses the extent of interest in gardens by governments and gardeners. While national governments tend to be favorable, city governments often come into conflict with gardens over land use, sanitation, etc., or because of Western-inspired standards of a "modern, clean city" (p. 16). However, authorities in the two cities seem open to arguments supporting gardens. Society benefits from gardens in the areas of food supply, jobs, land use control, flood control (gardens instead of houses on the flood plains), waste recycling, and aesthetics. Gardeners need a source of clean water for washing produce, since often only polluted water is available for the garden.

In part III Tricaud lists actions needed to develop urban agriculture, including access to land, composting of urban wastes to be used in gardens, and organizing for increased economic and political strength.

Comment: No information is given on site or sample selection, or on how these data were collected.

4A.27 **Vasey, D.E.**
1982 Management of Food Gardens in the National Capital District. Science in New Guinea 9(3):141-166.

Key words: impact-consumption, survey, Asia, Papua New Guinea

A random sample of households in the NCD [National Capital District] were surveyed by means of a questionnaire and observations of food gardens during March, April and May, 1981. This paper reports on the methods of management in these gardens. Some highlights are: (1) most gardens are worked continuously or at least annually, with little fallowing; (2) the crop mix tends to feature cassava and banana; (3) most gardens contain crops that are a good nutritional complement to bulk purchased foods and plantings of these have increased since earlier surveys; (4) tillage shows some regional characteristics, but these tend to lessen among older residents; (5) about 20 percent of PNG-born gardeners use soil amendments, and this is probably increasing; and (6) migrants tend to quickly adapt their crop choices and gardening methods to local conditions. Some recommendations are made for the provision of extension services. [Author's abstract]

The kinds of crops grown and their use supports Vasey's suggestion that these gardens are important supplements to the staple diet, supplying among other nutrients, vitamin A from green leafy vegetables and yellow and orange fruits and tubers.

The findings that locally adapted garden management strategies (e.g. mulching in the dry season and cultivation primarily of cassava and banana) and sources of gardening information do not differ according to gardeners' income or level of formal education are an indication of these gardeners' innovation and responsiveness to their environment. It is also significant that this local adaptation is overlain with some variations characteristic of the regions from which new immigrants to the National Capitol District came, such as garden bed ("mound") height, or presence of some crops which are regional specialties such as yams or winged beans.
Comment: Recognizing the combination of local adaptation with people's own gardening tradition provides valuable insights for creating viable garden support projects.

4B. INCOME AND SAVINGS [impact-income]

4B.1 Brock, Lina

1976 Innovation of Winter Season Vegetable Gardening Among the Tamejirt, an Iklan Group of the Northern Ader and Southern Azawagh Regions, Department of Tahoua, Republic of Niger. In Colloquium on the Effects of Drought on the Productive Strategies of Sudano-Sahelian Herdsmen and Farmers. M.M. Horowitz, editor. Pp. 26-31. Binghamton, New York: Institute for Development Anthropology.

Key words: impact-income, Africa, Niger

The Tamejirt are a former slave class living in northern Niger. Before the 1968-74 drought "the subsistence economy of the Tamejirt was based on a combination of millet and sorghum cultivation and herding with...a twenty-five-year tradition of migration to Abidjan to seek salaried labor" (p. 27). Although there was some winter gardening before the drought, it increased spontaneously and dramatically in 1973 and 1974 in response to losses of sorghum, millet, and animals due to the drought. Two types of flood recession gardening are practiced by the Tamejirt. The first is planting on the banks of receding ponds. These gardens contain "tomatoes, onions, wheat, tobacco, maize, okra, chiles, and various leafy sauce plants." Wells and irrigation channels allow this cultivation to continue into the dry season. The second garden type is also flood recession but in areas where water flow has occurred but no pond formed. These former pasture areas are now planted in yams. Even though some garden produce is consumed, the majority is sold, and so this gardening represents a shift in subsistence strategy from production for direct consumption to an increasing emphasis on production for sales. However this new income has not yet created a change in the Tamejirts' diet.

4B.2 Cleveland, David A., Thomas V. Orum and Nancy Ferguson

1985 Economic Value of Home Vegetable Gardens in an Urban Desert Environment. Hortscience 20(4):694-696.

Key words: impact-income, urban, North America, USA

Two home vegetable gardens (77.4 and 58.3m^2) in Tucson, Ariz., yielded an average of 1.24 and 2.31 kg/m^2 of produce per year over 3 and 2.5 years, respectively. Average net returns were $109 and $123 per year, $0.72 and $1.11 per hour, or $8.80 and $7.75 per dollar of water used. Thus, in the southwest desert, a weekly investment of 2-to-3 hours in a home garden can provide savings. [Authors' abstract]

This article also contains a table comparing economic performance from 5 other garden studies in the USA.

Comment: Yields for active growing area only, not including walkways and fallowed plots were 7.3 and 5.7 kg/m^2 for the two gardens. This is one of a small number of output/input studies of small household gardens in the United States that show yields as great or greater than modern commercial agriculture.

4B.3 Duggan, William

1985 Irrigated Gardens, Molepolole, Botswana. In Rural Development and Women: Lessons From the Field. Vol. 1: Women in Production and Marketing and Their Access to Credit. ILO/DANIDA/80/INT/35. Pp.7-20. Geneva, Switzerland: International Labor Office.

Key words: impact-income, women, Africa, Botswana

At a cooperative garden site in Botswana of 33 plots (280 m^2 each) hand irrigated with water stored behind an adjacent dam, 29 are worked by women from households in the poorest segment of the community. Most of the women are household heads with no permanent husband. The garden produce was eaten by the gardeners, shared with those who helped in the garden, or marketed. For 21 of the 33 gardeners, gardens were their major or sole source of cash income. But as the commercial potential of such gardens is realized, better-off individuals are claiming entire dam sites for themselves, and it is suggested that in this situation "horticulture needs to be preserved as an enterprise for the poor," most of whom are women (p. 18).

4B.4 **Eskelinen, Riitta K**

1977 Dogon Agricultural Systems: Sociological Aspects Relating to Development Interventions. Report to The Research Foundation of State University of New York [Binghamton]. 99 pp. Manuscript.

Key words: impact-income, women, children, Africa, Mali

The gardens of the Dogon people of central Mali are the focus of this research report. They ranged in size between 1 and over 300 m^2, with 71% being 200 m^2 or less, and were hand watered from nearby water sources. A "local shallot variety" dominated the crop repertoires of most gardeners, although a number of other crops such as tomatoes, chiles, sweet potatoes, squash, okra, Hibiscus sabdariffa, Solanum aethiopicum, groundnuts, Bambara groundnuts, sesame, fruit trees, cotton, and tobacco were also grown. The onions were grown primarily for market. Dogon gardening is a production system controlled and used by individuals. In the area studied it was always a male activity, with 79% (309) of males over 15 years of age gardening (p. 11). Water is the most limiting resource for gardening and according to Eskilenin, this scarcity combined with a tradition "that economic gain is rightfully the prerogative of males" (p. 15), are the reasons why women in this area do not garden.

By selling both fresh and dried onion bulbs and greens, gardeners are able to spread out their earnings and take advantage of higher off-season prices for dried onion products. However, men's income from garden sales does not necessarily benefit their households, and women and children may suffer from lack of economic power. This power is directly linked to access to many nonstaple foods such as fruits and vegetables and animal products, all of which are important sources of many nutrients, including vitamin A. For this reason one of Eskilenin's recommendations for development projects to improve the well being of women and children was that "some garden areas be reserved for women with training programs to teach women the necessary methods" (p. 47).

Eskelinen points out that the success of Dogon gardens is due to the experimentation and innovation of the gardeners in response to local gardening conditions. For this reason she cautions against attempts to "transfer" the Dogon gardening model to other communities and regions.

Comment: The careful documentation of water use and garden yields, along with other more general observations about garden management, the place of gardens within the agricultural system, and their contributions to social structure make this report valuable.

4B.5 **Gladwin, Christina and John Butler**

1984 Is Gardening an Adaptive Strategy for Florida Family Farmers? Human Organization 43:208-216.

Key words: impact-income, North America, USA

The climate and economic situation of the last five years has been disastrous for many of Florida's full-time farmers. As a result, more and more full-time farmers are being forced to cut back or stop farming commercially and get a higher-paying off-farm job. For these part-time farmers it makes more economic sense to secure a stable income from off-farm work and guarantee more than half the family's food supply through gardening and livestock production, than take the risk of full-time farming. Although gardening is not often considered to be as important as commercial farming, the results presented here of a gardening survey in four Florida counties show that gardening today is a key survival strategy for Florida farmers. How it became an adaptive strategy is the theoretical point of this paper. We propose that originally survival strategies are processed by the individual as sets of decision rules, which can be modeled using hierarchical decision models (HDMs). Over time, the decisions are made so frequently and routinely that they become part of a preattentive plan or script. The more successful plans or scripts diffuse from farmer to farmer and endure over generations, and thus become adaptive strategies. [Author's abstract]

Comment: This article is important because it documents the important contribution of household gardens to rural areas of industrial countries.

4B.6 **La Rovere, Emilio Lebre**

1987 Food and Energy in Rio de Janeiro: Provisioning the Poor. FEN Research Report No. 13. 59 pp. Paris, France: The Food Energy Nexus Program, United Nations University.

Key words: impact-income, yields-indigenous, applied, urban, Latin America, Brazil

This document discusses four case studies of which two are relevant: market-garden production under urban electric lines and direct links between rural market gardeners and urban consumers.

Electric companies in Brazil by 1982 had some 230,000 hectares of right of way under transmission lines of over 230 KV. Between the 1900s and the 1950s the electric company in Rio de Janeiro State had leased land under lines for subsistence cultivation, in order to reduce maintenance costs and avoid squatters. As the population grew and farm land was lost to urbanization, there was increasing commercialization of production under the lines and subleasing. In response to this, and to increasing resistance to the penetration of electric lines in urban areas, the company introduced a new loan contract scheme for gardeners, which required them to report type and quantity of produce every six months and to sell a portion of their produce to the company. La Rovere feels that the loan contracts should allow gardeners to participate in government programs, including credit for increased inputs, which they were not able to do before. About 172 hectares of the 900 under electric line in Rio were under cultivation in 1983, producing mainly market produce with an annual value of about $10 million.

The second case study describes how rural small holders from the interior of the State got together with residents of the city in 1980 to supply market-garden produce, increasing awareness of both groups of the political economy of the food system that was currently exploiting them. Starting small, the experiment spread quickly. Previously, "the

small holders were obliged by the middlemen to use insecticides and chemical fertilizers on their crops, whereas formerly they had used manure. Direct contact with the consumers reversed this process and led to the production of more healthy products" (pp. 41-42). As the program expanded it ran into many logistical and political problems, which small holders and consumers had to work out without any help because the city government was insensitive to their requests for help. La Rovere concludes that it is necessary for small holder market gardeners to become politically organized in order to resist exploitation by the existing system, which is dominated by large scale growers and middle men.

Comment: The case studies demonstrate the high level of interest of urban dwellers in producing food for consumption and market, of rural market gardeners in having more control over production and sales, and the potential for innovations in social and economic structures in response to these interests. In the first case study La Rovere assumes that production with modern inputs is more efficient than "mere subsistence." No consideration is given of possible negative health effects of gardening under the electric lines.

4B.7 **Milimo, Mabel C.**
1985 Chikuni Fruit and Vegetable Producer's Co-operative Society, Zambia- A Case Study. In Rural Development and Women: Lessons From the Field. Vol. 1: Women in Production and Marketing and Their Access to Credit. ILO/DANIDA/80/INT/35. Pp.21-35. Geneva, Switzerland: International Labor Office.

Key words: impact-income, impact-consumption, women, Africa, Zambia

A fruit and vegetable growing project on the Tonga plateau of Zambia was originally begun to provide more nutritious foods for poor women. Vegetables are usually grown in dambo [valley] plots of less than 1 hectare, while fruits are grown near the house. The project was taken over by men as it became more profitable, resulting in only 33 of 73 participants being women. The remaining women were able to gain benefits from their gardens, partly because they grew vegetables in plots obtained independently of their husbands (78% of women responding, 26/33). Ten of the 33 women made decisions over income themselves, 13 did so with their husbands, and for 10 the husband made the decisions. Many (44%) of the women felt that their garden income made them less dependent on husbands.

Comment: This paper reports another example of the necessity of guarding women's gardening against the encroachment of men.

4B.8 **Nath, Kamla**
1985 Women and Vegetable Gardens in The Gambia: Action Aid and Rural Development. African Studies Center Working Paper 109. 13 pp. Boston, Massachusetts: Boston University.

Key words: impact-income, women, Africa, The Gambia

The impact on women of a vegetable garden project supported by a British non-governmental organization (NGO) in The Gambia is discussed in this paper. In The Gambia the majority of agricultural development assistance both from the government and foreign NGOs has gone to men, even for those crops such as rice and vegetables, which are traditionally grown by women. Action Aid's integrated rural development program included support for improving women's incomes through market gardening,

especially onion production. These garden projects included organizing women's groups, providing short-term credit, digging wells, supplying industrial inputs, and developing storage, marketing, and transportation facilities. Nath implies that the establishment of wells was successful and involved local participation, although she does not indicate if men, women, or both sexes were involved. However, based on her observations during a field visit, the author suggests that while the gardens seem to be capable of improving women's incomes, men were using their influence to gain control of some project benefits and exploit women's labor.

Comment: The issue of exploitation needs further investigation because the author has equated labor which does not receive monetary compensation with "free labor." This report, based on a very brief investigation, points out the importance of a careful understanding of local social organization when attempting to target garden projects to special populations within a community. It also demonstrates the difficulty of supporting activities that are locally controlled and yet encourage changes in inequitable social relations.

4B.9 **Sanyal, Biswapriya**
1984 Urban Agriculture: A Strategy of Survival in Zambia. Dissertation, University of California, Los Angeles.

Key words: impact-income, impact-consumption, urban, Africa, Zambia

Low-income households in Zambia are increasingly growing food within cities. Much like squatter housing, this phenomenon may be viewed as another survival strategy created by the urban poor in the face of insufficient real income. Since no research has yet been done on this self-help approach, an exploratory study was conducted to understand its emergence in and its contribution to the development process. The survey of 250 low-income households in Lusaka, Zambia, collected data on various aspects of urban agriculture. The survey findings are organized in seven chapters. Chapter one provides a historical overview of the post-independence Zambian economy and indicates a trend of steadily declining real earnings of low-income households. The second chapter focuses on the extent of cultivation as a response to this trend. Two types of gardens, i.e. plot gardens and gardens in the city's periphery, are identified and it is estimated that nearly 60 percent of low-income households cultivate one or both types of gardens. Various factors, other than low income, that affect a household's decision to cultivate are also analyzed.

The third chapter examines the process by which access to land is gained and identifies the barriers encountered by households in gaining access. Chapter four analyzes the role of domestic labor in cultivation. Labor-time expenditure for each task for gardening is estimated and specific time contribution by each household member is calculated. The role of women, which emerges as the single most important factor, is closely examined.

The nature of access to other inputs, namely seeds, water, fertilizer, and insecticides, are viewed in chapter five. Further, the benefits of cultivation to the household economy is also estimated. The estimates indicate that gardening, on average, provides the equivalent of 10 percent of income and 15 percent of expenditure on food. In chapter six, the theoretical significance of the findings for a new approach to development planning are discussed. The study concludes with a discussion of policies to enhance the contribution of urban agriculture. [Author's abstract]

Comment: See 4B.10 Sanyal 1985 and 4B.11 Sanyal 1986 for briefer accounts of this research.

4B.10 **Sanyal, Biswapriya**
1985 Urban Agriculture: Who Cultivates and Why? A Case Study of Lusaka, Zambia. Food and Nutrition Bulletin 7(3):15-24.

Key words: impact-income, impact-consumption, urban, Africa, Zambia

Comment: See 4B.11 Sanyal 1986 for a more detailed description of this research.

4B.11 **Sanyal, Biswapriya**
1986 Urban Cultivation in East Africa. 75 pp. Paris, France: The Food-Energy Nexus Program, United Nations University.

Key words: impact-income, impact-consumption, urban, Africa, Zambia

This is a case study of gardeners in Lusaka, Zambia, and why they garden, with suggestions for government policies to support urban gardening as an important survival strategy for poor city dwellers. Sanyal emphasizes urban gardening as a survival strategy for low-income households. Part I discusses the results of a survey of 250 low-income households in Lusaka, placing it in the context of data on urban gardening elsewhere in East Africa. As in West Africa, where it has been better documented, urban gardening in East Africa is an important economic activity that was strongly discouraged by governments as being a remnant of bush life. Recently, as in Zambia in 1977, some governments have realized the benefits of urban gardens and begun to encourage them. In 1980 the author surveyed 50 homeowners (tenants, about 25-35% of residents excluded) in each of five representative low-income areas of Lusaka. Findings show 40% cultivate only plot gardens near their house, 25% cultivate only rainy season gardens on the periphery of the city, and 19% cultivate both types of gardens (p. 11). An American Friends Service Committee project, which provided very limited assistance in one of the five areas, appears to have had a major impact, with nearly 40% of households cultivating both types of gardens compared with 14% in other areas (pp. 12-13).

Contrary to expectations based on the common assumption that urban gardening is a "rural habit," gardening increased with length of residence in Lusaka. Lack of sufficient income to buy food is the reason given for gardening by a large majority of households. Size of house plot (room for garden) had a strong positive correlation with having a plot garden and a strong negative correlation with having a rainy season garden. Most households (88%) use garden produce only for consumption, while 12% sell part of it, with most of the lower income households stating that they would like to grow more so that they could sell some (p. 27). The economic value of garden produce consumed varied from 37% of household income for the lowest income group to 8% for the highest (p. 32).

Part II discusses reasons why East African governments should take a more positive attitude toward urban gardening. After three decades of top-down development focusing on urbanization and industrialization, many East African cities "appear to be on the verge of collapse." Gardens as a form of "development from below" appear to be a very efficient way of supplying food and nutrients to low-income households with social benefits to aesthetics and the environment. Part III discusses policy options for governments to encourage urban gardening, beginning with the need for a change in attitude. Access to land is most limited for those most in need of gardens, and policy must provide access to vacant public land, vacant private land, public land around government buildings like schools, currently unusable land through reclamation, and plots in public housing through planning and site service (p. 56), as well as looking for

innovative ways to make land available. "But the real thrust for change must ultimately come from the urban poor themselves" (p. 66).

Comment: See 4B.10 Sanyal 1985 for a brief summary of this research, and 4B.9 Sanyal 1984 for the dissertation on which it is based.

4B.12 **Soleri, Daniela**
1986 Food Gardens and Some Characteristics Distinguishing Gardening and Non-Gardening Home-Owning Households in a Low-Income Census Track of Tucson, Arizona. Unpublished M.S. thesis. Tucson, Arizona: University of Arizona.

Key words: impact-income, survey, North America, USA

The purpose of this study was to determine if there are differences in certain household characteristics, household income and attitudes between home-owning households with food gardens and those without in a low-income census tract in Tucson, Arizona.

Two random block samples, one of 15 food gardening households and the other of 15 nongardening households from census tract 10, were interviewed during home visits. In addition to questions relating directly to the objectives of the study, information about existing gardens was also collected.

The results showed that compared with nongardening households, those with food gardens have more members, had a larger proportion of higher incomes among them, were aware of insect problems in the garden, and tended to perceive gardening not as work but as a source of pleasure and relaxation.

In addition, there were indications of cultural differences among gardeners as expressed by their gardens and two garden types were identified. This information raises questions regarding concepts of gardens specifically and the influence of culture generally which are important for community development efforts. [Author's abstract]

4B.13 **Soleri, Daniela**
1989 Hopi Gardens. Arid Lands Newsletter 29:11-14.

Key words: impact-income, Native Americans, North America, USA

This article describes the terraced gardens of the Hopi Native Americans of northern Arizona, USA. Traditional management techniques, including irrigation groups, help gardeners cope with the stresses of a hot, arid environment. The gardeners interviewed felt that their production of vegetables such as chiles, string beans, and onions saved their households money.

4B.14 **Streiffeler, Friedhelm**
1987 Improving Urban Agriculture in Africa: A Social Perspective. Food and Nutrition Bulletin 9:8-13.

Key words: impact-income, impact-consumption, urban, Africa, Nigeria, Zaire

Urban agriculture plays a particularly important role in sub-Saharan Africa. In Zaria, Nigeria, for example, aerial photography shows 66.2 percent of urban land under cultivation. Urban gardens are an important resource for women and provide household income. In this study the author analyzes an urban agricultural project in Kisangani,

Zaire, from a social viewpoint, in contrast to most studies made by geographers, which emphasize location, space, physical conditions, and ecology.

Urban agriculture functions in the informal economic sector and has a role in encouraging people to form their own production and consumption systems and bypass control of costly middlemen. Urban gardening in Kisangani is often a privileged occupation of those residents who have sufficient land around their home. It is a combination of subsistence production and market gardening, depending on local conditions. Limits to urban gardening include lack of appropriate agricultural knowledge and cultivation techniques, lack of networks of solidarity to reduce the impact of experimental losses, and lack of tools and seeds.

The urban agricultural improvement project in Kisangani began in 1978 primarily to address the problems listed above. The project enjoyed initial success largely because it was organized through an expatriate who was not compromised by local power struggles and intertribal conflicts. After these supervisors left, the project failed for a number of political and economic reasons, one of which was governmental disdain for urban agriculture. According to the author, industrial countries share the blame for the failure of urban agriculture because, for the most part, they are not funded from foreign development programs and consequently local officials, as well, do not give them a high priority.

4B.15 **Villien, Francois**
1988 L'agriculture dans la Ville: l'example de Bangui. Cahiers d'Outre-Mer 163:283-302

Key words: impact-income, impact-consumption, urban, Africa, Central African Republic

As do several other cities in tropical Africa, Bangui, in the Central African Republic, has important inter-urban agricultural activities. This form of agriculture reflects the overall poverty of the population, which seeks refuge in primary activities in order to eke out a living. There are two types of city agriculture, the 'hut garden' or 'jardin de case,' aimed at food production, and the 'hut field' or 'champ de case,' aimed at a single crop production, usually cassava, used to supplement family income. Agricultural production in Bangui has become necessary to family survival and as part of the national food supply. [Author's abstract; text in French]

The migration of people from rural areas to large urban centers is a worldwide trend. This article describes how the agricultural skills of rural immigrants to Bangui, the capital of the Central African Republic, form an important part of their survival strategy as well as contribute to the urban food system. Types of agricultural activity in Bangui are described, two of them occurring within the household compound area and three of them located at varying distances from the house. The "hut" garden is close to the house, contains a mixture of sauce and condiment fruits and vegetables used solely for direct consumption, and is tended by women. The "compound field" is a small area close to the house, which is devoted to crops such as manioc, maize, or sweet potatoes, usually for home consumption, but is increasingly used to plant marketable vegetables for sale.

Away from the home and near a water source such as a river are the market gardens, characterized by their resemblance to European market gardens. These are intensively managed, may use purchased inputs, and are planted with "European" vegetables for sale to the urban elites. The last two types of agriculture are manioc fields located either within settled neighborhood areas or just beyond the frontier of urban growth into the surrounding savanna.

Villien argues that the economic and nutritional contributions that these gardens make to the poorest urban residents are strong reasons why urban agriculture should be protected and supported.

Comment: Urban agriculture, especially gardens, are frequently overlooked by development programs, or there are efforts to eradicate them based on Western, industrial concepts of a formal urban landscape. Recognition of urban gardens and their contribution to the economic and nutritional status of the poor, the urban food system and even their aesthetic value, are essential if the productive abilities of the poor are to be supported.

4B.16 **Yeung, Yue-man**
1987 Examples of Urban Agriculture in Asia. Food and Nutrition Bulletin 9:14-23.

Key words: impact-income, impact-consumption, urban, Asia, China, Malaysia, Philippines, New Guinea, Hong Kong, Singapore

Food availability and access to food are acute problems in urban areas of Asia. Furthermore, price surveys in five developing countries showed that food prices for city dwellers were from ten to thirty percent greater than prices for rural dwellers. The author examines the problems of Asian urban agriculture, describes present production patterns, and profiles six Asian cities. Most Asian cities have been unable to harness their food production potential because 1) urban-fringe farmland is being converted to non-agricultural use, 2) land speculation has made urban open areas inaccessible, 3) urban agriculture is viewed as undesirable and backward by urban planners, 4) its development is hindered by other governmental policies and lack of democratic participation in the government, and 5) a shift from agriculture to industrialization has made urban dwellers more dependent on imported foods.

Urban agriculture in Asia is usually intensive for land and labor, is integrated with other production systems such as pond fishing and aquaculture, and is tied to other household and community systems as well. "Vegetable production...has evolved as part of the traditional ecological complex tied to pig breeding and recycling of night-soil and rubbish produced by the urban population" (p. 16).

Some issues discussed of relevance for household gardens are the importance of land tenure for establishment of gardens; the positive contribution of gardens to the nutritional, social, and environmental problems of the urban poor; and the role of gardens in making unused urban land and abundant organic urban wastes productive.

The author describes different approaches to urban agriculture in six cities in Asia, including Shanghai; Lae in Papua New Guinea; Georgetown, Penang, Malaysia; Hong Kong; Singapore; and Metropolitan Manila, The Philippines. Yeung concludes that it is possible for Asian cities to supply their food needs if obstacles to urban agriculture can be overcome and cities ensure that population increases do not overrun their ability to produce enough food within urban areas.

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Survey	2A.16, 4A.2, 4A.3, 4A.4, 4A.5, 4A.6, 4A.11, 4A.14, 4A.18, 4A.21, 4A.24, 4A.27, 4B.12.
Theoretical	1A.1, 1A.2, 1A.3, 1A.4, 1A.5, 1A.6, 1A.7, 1A.8, 1A.9, 1A.10, 1A.11, 1A.12, 1A.13, 1B.2, 1B.4.
Urban	1B.9, 3B.1, 4A.7, 4A.8, 4A.26, 4B.2, 4B.6, 4B.9, 4B.10, 4B.11, 4B.14, 4B.15, 4B.16.
Vitamin A	1B.1, 1B.7, 1B.8, 2A.4, 2A.5, 2A.16, 2A.17, 2B.1, 2B.3, 2B.4, 2B.5, 2C.1, 2C.2, 2C.3, 3A.2, 3B.1, 3B.3, 4A.1, 4A.4, 4A.6, 4A.9, 4A.10, 4A.12, 4A.15, 4A.21, 4A.22, 4A.23, 4A.25.
Women	1A.3, 1B.8, 2B.2, 4A.3, 4A.7, 4A.9, 4A.10, 4A.11, 4A.17, 4A.18, 4A.19, 4A.20, 4A.24, 4B.3, 4B.4, 4B.7, 4B.8.
World	1A.1, 1A.2, 1A.4, 1A.5, 1A.8, 1A.10, 1A.11, 1A.13, 1B.2, 1B.9, 2A.11, 2A.12, 2A.15, 2B.2, 4A.25.
Yields-indigenous	1A.2, 1A.4, 1B.3, 3B.1, 3B.2, 3B.3, 4A.6, 4A.22, 4A.23, 4B.6.
Yields-model	1A.2, 1A.4., 3A.1, 3A.2, 3A.3