Household Gardens as a Development Strategy

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Household food gardens have been a major subsistence strategy for *Homo sapiens* since the Neolithic, and their form and function are intimately related to the evolution of society, culture and agriculture. Gardens have played an important role in the domestication of grain and root crops and continue to serve as an avenue for the introduction and adaptation of new crops (Johnson 1972; Niñez 1984). Household gardens also serve important economic, nutritional and social functions not only in largely agricultural, developing countries, but also in highly industrialized, developed countries like the U.S.[1] Household gardens, however, cannot be justified as a development strategy solely because of their ability and persistence in serving a wide range of needs. Rather, programs to support gardens must be examined as an alternative use of scarce development resources. There may be better ways to use these resources than in promoting gardens and there may be very good reasons why some households do not have gardens, or why others do not have bigger or different gardens. On the other hand, household gardens, because of their special characteristics, may be able to play an important role in supporting development.

We define development as the process of improvement in the well-being of the poor majority of the population in ways that are sustainable socially, economically and environmentally over the long term (see Cox and Atkins 1979:677; Lappé and Collins 1978; Latham 1979:198; Perelman 1977:3; Todaro 1985:85). After defining household gardens and discussing them within the context of development practice and theory, we will summarize evidence for household gardens as a viable development strategy for improving food production, nutrition, and income.

Towards a Functional Definition of Household Gardens

In defining household gardens in the context of development, functional characteristics take precedent over form or cultural norms, because our interest is in how the garden is related to systems of household production, nutrition and economics. This includes relationships both within the household, and those which connect the household to the rest of the world. For our purposes the household can be considered the elementary unit of production and consumption.

We define the household garden as a supplementary food production system which is under the management and control of household members. In addition to food it may provide herbs, fuel, medicine, fodder, building materials, shade, social or recreational space, and beautification. A household garden can be consumption or market oriented, but at least some of the produce will be consumed by the household. As a supplementary production system the household garden is secondary to both the primary source of household food, whether from field production or purchase, and to household income, whether from sales of field produce, wage labor, migrant remittances or other sources. A corollary of this is that households do not invest a major portion of their labor or other resources in gardens.

While many writers, researchers and development personnel use the term household garden, there is no consensus on its meaning. Like the concept of the household itself (cf. Netting et al. 1984), a precise, detailed, universally applicable definition of the household garden is neither probable, nor, given the variety of phenomena that have been usefully considered as household gardens, necessary or desirable. Rather, within the definition outlined above, the household garden will vary in form and function through both time and space, within and between cultures. Our concern here is not to give an all-encompassing definition, but rather to call attention to the development potential of small-scale, secondary household food production, characterized by low cost and risk, and potentially important nutritional and economic benefits. This is epitomized by household gardens.

We offer the following brief review of some of the important features of household gardens in order to provide an indication of the similarities and differences which household gardens exhibit in various circumstances. This is not meant to be a definitive typology.

LOCATION, CONTENTS, AND SIZE. Household gardens located near the house are often referred to as "kitchen" or "dooryard" gardens (Anderson 1954; Kimber 1973; Wilhelm 1975). In African production systems characterized by concentric ring agriculture, the "compound" area closest to the house where most fruits and vegetables are grown may be considered a household garden (see Lagemann 1977; Netting et al. 1980; Ruthenberg 1980:127). Proximity to the house confers on gardens special advantages of being easily tended in the context of other domestic work, being readily guarded from animals or human thieves, and minimizing transport to and from the house. In many situations, however, as in highly nucleated rural settlements in Egypt, in crowded urban areas (Sanyal 1985), or where water resources for dry season gardens are centralized (Duggan 1985), garden plots may be located at some distance from the house. This may include plots within fields, interplanting with field crops, and planting along pathways or canals. Household gardens may also exist as individual, contiguous plots within communal areas, as is common in dry season gardens in savanna Africa.

Because gardens are functionally secondary and supplementary, the crops grown there are usually different from those which supply the main source of household food or income, and often consist primarily of fruits, vegetables, and herbs. Crops normally thought of as field crops or staple crops may also be grown in small quantities in gardens when they are used in a supplementary manner, for example, to provide a supply of the crop in the off-season, or for small amounts of fresh produce for immediate consumption, as with maize. Because of this, and because garden and non-garden crops

may be interplanted, gardens may, as in the Caribbean, "pass imperceptibly into fields" (Kimber 1973:20). Gardens are not defined solely by their contents. The fact that roots, tubers or starchy fruits are the main crops, or that there is a polyculture of many different crops, does not classify the system as a garden. The "gardens" belonging to what anthropologists have often described as "horticulturalists" are more appropriately referred to as fields because they are the primary site of staple crop production. Similarly, neither the lack of animal traction or mechanization automatically classifies a production system as a garden.

Garden crops may also include "weeds" which may only grow well in a managed environment such as the garden or garden borders. While not intentionally planted, they are utilized along with other garden crops, and may even be cultivated after they "volunteer."

Animals such as honey bees, fish, goats, guinea pigs, rabbits, and poultry may also be incorporated into gardens, many times requiring fences to keep them from plants. Gardens may even originate as places for growing fodder for household animals, as in Peru (Niñez 1985). Animal husbandry can be an important part of household gardens or in the extreme case can compete with fruit and vegetable gardening for household resources necessary in both types of food production. We do not consider animal husbandry in this paper.

In terms of contents, gardens would appear to lie on a continuum. At one extreme, crops are all domesticated and the garden highly managed. Gardens at the other extreme consist primarily of non-domesticates, many of which are simply allowed to grow where they are found. The first type is more intensive, and requires greater inputs of labor, management and other resources to maintain soil fertility and production in a highly "artificial" environment, while the latter is represented by the managed forest gardens of Mexico, Southeast Asia and Africa discussed below.

The size of the household garden may vary from very small, just a few fruit trees or some herbs and greens growing in containers in the dooryard, to quite large, 1,000 m^2 or more. Our definition would probably eliminate Chagga "home gardens" on the slopes of Mt. Kilimanjaro, not because of their size per se, which averages 6,700 m^2, but because they appear to be the primary source of staples like bananas as well as cash income from the sale of coffee (Fernandes et al. 1985).

GEOGRAPHICAL, CULTURAL, AND TEMPORAL VARIATION. A broad categorization of household gardens by geographical regions is possible, though there may be much variation between households, ethnic groups, and ecological zones within these regions. In the humid tropics traditional gardens tend to resemble forests, and in some cases may even be considered managed forest systems. They have been reported from a wide variety of locations including Indonesia (Soemarwoto and Soemarwoto 1981), Mexico (Alcorn 1984; Gliessman et al. 1981), West Africa (Lagemann 1977), and the Caribbean (Kimber 1973; Brierley 1976). They are often referred to as "mixed gardens" and because they have so many promoters (for example, Sommers 1982), there may exist a misconception that all traditional gardens are mixed gardens (see Brownrigg 1985:7). They are mixtures of plants forming several distinct canopies dominated by large, perennial trees with the more shade tolerant plants at the lowest level, though they may include separate beds of vegetables.

In the savannas of the semi-arid and sub-humid regions, gardens usually have fewer trees, especially fewer large, evergreen perennials. For example, in Durango, Mexico peach, pomegranite, apple, fig and citrus trees, and Indian fig cactus dominate the gardens, all but the cactus and citrus being deciduous. Herbaceous annuals and vines are intermixed (Cleveland and Soleri 1985). In savanna West Africa we have observed that in the rainy season okra, amaranth and other vegetables are grown by women in small garden plots next to the houses, with vines such as luffa and pumpkin growing over roof tops. The gardens spread out from the house into the permanently cultivated millet and sorghum field where sesame, roselle, kenaf and other crops are grown along pathways, and cowpeas and cucurbits are interplanted with cereals. In addition, in the area round the house a number of trees producing fruit and other products are found.

In arid areas, and in the dry season of semi-arid and some sub-humid areas, gardens are greatly influenced by the availability of water. In savanna Africa this often means location in river valleys where retreating flood waters provide residual soil moisture (Adams 1986), along dry stream beds where hand-dug wells can be used to supply water, or below dams, where individual household plots are contiguous. In Egypt, with its vast system of canals which make year-round cultivation possible, we have observed that gardens are often not present near houses because of lack of space, but may be spread out along canals, planted as tiny plots in larger fields, or even interplanted with field crops.

In temperate regions vegetables and fruit trees are commonly grown separately with vegetables planted in neat rows in clearly defined beds. We will discuss the importance of this garden form as a model in development in the following section.

Gardens in all regions vary within seasons as crops mature and mixtures within gardens change, between seasons with major changes in environmental conditions or labor supply, and through the years as perennial crops mature or the household moves through a domestic cycle. These changes may all affect the functional role of the garden within and beyond the household.

As with households, the persistence of "norms and structures through time and over large areas and the ways in which people manage to perpetuate them despite changing economic and political situations" (Netting et al. 1984:xxx) seem to be important characteristics of household gardens. Gardens in a given community may vary according to ethnic group (Soleri 1986), or socioeconomic class (Kimber 1973). They will also vary in regard to the influence of cultural models (Kimber 1973; Wilhelm 1975). It is even possible to find two quite different gardens within the same household, one traditional, and one based on an imported model (Cleveland and Soleri 1985).

Gardens and Development

The success of household gardens as a development strategy depends not only upon their efficacy in addressing concrete development goals, but also on the way the problems

and goals of development are defined, and upon the structure of the gardens and their functional relationships within and beyond the household. Like any other development strategy, the promotion of household gardens involves judgments based on human values (de Kadt 1985).

The household garden as a means of reaching the least well-off segment of the population has persisted as a part of the development repertoire for at least 30 years, often as a component of large-scale projects (Brownrigg 1985:67). Its popularity has varied, however, and unlike programs for breeding improved varieties of staple crops, mechanizing farm operations, or increasing chemical fertilizer consumption, it has not become accepted as an important component of development strategy, and future support is always in jeopardy.[2] Neither have gardens received much attention from researchers in nutrition, agriculture or the social sciences. The classification of garden crops as "minor" or "women's" crops (Longhurst 1983) has contributed to this lack of attention. There are, however, several factors which suggest that now is a good time to evaluate the potential of household gardens as a development strategy for improving the well-being of the most nutritionally and economically disadvantaged.

There is much evidence for the frequent failure of large-scale, production-oriented projects, such as those based on the Green Revolution, to improve the relative well-being of the poorest, because these projects are biased toward larger scale farmers and depend extensively on imported inputs (Lappé and Collins 1978:414–415; Moreno 1985; Todaro 1985:312). In fact many large-scale projects, even when they have improved some aggregate measures of production, have had little effect on the poorest, and in some cases have even worsened their lot (Dewey 1979, 1981; Fleuret and Fleuret 1980; Pines 1983). Rates of growth in food production per capita have been decreasing in most of the Third World since 1960, and in Africa have been negative (Cornia 1985). At the same time hundreds of millions of people worldwide remain chronically ill and underfed today (Latham 1984). This dilemma has been recognized in calls for programs which directly affect the "poorest of the poor." These people are the most difficult to reach because development organizations have shortages of qualified staff and are under pressure to produce quantifiable results in short periods of time, and thus often lack understanding of the local situation.

In addition, resources for development are becoming scarcer as oil-producing countries' revenues are falling, and industrialized countries' budgets are tighter. Low income households and communities, development agencies and Third World countries want to put scarce money where there will be visible returns. The question is, "How can human progress be maintained in the absence of increased economic resources?" (Grant 1984:4). Household gardens may offer one low-cost alternative for the poorest to obtain food and income.

Indeed, interest in small-scale household food production may be at its highest point since the FAO Applied Nutrition Projects, which promoted household gardens in Nigeria, India and other countries in the 1960s and 1970s. Household gardens are currently a component of Private Voluntary Organization (PVO) and government programs in many countries. FAO continues to support household gardens, and UNICEF has recently published three pamphlets on nutrition-oriented gardening for humid and dry-season areas (Sommers 1982, 1984a; UNICEF 1985), and is implementing a major household garden project in the Pacific region with the United Nations Development Program (UNDP) (Sommers 1985). USAID and the Peace Corps are also supporting household gardens (Peace Corps 1985; Sommers 1984b; USAID 1985).

There appear to be two major models for household gardens in development which we shall describe briefly below. They reflect two schools of thought or value systems in the field of development itself, and an understanding of their similarities and differences is essential for an understanding of the role of household gardens in development. While these two models are often distinct and easily differentiated in the field (see, e.g., Cleveland and Soleri 1985), elements of each are frequently combined within the same garden or garden project. Just as they are not mutually exclusive types, neither one is all good or all bad. What they have in common are the attributes which make them household gardens: secondary role in the household food system and economy, and control of production and consumption by the household. They differ in the management strategies, the type and method of obtaining inputs, and possibly their short and long term effects on household and environmental well-being. It seems clear that the household garden, like any other development strategy, can take different forms, serve different interests, and have differing effects.

INDUSTRIAL GARDENS. Household gardens, like food systems in general, have been very much influenced by agriculture in the industrialized, north temperate regions, especially the United States. This has been characterized by a decreasing number of farmers and increasing size of farms, made possible by the substitution of machines, fossil fuels and chemicals for human and animal labor. The subsequent increases in labor productivity have been accompanied by increases in yields per unit of land, and by increasing concentration of control in the food system (Lappé and Collins 1978; Buttel et al. 1985). The so-called Green Revolution in the 1950s and 1960s promoted new varieties of maize, rice and wheat which responded with increased production to irrigation, commercial pesticides and fertilizers and mechanization, and is the major example of the spread of the industrial model to the Third World. The successes of industrial agriculture have made it a very powerful cultural model worldwide, and traditional agriculture is often viewed as inferior.[3] Industrial agriculture has not, however, been an unmitigated success, and there has been much criticism of its adverse effects on the environment, on consumer health, and on the poor in the Third World (Altieri 1983; Buttel et al. 1985; Cox and Atkins 1979; George 1984; Lappé and Collins 1978; OTA 1982; Perelman 1977; Vogeler 1981).

The values which industrial agriculture brings to development are those of large-scale production and continued growth of the world economy along present lines. Most large development organizations see the role of the poor, Third World household in development as becoming more integrated with a growing world economy (Lappé and Collins 1978:414–415). Industrialized First World countries recognize that increased production in the Third World means a

larger marketplace for their own exports, including agricultural commodities, and actively promote policies along these lines (Todaro 1985:450). However, there is some evidence that the impact on the Third World poor has been either negative or only slightly positive (see Kent 1985).

It is not surprising that the industrial agricultural model in combination with temperate region row gardens has had a strong influence on the kind of gardens promoted by industrialized nations and extension personnel trained in this tradition (Brownrigg 1985:8; Cleveland and Soleri 1985; Niñez 1985; Will 1972). The ethnocentrism of horticulturalists and other development personnel who equate household gardens with this model (Bittenbender 1985) may be compared with that of social scientists who write of the household as if it were everywhere based on the "monogamous, coresidential, nuclear form that has been the . . . norm in Western Europe (Netting et al. 1984:xxvi–xxvii). It has been suggested that project personnel who remain unaware of the local situation or the implications of introducing models from their culture may be denying that their work "carries the moral responsibilities of political action" (Wright 1984:149).

Garden projects are often characterized by a tendency to overlook local gardening practices, and to promote improved seed for temperate European vegetables, European-style tools, and manufactured agricultural chemicals. Purchased inputs may be subsidized by the government or sponsoring agency. Orientation is often toward local, national, or even international markets (see Brana-Shute 1985 for a Caribbean example). Third World extension materials promoting this model have been common (for example, FUSAGRI 1984; Sekyere and McCorvey 1966). One of the first large household garden projects was carried out in Mexico as part of the emergent Green Revolution (Stackman et al. 1967:117–121). It concentrated on introducing vegetables familiar in the United States and seems to have ignored most indigenous crops, cultivars, and gardening methods, although it may have "contributed to Mexico's multi-million dollar export of winter vegetables to the United States" (Bittenbender 1985: 647).

TRADITIONAL GARDENS. Traditional gardens exist in most parts of the Third World, but have not been adequately studied. They are often mixtures of perennial trees, vines, and annual herbaceous crops. They are one component of traditional food production systems, and share many basic characteristics in common with small-scale traditional agriculture. Key features are the use of locally adapted crop varieties with resistance to a wide range of pests and diseases and tolerance of local soil conditions, open pollinated cultivars with a high degree of phenotypic variability, crop rotation, mixed cropping and the exploitation of several different microenvironments (Altieri 1983; Moreno 1985; Ruthenberg 1980). Cultivated areas may often resemble natural ecosystems, and may contain dozens or even hundreds of both domesticated and utilized wild and semi-wild species (Alcorn 1984; Grivetti 1978; Kimber 1973; Okigbo 1977; Soemarwoto and Soemarwoto 1981). Because of these features, pest, disease and weed problems are often minimized and are managed by system adjustments rather than specific chemical or other controls, as in industrial gardens and agriculture (Moreno 1985).

Traditional gardens may combine planting in rows, raised or sunken beds, with mixtures of trees, vines, living fences and annual vegetables and herbs, and a variety of animals. They provide many other products in addition to food, including shade, medicines, fodder, building and craft materials, flowers and a place for relaxation and social activities.

There has been increasing interest in the use of traditional agriculture as the basis for an alternative agriculture for development in the Third World (Altieri 1983; Alverson 1984; Gliessman 1981; Harwood 1983). This is paralleled by developments in household gardens, and many have spoken out in favor of traditionally based gardens (Pacey 1978:23–24), mostly in reference to gardens in the humid tropics (Soemarwoto and Soemarwoto 1981; Sommers 1982, 1984b), though there is growing interest in traditional gardens and crops for dry areas as well (FAO 1985; UNICEF 1985).

The role of the traditional garden model in development tends to be based on a value system which emphasizes local self-reliance and environmental sustainability through the use of local knowledge and resources, does not require credit for major capital investments, and whose primary goal is the improvement of household well-being. Extension materials promoting traditional style gardens are much less common than those for industrial gardens (see Sommers 1982, 1984a). Projects, too, are uncommon. The large FAO projects in Nigeria and some other African countries are major examples (Brownrigg 1985:68–76), as is the current UNICEF project in the Pacific (Sommers 1985). In fact, local authorities may promote the replacement of traditional style gardens by industrial style ones (Brierley 1976), or their complete elimination in urban areas as being un-modern (Sanyal 1985). In the Lima slums, however, authorities consider the expansion of traditional household gardens into public spaces as "free beautification projects" (Niñez 1985:9).

There is another distinct type of household garden which combines many elements of traditional gardens and alternative vegetable gardening from the temperate zone industrial countries. These "organic," "French intensive," or "biodynamic" gardens of Europe and North America have been referred to as an "intensive fixed model" (Bittenbender 1985). Examples of this approach include the work of the Asian Vegetable Research and Development Center (AVRDC) in Taiwan (Gershon et al. 1985), and the attempts to transfer the French Intensive system to Latin America from California (see L.I.F.E. 1976; Niñez 1985:10). Even though this approach seeks specifically to improve household nutrition and well-being, it tends to ignore local traditions and knowledge.

In the following discussion of the potential contribution of household gardens to production, nutrition and income, we will emphasize the differences between industrial and traditional gardens where relevant.

Increasing Food Production

There is little doubt that the household garden as a production strategy has suffered from the bias within development circles in favor of large-scale production on the industrial model. On the other hand, it is frequently claimed that household gardens are a valuable resource and should not

be neglected. Production advantages cited for household gardens include efficient use of soil, water, and sunlight, continuous harvesting, high and sustained yields, and utilization of labor supplied in small amounts integrated with other household tasks. Gardening is even reported to improve subjective feelings of well-being (Soemarwoto and Soemarwoto 1981). Most evidence supporting this claim comes, however, from studies in industrialized countries, including rehabilitation programs (Kaplan 1973; Relf 1981). In addition, some features of traditional style household gardens are preservation of diverse genetic resources adapted to local conditions, minimized pest and weed problems, a mixture of many different crops providing other products in addition to food, and little if any cash investment (Alcorn 1984; Altieri 1983; Binkert 1981; Gliessman et al. 1981; Moreno 1985; Soemarwoto and Soemarwoto 1981; Sommers 1982).

A special advantage of traditional style household gardens is that they rely primarily on cultivation practices rather than toxic chemicals to control weeds, pests, and diseases. Thus there is little risk of poisoning people or the environment, a serious and growing problem in the Third World (Bull 1982; Moreno 1985). The non-use of manufactured chemical fertilizers and fuel-powered machinery as well as pesticides, means that these gardens are not dependent upon high energy inputs whose price has been steadily rising, nor upon transportation, marketing or bureaucratic infrastructures to deliver them. Combined with cultivation techniques which maintain or increase fertility while conserving soil and water, these gardens can be socially and environmentally sustainable food systems.

Frequently among low income households the factors of production, including time, energy, money and land, are available in small, discreet increments through time and space. Accumulation of these factors in order to make larger investments of them can be difficult for these households, and household gardens may be a very efficient way to use them without competing with staple crop production or other claims on household resources. Labor inputs effectively utilize small amounts of the spare time of men, women, children, the disabled and the elderly, and can easily be combined with child care and domestic tasks. Because of the nature of resource use in gardens, and the great number and variety of crops often grown, household gardens, especially traditional style ones, carry very little risk, an important consideration for poor households (see Levi and Havinden 1982:71; Todaro 1985:306).

Quantitative studies of household gardens are rare, but some insights can be gained by consideration of small-scale agriculture where a relationship has been established between intensification of land use (measured as the ratio of time land is in production to time that it is fallowed, and the number of crops grown per year), yield (unit of harvest per unit of land), and labor productivity (unit of harvest per unit of labor). As arable land becomes more scarce (i.e., effective population density increases) under a given productive technology, farmers will be willing to intensify, even though it usually means decreased labor productivity, because they can maintain or increase yields (Boserup 1965; Geertz 1963; Netting 1974:38). A recent analysis of data from 15 developing countries shows that intensity, yields and inputs of resources (labor, land, capital and intermediate goods) all increase with decreasing farm size (Cornia 1985). When gardens are the most intensive component of the household production system they may supply a larger and larger proportion of household production as population density increases (Ruthenberg 1980:127; see Lagemann 1977:55 and Netting 1969 for the Ibo case), or as size of area for staple crop production decreases within a community (see Stoler 1979:247 for Java). A study in Eastern Nigeria shows that dry weight yields from "compound" gardens are twice as large as those from more extensively cultivated outer fields (Lagemann 1977:55–56). There is also evidence that under certain conditions the smaller the garden the greater the labor input, as in Java where Stoler (1979:249) found that for small gardens (0.1 h or less) labor inputs per unit of land area were three times that for larger gardens (more than 0.3 h).

However, unlike field crop production, intensive garden production may not mean lower labor productivity. Most of the evidence showing drops in labor productivity with increasing intensification or increasing mixed cropping, such as Norman's (1972) classic work in Northern Nigeria, are based on studies of annual field crops. There is some evidence that with intensification in traditional mixed gardens, especially those with many trees, returns to labor may actually increase because of the greater biological diversity, continuous harvesting, and large proportion of perennials (Altieri 1983:73–75; Lagemann 1977:94). Continual harvesting may not only raise annual yields, but encourage fine tuning of management strategies. For example, the mixed household gardens ("compounds") in Eastern Nigeria yield returns to labor which are four to eight times greater than those in outer fields (Lagemann 1977:94).

As previously mentioned, the household garden, like field agriculture, varies along a continuum between extensive and intensive. Gardens might therefore be expected to show a similar variation in yield per unit area and labor productivity, but little data exists.

Another body of literature on experimental and demonstration gardens producing annual vegetable crops also suggests that small size does not limit garden yields. Data from the United States (Cleveland et al. 1985; Stevens et al. 1984), Taiwan (Chen et al. 1983), and Uganda (Will 1972), showed yields ranging between 2.5 and 15.5 kg/m^2. Two household gardens in an urban desert environment showed yields between 1.2 and 6.5 kg/m^2 (calculated from Cleveland et al. 1985). These results can be compared with commercial vegetable production in the U.S. which yielded on average 1.7 kg/m^2 in 1974 (Terhune 1977:775). A low yield is Arkansas spinach with 1.1 kg/m^2 (Terhune 1977:776), and a high yield is Arizona tomatoes with 3.4 kg/m^2 (calculated from Hathorn and Harper 1984).

Returns to labor in these gardens, from less than one to almost 16 kg/hr, is much lower than that in large scale, commercial agriculture, for example, 296 kg/hr for Arizona tomatoes and 200 kg/hr for Arkansas spinach. It may, however, also be lower than that in traditional style household

This does not mean that production in large, mechanized fields is necessarily more efficient than that in gardens, because the increase in labor productivity is bought with large amounts of expensive, non-renewable energy in the form of pesticides, fertilizers, electricity and fuel (Pimentel and Pimentel 1979; Steinhart and Steinhart 1974).

Yet while traditional or introduced gardens may seem an extremely successful production strategy for those households which have them, there may be many reasons for nonadoption among those that do not have them. Required resources, including labor, may often produce more highly valued returns when invested elsewhere, for example in craft production or wage labor, than in extra production from a garden. As production units gardens may also be unsuccessful because inputs are unavailable or expensive. In addition to labor these include land, good quality soil, water, organic matter and fertilizers to maintain soil fertility, planting materials, tools, and materials for fencing, shading, mulching, windbreaks and trellises (Cleveland and Soleri n.d.).

Improving Nutritional Status

Malnutrition continues to be a major obstacle to improving the well-being of poor households because it impairs early mental development, increases morbidity and mortality rates for infectious diseases, and decreases physical and mental capacity of productive household members. There is little direct evidence for the influence of gardens on nutritional status, although they have been widely promoted as nutrition interventions (Oomen and Grubben 1978; Pacey 1978; Sommers 1982, 1984a, 1984b).

As with agricultural projects (Pines 1983), the nutritional impact of garden projects has seldom been measured, partly because this is so difficult to do. The nutritional status of household members is influenced by gardens through a complex chain of events subject to many intervening variables: quantity and quality of garden nutrient production, availability of nutrients in garden produce, storage and processing, food distribution and diet. In addition, nutritional status is particularly difficult to define and measure.

Although a clear, causal relationship is not easy to establish, it is often argued that the potential of household food gardens to contribute directly to improved household nutrition is higher than strategies that rely upon increased income or large-scale agricultural production. This is because even when increased income is spent on food, it is often on cheap, widely promoted empty-calorie foods like soft drinks, and not fruit and vegetables (Dewey 1981). Consumption of garden produce depends only marginally on market structures and government programs which can be unreliable and may often reduce nutritional effectiveness of increased household income or large-scale production (Fleuret and Fleuret 1980; Pines 1983). We will discuss the effects of increased income in a subsequent section.

NUTRIENT YIELD AND AVAILABILITY. Nutrient yields are a result of nutrient density of the plant and yield of plant material per unit area as determined by genotype, environment and cultivation practices. As with indigenous gardens, most indigenous fruits and vegetables, domesticated, semidomesticated and wild, have received scant attention. This is true even in the Third World, where local research continues to follow the colonial emphasis on exotic imports and a few local commercial crops in isolation from their ecological context (FAO 1985; Gliessman et al. 1981; Okigbo 1977).

Fruits and vegetables are widely acknowledged as important sources of vitamins, minerals and fiber in the diet. Vitamins A and C are present in largest quantities, with fruits and vegetables supplying, for example, 91 and 48% respectively in the U.S. diet (Goddard and Matthews 1979). Other nutrients present in significant quantities include the vitamins riboflavin, pyridoxine, folacin, thiamin and niacin, and the minerals magnesium, zinc, iron, and calcium. Vegetables can also supply important amounts of protein in the diet (Kelly 1972; Oomen and Grubben 1978). For example, the dark green leaves of jute (*Corchorus olitorius*), cowpea (*Vigna unguiculata*), and pumpkin (*Curcurbita pepo*), widely eaten in the developing world, are only 4% or more protein by weight when fresh, but are 20–35% protein when dried (calculated from Leung 1968). While caloric density of most fresh fruits and vegetables is only about one-sixth or less than that of grain, this increases several times when dried. The caloric content of some vegetables grown in household gardens such as tiger nut (*Cyperus esculentus*) and dried sweet potato, yam, and cassava, and of many dried fruits, approaches or exceeds that of grains, which is about 350 kcal/100 grams. While the major source of energy and protein is not from the garden, it may supply these nutrients in more convenient forms and at times of the year when major sources are unavailable. This may be especially important for weaning children, the most nutritionally at risk group in the population (see Cameron and Hofvander 1983:53–56, 117; Gibbons and Griffiths 1984: 30; Latham 1979:195).

Thus, three of the four most important nutritional problems in the Third World, protein/energy under-nutrition of infants and children, vitamin A deficiency, and anemia resulting from lack of iron and vitamin C (Latham 1984), may be directly addressed by gardens.

Little research has been carried out on nutrient production in traditional Third World gardens, but data from other types of gardens are available. Output from two small experimental gardens in Hawaii (18.5 and 25.7 m^2) measured for 40 and 34 days respectively, supplied the following percentages of RDAs for a family of five: 8% protein, 28–48% calcium, 21–22% iron, 174–177% vitamin A, and 157–160% vitamin C (Yang 1981). When distributed over a complete garden year these yields would probably be significantly lower, however. A study of two household gardens (77.4 and 58.3 m^2) in an urban desert environment recorded a year-round harvest of vegetables that provided the gardeners with significant proportions of the RDAs for ten nutrients, including more than 50% of the RDA for vitamins A and C for more than half the months of the year, while only 2–3 hours per week were spent in the gardens (Cleveland 1982). Perhaps the most ambitious study to date is being carried out in experimental gardens by the AVRDC in Taiwan (Gershon et al. 1985). Results from the third year of the study (1983–1984) showed yearly production of RDA for a family of five determined quarterly on samples from the gardens as follows: 13–18% protein, 33–42% calcium, 56–82% iron, 82–125% vitamin A, and 336–374% vitamin C.

A major potential advantage of consuming produce from household gardens is that much of it can be eaten soon after harvesting. Nutrient content, especially that of vitamins in fresh fruits and vegetables, particularly if eaten raw or only partially cooked, is much higher than when they are stored, processed or preserved. However, preservation may be a

viable alternative to year-round garden production where there is a marked seasonality in availability of production inputs due to lack of water or low temperatures. Some preservation methods, such as drying leafy vegetables in the shade, are quite appropriate for poor households, and may preserve a high proportion of ascorbic acid, carotene (Maeda and Salunkhe 1981), folacin (Chen and Saad 1981) or other nutrients.

HOUSEHOLD DISTRIBUTION AND CONSUMPTION PATTERNS. Most information on the nutrition available from garden produce is from experimental gardens. The implications for household well-being are largely theoretical and depend on the complex of structural and physiological relationships determining use of food within the household and by individuals (Piwoz and Viteri 1985). The availability of nutrients within the household may be related to social and cultural patterns of distribution of foods. For example, working males may be the first to eat, then older women, then younger women and their children. This may be attributed to women and children's weaker bargaining power within the household, due to low social, economic and cultural status outside the household, which results in inadequate consumption of calories in contrast to men (Folbre 1984). More household food may lead to more reaching the last in line. When women control the garden and its produce, household food distribution may also change for the better nutrition of children, especially during weaning (Carloni 1981). Yet there is little evidence on this point, and no justification for assuming that project gardens will automatically be controlled by or benefit women (see Piwoz and Viteri 1985).

The combination of foods in various household meals can have a great effect on the total nutritional value of the meal (Lappé 1982; Oomen and Grubben 1978). Theoretically, an important characteristic of gardens is that they facilitate the continual consumption of small amounts of a variety of nutrients which complement the rest of the diet (Grivetti 1978; Longhurst 1983). For example, the essential amino acid patterns in the protein of vegetables complement that of many grains, seeds and nuts.

There is some evidence to suggest that household gardens can positively affect the diet. In Tabasco, Mexico it was found that fruits and vegetables were not eaten unless grown in the family garden because they were too expensive to purchase (Dewey 1981). A study in Java found that low-income households consumed the least amount of rice, but the greatest amount of leafy garden vegetables high in vitamin A, and that gardens provided up to 40% of the household caloric requirement (Stoler 1979). In Puerto Rico, "homemakers" were more likely to have diets adequate in vitamins A and C, and preschoolers in vitamins A, C and riboflavin, calcium, energy and protein, when their households produced fruit and vegetables for consumption in home gardens (Immink et al. 1981).

EFFECT ON NUTRITIONAL STATUS. There is also evidence that household gardens in developing countries can positively affect nutritional status. Home garden production was found to be a strong predictor of "weaning age" children's nutritional status (percent weight for age of the Harvard standards) during a nine-month study of 48 households in India (Kumar 1978). This was especially true in the slack season for off-farm employment when garden produce, or the income it brought, provided a "buffer against reductions in child nutrition."

An 18-month study in the Philippines evaluated the effect on nutritional status of three different interventions in combating vitamin A deficiency, one of which, public health-horticulture, included household gardens (Solon et al. 1979). Compared with massive dose vitamin A capsules and vitamin A fortified MSG, the public health-horticulture intervention was by far the least effective. It did, however, result in significantly higher serum levels of vitamin A in those children who had the lowest levels before the intervention. It also had positive effects which the other two did not have: a significant increase in weight for height of children, and a reduction in third degree malnutrition (by the Gomez standard).

The evidence cited above suggests that gardens may contribute positively to household nutrition. It is also obvious that there are many links between establishing a garden and improved nutritional status, and problems can occur in any one of them which will diminish the nutritional importance of the garden (Cleveland and Soleri n.d.). For example, garden production may be minimal at just the season when nutritional needs are greatest, or the crops grown may not supply needed nutrients. Nutritious, easily grown local vegetables or fruits may lack status and acceptability and may therefore not be consumed. On the other hand, introduced exotic crops may not be fully utilized because of lack of knowledge. Cooking and storage may destroy much of the nutrient values of garden produce, and intra-household distribution and consumption patterns may leave malnourished members unaffected (see Kennedy 1983). Studies of the effect of gardens on the diet and nutrition need to trace carefully the pathways from one to the other.

Increasing Savings and Income

Another common goal in garden projects is increasing household income. Gardens can not only produce income through marketing of produce, but can save money by producing items which were formerly purchased. Cash incomes of large segments of the population in the Third World are quite low, and so even small amounts of savings or income from the sale of garden produce can play an important part in improving household well-being. It is necessary, however, to know the costs of production and the effect of the income on household well-being to ascertain whether this leads to development. Production could theoretically be at such a high price that net benefits would be negligible, or income could be used in ways that have negative effects on household well-being. It is also important to know how use of garden income is affected by internal household organization, including control of production.

Household gardens specifically designed for marketing of harvest may be quite different than those meant for household consumption of harvest. The former are designed to mesh with the market potentials of various fruits and vegetables or other products as they change throughout the seasons of the year. Rather than continuous harvests of a variety

of products, a market garden might emphasize large harvests of produce during the times of the year when it would bring the best net returns. Frequently, however, household gardens serve both functions, and the same garden products that are used by the household will be the ones sold locally along with some specializations for market (Kumar 1978; Stoler 1979). This has also been the experience of garden projects (Brownrigg 1985:18).

Traditional gardens cultivated primarily for household consumption can also provide significant income from sales of excess produce throughout the year, and production of income may be an important motivation for enlarging gardens and increasing labor input. In Java, lower income households with smaller gardens are more likely to sell some garden produce, and gardens may provide up to 20% of household income (Stoler 1979).

In some cases markets may be more influenced by upper income and foreign tastes. In a project in Senegal, an important reason for the success of communally organized women's gardens was that they responded to the demand for fresh produce by hotels serving a booming tourist trade (Yoon 1983). While some produce was consumed by the gardeners' households, lettuce, for example, was grown only for sale.

Income from sales of garden produce can not only provide resources for purchase of additional food and other items, but through savings may also make available resources formerly used to purchase items now produced in the garden. For example, average savings over a five month growing season for a sample of 40 gardens in the slums of Lima, Peru was found to be about 4% of annual earnings (calculated from Niñez 1985). Low income was the primary reason given for cultivation of gardens for home consumption in a sample of 50 homeowners in Lusaka, Zambia, where 57% of all households in low-cost housing areas have gardens (Sanyal 1985:18).

The economic contribution of household gardens in supplying items which would otherwise have to be purchased or would be unavailable is especially important for women. They are frequently the principal gardeners as well as being responsible for providing weaning foods, condiments, relishes and sauces (Smale 1980).

Gardens can also be important sources of income for women. For example, household gardens, along with other home-based activities, can provide women with a means of earning income while adhering to cultural or religious requirements for female seclusion, as in a Nigerian Moslem village (Barkow 1972). At a site in Botswana 29 of 33 household gardens adjacent to a dam belonged to women from the poorest segment of the community, and 21 of the 33 gardeners cited the gardens as their sole or major source of cash income (Duggan 1985). Among the female members (33 of 78) of a fruit and vegetable growing cooperative in Zambia, 44% felt that their garden incomes had made them less dependent on their husbands (Milimo 1985).

One potential problem is that if women's gardens become economically successful, men may use their superior social positions to usurp women's control, as was the case in the two examples just cited. This is especially critical to women for whom gardening may be one of the last sources of independent income, as agriculture is developed in a way that excludes them from much of the control over resources which they once enjoyed. It has even been suggested that "horticulture needs to be preserved as an enterprise for the poor," most of whom are women (Duggan 1985:18).

Whether in the form of savings or income, what additional household resources from gardens are actually used for is dependent on patterns of control within the household, as well as external factors influencing consumer preference and availability of goods. While one study in India has shown that increased income from household gardens contributed positively to child nutrition (Kumar 1978), this is certainly not always true. There is in fact some evidence that household income does not correlate with child nutritional status (Kennedy 1983). Although it is widely assumed that women are more likely than men to spend income on food that will improve household well-being, there appears to be little supporting evidence (Piwoz and Viteri 1985). It may be that correlations between increased women's income and improved child nutrition, when they occur, may be indicative of a desperate economic situation that forces women into the labor market (Rogers 1983), coupled with the high income elasticity for food at low income levels.

Finally, there is some danger that household gardens could function as a way of exploiting the cheap labor of the poor. The "provision ground" provided by plantation owners in the Caribbean for their slaves to produce their own supply of fruits and vegetables provides an historical example. The land allocated was "usually marginal for agriculture," and "relieved the planter of providing rations for his slaves" (Brierley 1976:30, 31). Household gardens, by allowing reductions in the very high proportion of income spent on food by the poor, could make it possible for them to survive on even lower wages (Deere and de Janvry 1979; Painter 1984). Under these circumstances household gardens, along with other types of domestic production, could subsidize cheap labor supporting a condition of "functional dualism" (Deere and de Janvry 1979; Geertz 1963). On Bangladeshi tea plantations where workers are provided unsanitary, dilapidated and congested housing, and unemployment and day labor are common, the managers encourage household gardens (Ahmed n.d.).

Conclusion

Household gardens are little understood as a development strategy despite their continuing, if generally subdued, popularity in development circles. We have reviewed the relevant literature in an attempt to clarify the present state of knowledge and the most important issues necessary for productive applied research on household gardens in development.

Project gardens, as well as traditional and spontaneously adapted gardens, have not been adequately investigated or evaluated to date. Yet available evidence indicates that the frequent failure of garden projects to achieve significant, cost effective, sustained and positive changes are due in large part to the familiar litany of development project errors. Foremost among them is a lack of understanding of and adaptation to local conditions, resulting in extension agents, demonstration gardens, planting materials and garden establishment and management strategies unsuited for local

environmental, social and resource supply conditions (see Brownrigg 1985:100–112).

As stated in the introduction and elaborated on in the paper, there may be many valid reasons why households do not have gardens, or do not have bigger or different gardens. In any attempt to improve the productivity, nutritional status or income of households through gardens, the evidence suggests the necessity of analyzing the internal dynamics of both garden and household, the relationship between the two, and the relationships of both with external social, economic, political and environmental forces which determine the household's control over resources for and production from gardens. The need for such a broad, structural perspective in development has recently been pointed out by Garrett (1984) in regard to farming systems research and extension, a currently popular methodology.

Perhaps the best place to begin when considering household gardens as a development strategy is with the examination of existing, especially traditional, household gardens. A respect for local knowledge and the involvement of local people in the design and implementation of the project will help insure success.

Judicious application of new technologies and techniques, including those which may be traditional in other areas, could be useful in some instances if done in ways that allow the local people to experiment. This is especially true when traditional gardens have been forgotten because of encroachment of "modern values" (Gliessman et al. 1981), or where traditional techniques may not be adapted to the new environments of migrants or refugees (Cleveland and Soleri 1985), or where expansion of gardens to new seasons or locations may be desirable (Duggan 1985).

However, application of new technologies is not value free (de Kadt 1985; Wright 1984), and such promising new developments as the biotechnology revolution in agriculture could help to improve the well-being of poor Third World households through, for example, increased garden production, or the benefits could be captured by the industrial world with long run negative effects on these households (Buttel et al. 1985).

It is likely that household gardens will be successful in improving the well-being of the poor in a socially and environmentally sustainable manner only if this goal is kept clearly in mind.

NOTES

[1] In the United States, economic, nutritional and social contributions of household gardens are the main reasons given for gardening in the Gardens for All/Gallup Organization poll taken yearly since 1973. In 1984–1985 34 million or 40% of all U.S. households grew vegetables with a total value of $12 billion, and spent $1.7 billion on garden supplies (GFA 1985). This can be compared with commercial U.S. production in 1982: 69,109 farms harvested vegetables valued at $4 billion (USDC 1984). GFA garden production is equal to 19% of the total U.S. agricultural production of $63 billion. Analysis of the 1977 National Food Consumption Survey (Blaylock and Gallo 1983), and a study in Florida showing that food gardens contribute up to 10% of net farm income (Gladwin and Butler 1984), also support the argument that household gardens in industrialized countries are much more than just hobbies.

[2] This impression, gained from discussions with colleagues and from the literature, was reinforced by participation of one of us (David A. Cleveland) in a "Home Gardens Planning Meeting" in Washington, D.C. in September, 1984 attended by representatives of donor agencies (including the FAO, UNICEF, USAID, and the World Bank) and of a number of private voluntary organizations involved in garden projects.

[3] Economists still commonly advocate a hierarchichal, evolutionary model of agricultural development, not unlike the ethnocentric anthropological models of cultural and racial evolution popular in the late 19th century. A widely used text, for example, states that agricultural development is the transformation of "primitive" traditional agriculture characterized by a "harsh and static" environment, "technological limitations," and "rigid social institutions," toward the "modern" industrial model which is "the final and most advanced stage of individual holding in a mixed-market economy" where "pure commercial 'profit' becomes the criterion of success" (Todaro 1985:304, 305, 309). See Alverson (1984) for a critique of this approach as applied to small-scale agriculture.

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