FOOD PRODUCTION FOR HOME CONSUMPTION: NATURE AND FUNCTION OF GARDENS IN HOUSEHOLD ECONOMIES[1]

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I. INTRODUCTION

Applied research oriented toward improving food production has traditionally concentrated on large to medium-size commercial agricultural enterprises. Recently, a new trend in development research (farming systems research) has focussed, in addition, on small farmers and their socio-economic environment. Despite this change of clients, however, a field production/surplus market orientation bias persists. Consequently, little attention has been given to a universal small-scale food production system referred to by Harwood (1) as "farmyard enterprise."

Farmyard enterprises, or household gardens, do not fit the traditional "development package" in either technological needs and extension services, social orientation, or methodology to assess production values. Garden technology varies drastically from that of field agriculture or field horticulture: home gardeners are predominantly women, and yields are not easily quantified: household gardens production goes almost exclusively toward home consumption and is therefore not measured. Lacking in quantified data, household gardens are considered not significant enough to warrant major research investment, and little remains known on this family-specific food production strategy. Yet, for many households the world over rural (and urban) backyard gardens represent a crucial day-to-day source of food as well as minor cash income.

This paper, thus, is a first attempt to call to the attention of development research the universal role of household gardens, their historical, economic, and nutritional importance, and their function in present-day farming systems. Data are drawn from four zones in Peru, and examples from other world areas are cited.

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1 This study of household food production began in the summer of 1983. Quantifiable data are presently being collected and analyzed, and will be given in a subsequent publication.

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II. HISTORICAL SIGNIFICANCE OF HOUSEHOLD GARDENS AND SMALL ANIMAL PRODUCTION

Students of prehistoric agriculture have long pointed to the role of garden plots adjacent to the prehistoric huts of sedentary or semi-sedentary peoples in the domestication of plants and animals. Childe (2) recognizes the progressively "purposeful pursuit of experimenting with seeds collected by groups of women for family consumption" "Probably, at first, cultivation was an incidental activity of the women while their lords were engaged in the serious business of the chase" [(2), p. 19]. All along, "...grains brought home (by women gatherers) for processing would be scattered by accident in the areas around the houses where human waste and garbage provided ideal growing conditions" [(3), p. 180].

Due to sexual division of labor in hunting and gathering societies, women rather than men were in the position to experiment with what they collected and take the "next step of deliberately planting..." until finally, "...cultivation won the status of an independent and ultimately predominant industry" [(2), p. 19]. Garden plots continued in their function as experiment stations, a pattern which persists until today.

Together with the domestication of animals a subsistence pattern of mixed agriculture resulted, which has been the most typical survival strategy of human groups through the ages. Fields, gardens, and animals, along with seasonal gathering of wild species, complement each other while providing a sound nutritional base for human kind.

Since then, the household garden has played many roles in feeding a growing world population. It represents the most universal of subsistence strategies for families with economic bases ranging from shifting cultivation to highly commercialized agriculture to the urban industrial context. The value of household gardens in providing entire populations with food and essential nutrients has found ample expression in recent history from pre-famine Ireland, the Great Depression, the Victory gardens of World War II, down to the present economic crisis which seems to have caused a renaissance of home food production in "developed" countries (4).

While furnishing much of the food needed for Northern Europe's industrial revolution, household gardens have acted as a unique force in the dissemination of plant genetic materials around the globe, especially during large-scale human migrations (e.g., colonization). Sri Lanka is a case in point: British tea growers introduced temperated garden vegetables through their colony gardens which evolved into commercial vegetable growing enterprises for the urban market. Gardeners everywhere continuously experiment with new varieties and exotic species while preserving genetic variablity through adherence to traditional ones, and continued planting of those considered non-economical for field production [cf. (5), p. 153-157].

The primacy of establishing an area of intense cultivation –a garden– close to the family dwelling following a move, applies not only to European migrants. Migratory peoples around the world, including shifting cultivators, have planted gardens close to the house to insure immediate food supply while waiting for their new fields to produce. Raffles, in his History of Java (1817), found that:

> In the first establishment or formation of a village or new ground, the intended settlers take care to provide themselves with sufficient garden ground around their huts for stock and to supply the ordinary wants of their families.... the settler labors to plant and rear in it those vegetables that may be most useful to his family and those shrubs and trees which may at once yield him their fruit and their shade [cited in (6), p. 85].

Colonists of the Inca era, the *mitimaes*, who were resettled by "divine command" in newly acquired areas,

> carried with them their seeds for rapid propagation in their new homes... even today, when *campesinas* migrate, they carry in their bosoms grains of maize which they will plant in their new homes [(7), p. 77].

In modern times, *campesinas* (women peasants) migrate to Lima slum settlements. And although the chances for a functional household garden are often slim, the first green to appear in front of the reed-mat housing are a few plants of corn, like symbols of hope for a productive plot of green vegetables in the sandy sadness of shanty town.

III. HOUSEHOLD GARDENS AROUND THE WORLD

Little is known cross-culturally about household gardens, their function within farming systems, and their economic and nutritional role. Information on gardens has to be extracted from writings with other foci that touch on garden production only in passing, while concentrating on commercial or subsistence field crops [a few exceptions exist: e.g., (6, 8, 9)].

Gardens are highly diversified both in form and function throughout the world. They are found in arid regions with irrigated field production; in the tropics with permanent and semi-permanent cultivation; in subsistence as well as commercial agriculture; and they form the only possibility of primary food production in the urban context.

In describing the highly diversified semi-permanent farming systems of the African savannah south of the Sahara, Ruthenberg (10) notes that located in the center of the village adjacent to permanent houses, one of the main features is the "permanent garden with fruit trees and perennial crops like banana and papaya... which is either no longer shifted or is moved only a short distance at short intervals" (p. 61).

Permanent gardens are also cultivated in the hot, humid tropics where they supplement wet rice agriculture as "an important branch of the holding... which can become dominant where there is a town in the vicinity or where there is marked shortage of land" [(10), p. 104]. Land is a limited resource, especially in areas of high population density like Indonesia. Thus, Ochse and Terra (1934) found that on Java, "the proportion of land alloted to gardens, together with the intensity of their cultivation, increases as total amount of crop land per head decreases" [(6), p. 93]. One fifth of Javan land area under agricultural exploitation is

made up of plots that are more like gardens than field [(10), p. 104]. Stoler (6) states that gardens constitute 15 to 75 per cent of the cultivated land area (p. 86) while from densely populated Nepal, Rhoades (11) reports on a government statistics that failed to take into account 4,000 hectares of potato production in the form of backyard gardens.

Closeness to urban markets has in some world regions stimulated household gardens to expand production for market sales (cf. Sri Lanka, coastal and highland Peru), thus altering traditional farming systems. An inverse process seems to have occurred in Upper Volta where vegetable production for urban markets was introduced about 10 years ago and, "... as the fresh product has found acceptance in *rural* centers, there has been considerable expansion of areas under cultivation (mimeograph doct. by Walstein and Anderson, USAID, n/d. Emphasis added).

Vegetable gardens and small farm animals have always formed a vital part of German village economy. Since World War II, German farmers have increasingly looked for industrial employment leasing their small holdings to a diminishing number of full-time farmers. Farm women, however, continue to plant large gardens and keep small farm animals, up to several milk cows, to supplement city income. Also supplementing industrial income are city Germans by cultivating municipal plots set aside for urban family-level food production *(Schrebergaerten)*, as well as health, recreation, aesthetic, and therapeutical motives.

City gardening has also become popular in North American cities. Seattle, for example, has a "pea-patch" program which features international and communal gardens for food production, utilized most intensely by the most recent immigrants from Southeast Asia. And Universities and colleges across the United States –like the University of Kansas at Lawrence– have followed the demands of their students in allocating space for student gardens to help make ends meet.

IV. PHYSICAL NATURE AND SPATIAL ARRANGEMENTS

Gardens vary widely in physical appearance from one world region and one culture to another. They range from the crude beginnings of a tiny spot by the house with five corn stalks, a squash plant and an herb or two in a city slum, to the highly productive, raised-bed gardens of the Chinese. What functions as a household garden for a Shipibo Indian appears to a European a mere toleration of growth around the hut.

Physical appearance of household gardens is determined in large part by the natural ecology and people's attempts to utilize as many locally adapted species as possible on a relatively small extension of land and for a multitude of purposes. Geetz (12) describes the "tiered" nature of tropical gardens which imitate the tropical forest as opposed to the single-tiered rice fields. Tropical gardens, roughly speaking, have a tall canopy of shade trees, followed by fruit trees of intermediate height, a yet lower tier of bushy growth, and finally ground-covering species (Figure 1). Layering is also found in temperate gardens –a fact which is usually overlooked– albeit to a less obvious extent. The temperate garden features well-spaced trees and bushes along borders, mainly with ground covering species unshaded (Figure 2). Shading, often a necessity in the tropics, is

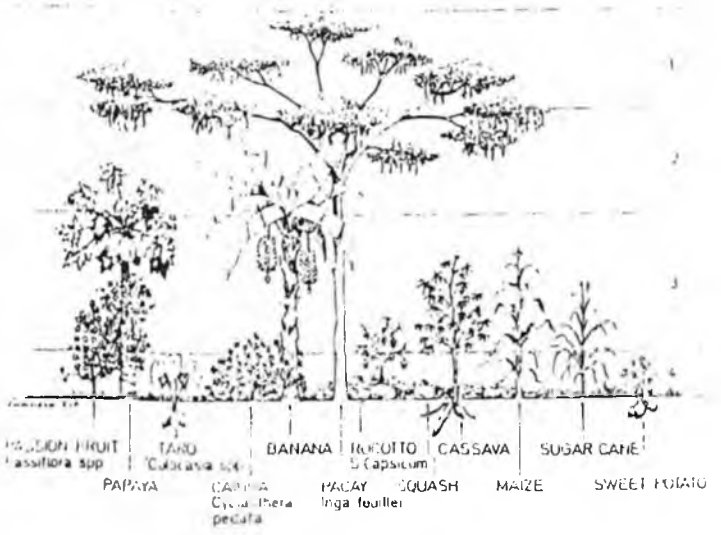

FIGURE 1

Ecological profile and production levels of HGs: Tropical

not always desired and could be inhibitive to growth in the sun-poor regions of the world.

Several micro-ecological considerations also determine spatial arrangements within garden boundaries. These are mutually inclusive and interdependent, and originate from the interaction of environment, garden infrastructure, and species variety. Not all of them can be observed in all gardens simultaneously due to the presence of other constraints. They should be regarded as guiding principles which influence decision making.

In traditional gardening situations, such considerations have become "folk" knowledge, and from childhood, those who actively assist in the garden production process, learn about intricate plant-environment relationships through first-hand experience. Gardens, moreover, "evolve" over years of usage rather than being non-alterable, static units; neither can they be changed –successfully– overnight.

1. *Micro-Niches*

Gardens essentially consist of a number of micro-niches created by differences in soil composition, micro-climates (e.g., exposure to the sun, shading plants), presence of other vegetation, water table, access to water, etc. The experienced gardener knows which micro-niche is best suited for a specific species and, other factors neutral, will choose the most appropriate micro-niche for any particular species. Thus, for temperate climate species like cabbages or lettuce, the tropical gardener –if production is at all attempted– will find a shady location, while in the northern hemisphere, sunny locations are preferred for nearly all vegetables. If the

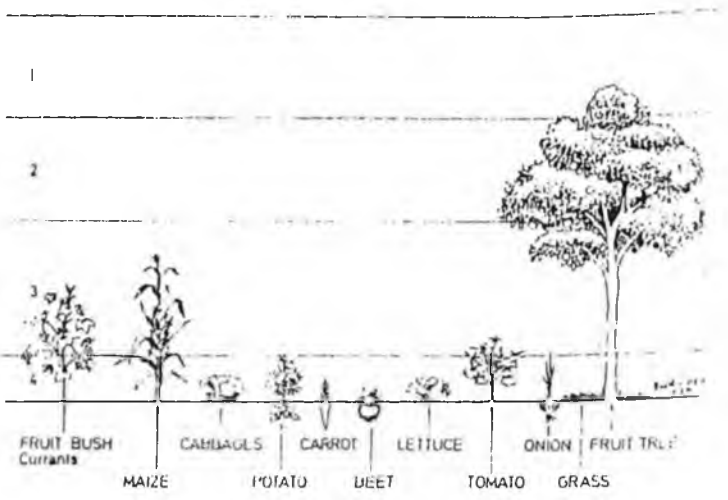

FIGURE 2

Ecological profile and production levels of HGs: Temperate

water requirement of a species is high, an attempt will be made to plant close to the water source. In water-logged areas with heavy soils, gardeners will labor to raise beds for better drainage.

Usually, all areas within the garden plot are under production, either in food or fodder species, or plants serving some household utilitarian purpose (e.g., maguey fiber serves to tie up marketable produce).

2. *Duration of Vegetative Cycle*

This is a major determining factor for species placement within household gardens. Species with long growing cycles (e.g., staples perennials) tend to be planted in outlying areas. Cassava, for example, is often planted as "living fence" around the garden, thus serving the dual purpose of production and protection [(13), p. 23]. Long-cycle species tend to have a lower moisture requirement than short-cycle crops (e.g., several irrigations per growing season versus daily-weekly watering). Also intercropping is more intense in fast-maturing species. With long-cycle crops (5 to 12 months, mainly garden staples), intercropping is practiced in overlapping fashion. In a potato plot, for instance, maize is planted at first hoeing of the potatoes, while the potato harvest provides the first hoeing for the maize.

Species with a shorter growing cycle and/or frequent harvesting require strategic locations relatively close to a water source and main paths for convenient access and timely cultivation and harvest. Short-cycle crops may be harvested and replanted one to several times over long-cycle species.

Also, the margins of any long- or short-cycle plant bed may be multicropped with short-term or perennial species which are frequently harvested (e.g., herbs, flowers, medicinal plants, winding and climbing species).

3. *Area Functions*

Garden areas are marked by frequency of use and type of function. Two general categories can be outlined: intensive-use (versus non intensive-use) and intensive-care (versus non intensive-care) areas. The intensive-use category corresponds to frequent harvesting and/or replanting (herbs, a few specimens of vegetables which are essential in daily meals, readily marketable species like herbs and flowers). Conversely, non intensive-use areas are those with long-cycle crops, or short-cycle crops which require little attention between planting and harvest.

Intensive-care beds are those destined for seedling production, as well as observation of "exotic" species and new varieties. Also, species specimens destined for seed production are transplanted to the intensive-care beds for protection. Intensive-care beds, thus, harbor the most crucial aspects of garden propagation (seed production, nurseries), and possible improvement and change (experimentation).

4. *Activity Areas*

On the basis of their multiple functions and requirements, household gardens can be divided into high, medium, and low-activity areas. These correspond to both the length of vegetative cycles and special function of beds, and are located in those garden areas satisfying best their special needs.

High-activity areas correspond to intensive-use beds, and, to a lesser degree, the intensive-care beds. They occupy favored locations in the garden, either in terms of soil quality, proximity to water source for more frequent watering, or proximity to the garden entrance for easy and quick access without disturbing other growth.

Medium-activity beds tend to be given to short-cycle vegetable species of which a greater variety is planted than of staple species albeit in smaller number (e.g., onions, celery, chard, cabbages, vegetable root crops, lettuce, etc.). These beds may be partially replanted during one growing season. The total area of medium-activity beds tends to occupy more garden space than the high-activity area, be located further from either water source or garden entrance, and feature good but not prime soil conditions.

Low-activity areas are the largest single or dual cropping areas in the garden, occupied by garden staples (roots and tubers, maize), beans (for grain), or, if soil conditions, topography, or other considerations necessitate, by fodder crops and/or trees. These, therefore, are located farthest from the garden entrance and are not usually visited every day.

5. *Nutrition Areas*

The preceding analysis of garden spatial arrangements shows that distinct areas within the garden furnish different types of produce. Based on area specialization in the garden, three major "nutrition areas" can be identified: garden staples (maize, starchy roots and tubers), leaf and (non-starchy) root vegetables, condiments and flowers, the latter two often serving a multiple purpose (ornament, medicinal, bee pasture).

V. ECONOMIC FUNCTION OF HOUSEHOLD GARDENS

In relationship to the economic base of a household, two basic types of gardens exist: subsistence, and budget.

1. *Subsistence Gardens*

These gardens exist in conjunction with permanent or shifting field production, and supplement field staples with vegetables, herbs, and fruit. They include farmyard and forest gardens as well as parts of fields frequently set aside for garden-type production. While the bulk of family caloric intake comes from agriculture, garden produce provides essential nutrients (vitamins and minerals) and protein on a daily basis. Animals are always part of this production system. They are fed on kitchen and garden waste, fodder crops, and leaves from shade trees. The subsistence garden also yields construction materials, firewood, and handicraft materials [cf. (6), p. 89]. When a farming system becomes highly commercialized, and the wider infrastructure is able to provide produce through accessible retail markets, household gardens tend to diminish in size and eventually turn into lawns or flower gardens (Table 1).

2. *Budget Gardens*

Two types of budget gardens can be identified: urban and rural.

The urban budget garden exists in a context where, theoretically, all family consumption needs can be met by retail markets. Basic staples are purchased and wage earning is the major (aspired or real) economic activity of the household. Animals are not necessarily part of this survival scheme but more often than not, animal production is attempted on a small scale for full utilization of garden waste and marginal areas.

The rural budget garden is part of a household economy which depends on city or rural employment, but remains physically located in the countryside. Due to this location, farm animals are usually found in this production unit.

Budget gardens are quite versatile and tend to reflect economic trends in the nation at large: as jobs are plentiful and well-paying in the urban context, budget gardens tend to change their appearance: vegetable and staple production yield to ornamentals with lawn area increasing in size as productive area decreases. This process if often reversed during inflationary periods when job-generated income is hard-pressed to meet all household needs.

VI. PROBLEMS OF DEFINITION

In order to define a given plot of cultivated land as garden rather than field or simply a "cultivated plot of land," certain basic guidelines need to be established. This problem of definition is greater in the rural than in the urban context.

In the urban context, a household garden is easily distinguished from a flower garden, a pleasure garden, or a park by virture of species types. In

TABLE 1

HOUSEHOLD GARDEN TYPOLOGY: PERU

Region	Type of farming system	Type of garden	Cultivators	Household crops and animals	
Coastal Valley (Cochahuasi)	commercial irrigated agriculture	rural budget	landless labor families	sweet potatoes variety of vegetables bananas	pigs chickens ducks cuy
Highland Valley (Llacsacaca)	commercial irrigated horticulture rain-fed agriculture	rural subsistence	highland peasant households	potatoes corn variety of vegetables fruit	cuy chickens rabbits cow sheep
Tropical Hill Zone (San Ramon)	plantation system	rural subsistence	highland colonist	cassava corn sweet potato pituca some vegetables	chickens cuy pigs pigeons
Urban Zone (Lima)	retail markets	urban budget	urban poor	sweet potato corn variety of vegetables some fruit	pigs chickens turkey rabbits cuy cow sheep goats

the rural sphere, however, variation in land utilization is much greater. How do we classify a small field, for example, which is multi-cropped for optimal utilization of land, located relatively close to the family dwelling, and shaded by a few eucaliptus trees? Or the rock-fenced Bhutanese village gardens which produce mainly hot chillies and mustard greens? The field of shifting cultivation systems is referred to in German as *Wandergarten* and shows a wide variety of species, one of the trade-marks of gardens. And what about the tiny patch of ground and "wall of squash" beside a Sri Lankan home?

Due to tremendous worldwide variation, a definition of household gardens has to be based on *major intended use and real function* of a given piece of land to distinguish clearly between household garden, market garden, and field agriculture as separate though complementing production systems.

No attempt at definition will be made here. Instead, Table 2 isolates importante *tendency characteristics* of household gardens opposed to tendencies in field and market garden production.

TABLE 2

TENDENCY CHARACTERISTICS OF SELECTION PRODUCTION SYSTEMS

Concept	Household garden	Market garden	Field agriculture
Species density	High	Medium to slow	Low
Species type	Staple, vegetable fruit (cultural)	Vegetable, fruit (market oriented)	Staple (subsistence agro-industrial)
Main production objective	Home consumption	Market sale	Subsistence, market sale
Labor source	Family (female, elderly, children)	Family or hired (male, female)	Family, hired (male, female)
Labor requirements	Part-time	Full-time	Full-time
Water requirements type	High-irrigation	High-irrigation	Med. to low/irrig. rain food
Harvest frequency	Daily, seasonal	(Short) seasonal	(Long) seasonal
Size of unit	Small (relative)	Medium to large	Medium to large
Space utilization	Horizontal, vertical	Horizontal, vertical	Horizontal
Fencing	Frequent	Less frequent	Limited
Location	Close to dwelling	Close to urban market	Rural setting, close or distant from homestead
Cropping patterns	Irregular, row	Row	Row
Economic role	Supplementary	Major economic activity	Major economic activity
Technology	Simple hand tool	Hand tool or mechanized	Mechanized if possible, hand tool
Inputs - cost	Low	Medium to high	Medium to high
Geographical distribution	Rural and urban	Sub-urban	Rural
Skills	Gardening-horticultural	Market-horticultural, fruticultural	Agricultural, commercial
Government assistance	None or minor	Credit	Credit, extension

Ruthenberg [(10), p. 104] distinguishes "garden cropping from... arable cropping by the following features which are usually but by no means in all cases, found simultaneolusy: 1) cropping those plants for personal consumption that cannot be collected nor supplied by arable farming, 2) small plots, 3) proximity to the house, 4) fencing, 5) mixed or dense planting of a great number of annual, semi-permanent, and perennial crops, 6) a high intensity of land use, 7) land cultivation several times a year, 8) permanence of cultivation, and 9) cultivation with hand implements."

VII. THE NUTRITIONAL FUNCTION OF HOUSEHOLD GARDENS

The major function of household gardens is to produce food and essential nutrients on a day-to-day basis for immediate family consumption.

A wide-spread misconception on household gardens is that they are in essence "vegetable" gardens, aiming at production of the green leafy component recommended by nutrition improvement programs the world over. It is believed that their inherent function is to furnish "nutrition" rather than "food". One closer look at "native" gardens, however, presents a different reality. Gardens among developing countries' poorer social strata feature a larger absolute amount of garden staples. Leaf vegetables in these indigenous gardens are restricted to those species which are known to be well adapted to ecological conditions, and fit traditional diets and cultural food preferences. The overwhelming importance of garden staples to low-income families testifies to the fact that people anywhere are primarily concerned with producing "food", with "nutrition" relegated to second place.

This is not to say, however, that a chronic imbalance exists in indigenous dietary adaptations due to the absence of vegetables as known in European or North American gardens. In the case of Peru, for example, an analysis of the "traditional"diet of Andean tubers including potatoes, the Andean pseudograins, collection of semi-domesticated and wild vegetable plants, and occasional consumption of animal protein combine into a well-balanced diet.

Traditional diets evolve over centuries of adaptation. When they are suddenly disturbed, a situation of nutritional imbalance is likely to result. Principal causes for such disruption are 1) discontinuing traditional field production of a variety of highly nutritious staples in favor of cash crop production; 2) an increased reliance on one or two purchased staples, neglecting the collection of indigenous vegetables, and 3) developing a dependence on non-native vegetables produced commercially at high cost.

In rural subsistence gardens, where the majority of staples is derived from field agriculture, garden staples have several important functions. They 1) offer a ready-at-hand convenient supply of basic meal ingredients on a daily basis; 2) help bridge the supply gap in field production between end of storable period and new harvest, and 3) bring cash on local markets.

Garden production of staples in the urban context serves to supplement market-derived staples. They represent a sure source of calories, however small, for the family to fall back on. The most common urban garden staples in Peru are sweet potato and maize, serving both human and animal nutrition.

Although calorie-wise, staples rate highest, it is the nutritional value of leafy and leguminous vegetables which makes household gardens an invaluable companion to field agriculture and city wage earning. Not only are leafy vegetables "... excellent sources of vitamins, particularly niacin, riboflavin, thiamine, ...vitamins A and C, ...as well as calcium and iron". They function in achieving a more favorable vegetable protein balance, as for example in the meat-poor, grain-based diets of the Central American region |(14), p. 12|.

In rural Guatemala, "...a common food... is lime-treated maize dough

in the shape of a ball containing *chipilín (Crotalaria longirostrata)* which... contains a high amount of lysine, the amino acid limiting maize protein quality" [(14), p. 13].

A nutritional rating of seven vegetables consumed in Guatemala lists *Crotalaria* highest in protein content *(ibid).* Another testimony on the high nutritive value of native vegetables comes from the Peruvian highlands. Atúnez de Mayolo (7) cites the case of *cusburu* (unindentified) an Adean species which

> ... in fresh state contains 92 per cent water; upon dehydration, this is reduced to 15 per cent of moisture, and its caloric content of 25 Kcal increases to 248 Kcal with 29o/o protein, 46o/o carbohydrates, 1o/o sodium, .45o/o potassium, .06o/o phosphorus, .14o/o calcium, and .08o/o iron.
>
> [(7), p. 76]

In an experiment conducted by the Asian Vegetable Research and Development Center (AVRDC), the harvests of four model home gardens have shown that gardens can produce a daily average of 25.3o/o measurable protein, 74.8o/o calcium, 112.6o/o iron, 182.7o/o vitamin A, and 524.9o/o vitamin C of the daily total RDA of a family of five. The average edible daily garden yield was 1.66 kg of vegetable and fruit matter per garden which

> ... was more than would be consumed by the average Asian family of five.
>
> [(13), p. 29]

Often overlooked is the nutritional contribution of herb species and spice vegetables. Even small household gardens feature an easy-access area with spice and medicinal herbs. These are harvested on a daily basis to add flavor and vitamins to the family diet and are also highly sellable market items. Also extremely valuable source of micro-nutrients are fruit trees which are present in the majority of gardens.

Next in line of importance to supplying food for the family, primary and secondary fodder for an often sizable number of small farm animals comes from the garden. Primary fodder in Peru, for example, consists of alfalfa, barley, native grasses, and weeds which are grown or tolerated in marginal garden areas and harvested as needed. Secondary fodder derives from produce cleaned for home use or market sale.

Small animal production (rabbits, guinea pigs, fowl, pigs) is an integral aspect of household garden economies except where external limiting factors exist (e.g., regulations in the urban context against raising animals). Although the consumption of animal protein is reserved for special occasions among the poor in developing countries, it is a vital ingredient in the diet with underlying social significance: animals are slaughtered for large family gatherings at birthdays and holidays. Few large animals (sheep, goats, a cow/calf pair) are pastured on agriculturally marginal lands under the care of women or children and older family members.

One animal species especially well adapted to the Peruvian household economy is the guinea pig, or *cuy,* as it is called onomatopeically in Quechua.

Originally a highland dweller, the *cuy* has migrated –along with the peasants– to every ecological zone within Peru. Its reputation remains that of a "typical" *serrano* (highlander) with negative connotations from ignorant, poor and lacking in prestige. Nonetheless, whether *costa, sierra,* or *selva* (coast, highlands, or jungle), the guinea pig is the poor man's protein.

Cuyes have been raised by Andean peasant women for generations untold. Free roaming in the kitchen area, they find warmth and shelter beneath the clay hearth, a traditional feature of any highland peasant kitchen. In contrast to rabbits, *cuyes* don't gnaw, burrow, or stray. Labor-saving in every respect, the *cuyes* feed themselves on whatever they find at nose-level: alfalfa, potato peels, an occasional corn cob, vegetable waste, leaves, weeds, and banana peels. (In short, the *cuy* is a better garbage disposal than GE will ever produce!).

Food conversion rate of *cuyes* is approximately eight to one kg, while that of rabbits, the larger, "modern" competitor for the same niche in household economies, is three to one, approximately, but on higher quality feed.

Cuy reproduction is as trouble-free as their housing and feeding. After a gestation period double that of rabbits, two (in rare cases three to four) young are born, "ready-to-go." While baby rabbits are totally nest-bound for two weeks, and losses are high, newborn *cuyes* are highly mobile. Sexual maturation is between four to five months, when the seasons "crop" of *cuy* begins to be harvested for market or home consumption.

About 15 females and two males are kept by most families for constant reproduction and supply. These females can produce between 35 and 50 young per year. Andean women mention 10 to 15 animals as the number often prepared for festive occasions, averaging 1/2 *cuy* per person (per meal). A skinned and gutted *cuy* less than a year old will not weigh over 800 grams, yielding approximately 200 g of high-quality protein (30 g per 100 body weight, with 20o/o bone).

This amount may not appear significant in terms of human nutrition. Nevertheless, in light of the on-going shift in Peruvian diets from Andean grains (quinoa, canihua, amaranth) and tubers to imported white polished rice and wheat products, the *cuy* (as well as the occasional old hen) makes a significant contribution to family diets in the absence of more economical sources of high-quality protein: *cuy* production cost is practically nil in terms of labor and energy inputs.

This is precisely the reason why the *cuy* is such an important component of Peruvian lower class household economics. Production cost is low enough to *make its consumption affordable to producers* while rendering it a low-prestige food on the wider urban markets (as opposed to rabbit, chicken/eggs, milk/milk products which contribute cash but not nutrition to the producing household).

VIII. CASH FROM THE GARDEN

In addition to supplying vital nutrition, the garden may also insure a cash flow, however small, through sale of produce or animals, animal products in local markets, or to neighbors. Although rural women's

weekly trip to the market may not be "economically justifiable" in terms of time invested (RFR 1982:68), the money earned is vital to low-cash household economies for purchase of essential food and non-food items. The household garden has one big advantage over field production in that "... there is always something ready to harvest from the former and therefore something to sell when money for daily household needs becomes scarce" (15).

Most rural women carry produce to market on a regular basis. Market sales often represent their only direct access to cash[3]. Marketed produce varies according to location, season, family needs and cash requirements, and garden and animal productivity. Amounts tend to be small and reflect garden species diversity. Thus, peasant women, as opposed to the *revendedoras* (female middlemen), occupy marginal side streets to offer their goods. A "standard" combination of garden produce at the Peruvian market of Tarma, for example, consists of vegetables, garden staples, herbs, flowers, and, less commonly, fruit. Field products are added as need for cash arises or storability decreases. Most animals and animal derivatives are produced for sale, and eggs, milk products, and honey, are sold as quantity accumulated justifies.

Therefore, to a considerable degree, the cash available to women for household needs depends on their management and marketing skills, as well as the degree of productivity to which they utilize their gardens.

IX. COMPARATIVE ANALYSIS OF HOUSEHOLD GARDENS AND SMALL ANIMAL PRODUCTION IN PERU

Peru represents an ideal laboratory for the study of household gardens and related small-scale subsistence food production systems. Peru is divided into three major ecological zones running North - South: the desert coast, the Andes rising steeply in the West with intermontane valleys, descending more gently in the East via the piedmonte of the *montaña* (tropical hill zone), into the hot humid Amazon basin (Figure 2).

Household gardens are found in all three zones. However, while functioning in the same supplemental capacity, they vary in appearance and type of cultigens according to ecological conditions. The following section illustrates, in a summarized fashion, the role of household gardens and small animal production in Peruvian coastal, highland, and jungle settings, and the larger metropolitan area of Lima.

1. *The Rural Budget Garden: An Example from the Peruvian Coast*

On the desert coast, gardens form part of irrigated oasis farming devoted to commercial field production. They exist with small-holder commercial, cooperative member, or landless laborer household economies.

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3 Field production is sold large-scale by males, either in the market place or right out of the field to wholesalers. These earnings are used to pay off the bank loan with which the field was planted.

The gardens described here belong to the rural budget type and are located in Cochahuasi, a seaside settlement of landless farm laborers. The inhabitants of Cochahuasi have reclaimed a low-lying, narrow, waterlogged strip of land, situated between the margins of agricultural production and the beach, over many years of hard labor. Today, the gardens contain a variety of tree and vegetable species relatively tolerant to the unfavorable growing conditions of saline soils and constant sea breeze. Irregularity of agricultural employment makes small-scale supplemental vegetable and animal production essential to the survival of Cochahuasi families.

Each garden plot measures approximately 20 by 30 meters, is rock-fenced, and contains a ground-level water hole for irrigation and family drinking water. The main staple is sweet potato, which represents the largest area planted. Sweet potato is also the most versatile crop, serving family caloric needs and nutrition, as well as feeding the backyard animals each family keeps: sweet potato leaves are finely chopped for chickens and ducks and fed to guinea pigs, rabbits, sheep, pigs, the occasional cow, and transportation animals like donkeys. Banana, the tree crop that tolerates seaside conditions best, also is a major staple in the family diet. Maize is grown on a smaller scale.

Due to periodic inundations these gardens face from irrigation run-off of neighboring fields, many women opt to plant fast-maturing vegetables which can be consumed by the family and have constant market value rather than risking loss of the entire garden crop. The most important tree crop for family nutrition, banana, is represented by several varieties. Vegetables consist of cabbage, cauliflower, celery (a favorite, fast-maturing crop), beets, turnips, herbs, and flowers.

2. *Llacsacaca: The Rural Subsistence Garden*

At an altitude of 3,000 meters, the subsistence gardens of Llacsacaca, located in the fertile Tarma river valley, form an integral part of local farming systems. Irrigation and the mild climate of the valley which opens toward the eastern foothills, allow year-round commercial horticultural production. At higher altitudes, seasonal rain-fed subsistence and commercial agriculture is practiced. Commercial agriculture is oriented toward the coastal market of Lima; subsistence production, toward home consumption and local markets.

Holdings of Llacsacaca farmers are small, with scattered fields totalling on the average 5,000 m^2. Gardens average approximately 600 m^2 in size. Due to the favored nature of the Tarma valley, a variety of vegetables can be produced, ranging from temperate to tropical hill zone species as well as spices, medicinal herbs, and flowers. Trees are planted along the edges of the garden and fruit is a cherished item valued highly for sale and barter. Field-grown vegetables are duplicated in most gardens. They represent "European" species serving both home consumption and market sales (Figure 3).

Although subsistence crops are produced in the high fields, garden staples (potato and maize) occupy the largest garden area. They are multi-cropped in staggered plantings and serve to bridge the gap between end of storable period and new harvest of field staples. If need for cash arises, staples are taken to market in small amounts.

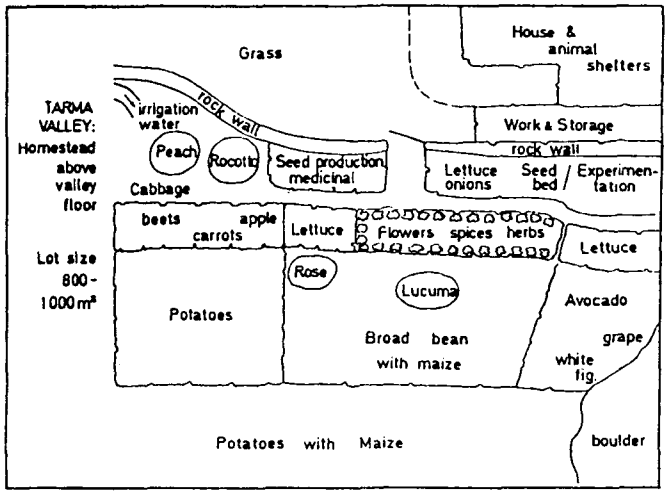

FIGURE 3

Spatial arrangements in HGs

While "modern" horticultural crops and staples occupy the central garden area, native tubers and vegetables are grown along margins (e.g., *Caihua* a Cucurbitacea, small non-starchy roots and tubers, wild mustard and garlic) where they require little care. Also, gathering of semi-domesticated vegetables in fields is practiced to seasonally supplement staples[4]. Generally speaking, neither household budget nor family diet receives any benefit from commercial field produce. Profits from commercial sales go mainly toward repayment of planting loans. Often, little cash is left over for day-to-day family needs. Such small amounts of cash required on a weekly basis are largely derived from selling garden and animal products on the local market (in this case, Tarma).

Animals are vital in highland farming systems, providing traction and supplementing the family diet with valued animal protein and cash income, while enabling the household to fully utilize garden waste and by-products as well as marginal grazing and collected fodder species. The most frequent farmyard animals are guinea pigs, rabbits, and chickens which provide the bulk of family protein consumption. Sheep and cow-calf pairs represent an investment and source of income for the female head of household rather than a ready source of protein for the family.

4 The use of herbicides in agricultural and horticultural fields is detrimental to rural nutrition where collection of highly nutritious volunteer plants is common. Wild mustard, for example, "appears" with both potatoes and maize.

3. *Household Gardens at Higher Altitudes*

It appears that in the higher altitudinal zones, where commercial vegetable production is not a profitable undertaking due to infrastructural or climatic constraints, home vegetable production and consumption is less frequent while the notion of flower gardens seems to be well known. The causes for this phenomenon are not clear. Evolution of agricultural society did not take place to the total exclusion of previously practiced gathering of wild species. Rather, gathering had remained a vital part of traditional Andean diets until recently. With the arrival of Europeans, however, alien food plant species were introduced, and the native dietary balance became disrupted as more land was planted with European grains and pet into pasture for European-introduced grazing animals. Also, a low-prestige value became associated with native foods, and, while collection of medicinal species continued, wild vegetable gathering decreased with no replacement filling the nutritional void (7). More research, however, is needed to explain the apparent lack of household gardens in the high Andes.

4. *Rural Subsistence Gardens in the Peruvian Tropics: Chanchamayo and Yurimaguas*

As case studies of gardens in the tropical hill zone and the lowland humid tropics, the Chanchamayo-San Ramón and Yurimaguas regions were selected. Both are areas of colonization with agricultural bases in subsistence crops, commercial rice production (Yurimaguas), and plantation fruit and coffee production (Chanchamayo) (Figure 4).

The tropical household garden in both areas is part of a semi-permanent system of shifting cultivation. While subsistence fields are fallowed every three to seven years, hut and gardens are not shifted except in cases of moving the entire household. Likewise, orchards with tropical fruit, coffee, and pineapple groves in the Chanchamayo and wet rice fields on the banks of the Huallaga river are not moved. To keep up production, trees are replaced while river flooding provides fertilization for rice. Upland dry-rice plots are shifted on a regular basis.

In addition to subsistence and commercial fields and orchards, each homestead has a number of food plant species growing in the immediate vicinity of the hut which are harvested daily. The arrangement of these gardens appears haphazard to the western eye, but on closer scrutiny proves extremely functional. Only species well-adapted to the tropical environment are found and the layered effect of the natural forest is replicated utilizing plant adaptations to the fullest. The top "layer" provides shade for the entire homestead and consists of well-spaced *pacay (Inga feuillei)* and avocado trees which also furnish nutrition and calories. In the second layer, family staples are grown (tree staples are banana and plantain). Maize, cassava, are staples comprising the third layer. They lend support to beans, squash which represent the lowest.... together with tomato, taro, and squashes.

Farmyard animals accompanying this tropical production system are chickens, ducks, pigeons, and pigs. To protect garden crops, pigs are tethered or herded, usually the job of children, or gardens are fenced, or

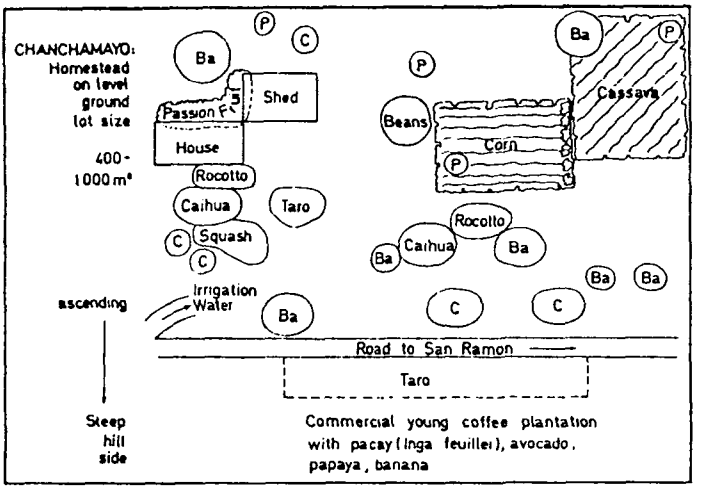

FIGURE 4

Spacial arrangements in HGs

moved some distance from the house. A family may keep up to 25 chickens and five pigs, including young. As is the case in the highland garden, small-scale animal production in the lowland tropics represents fullest utilization of the environment. Where animals can be allowed to roam adjacent forest areas in search of food, pressure is relieved on family food supply, a labor while adding scarce protein to diets. In the tropical setting above all, subsistence food production close to the house forms the base of settler existence, while income from commercial production is often oriented toward a small business enterprise (e.g., a truck).

5. *Urban Budget Gardens: Food Production in Lima Slums*

The household gardens of Lima are more varied in appearance than their rural counterparts, and the problem of defining a given plot of land close to a dwelling as a garden arises.

Urban gardens are found mainly in the poorer sectors and slum suburbs where people have access to water. They range in size from several square meters to an entire construction lot in an affluent area of almost 1,000 m^2. Gardens in the wealthier suburbs belong to families living as "watchmen" (guards) on future construction sites. The urban garden produces a wide range of temperate and tropical staples, fruits, and vegetables (cf. Table 1). According to one informant, a 400 m^2 lot of sweet potato furnishes 60o/o of the requirement for a family of two adults and three children, as well as providing 100o/o of the feed required for eight chickens, 15 guinea pigs, and two adult rabbits.

Sweet potato is the main crop in Lima urban gardens, followed by maize, banana, and cassava. Banana and papaya are predominant fruit

tree especies. The presence of leafy or fruit vegetables varies from garden to garden. If the garden is large enough, and gardening skill experience as well as time is available on part of the gardener, "urban" vegetables also are planted for small-scale sales in the neighborhood (e.g., carrots, beets, lettuce, and chard) over family consumption needs and habits. Urban gardens are not compatible to uncontrolled animal browsing for that reasons, and stalls are provided even for poultry. The garden represented schematically in Figure 5 supplies the immediate family living there, as well as relatives, with considerable portions of their nutritional needs. A sample of 76 Lima gardens studied show that they provide roughly 12o/o of a family's food needs (16).

In its ideal form, urban gardening is supplemental to city employment which provides the major source of family income. In many LDC urban contexts, however, employment is erratic and badly remunerated, or simply non-existent. A well-managed sizable garden or suburban field plot with additional small farm animal production often provides for many urban households a larger share of family sustenance than income from urban employment.

In Lima, many cases can be documented for city slum dwellers that have access to a marginal piece of land (neglected city parks, lee-way between housing developments and highway, along irrigation canals, etc.). This provides, in fact, the only means of putting food on the family table. In cases where city employment is part of the survival strategy, household gardens serve to supplement a high carbohydrate diet (Peru relies heavily on subsidized US rice and wheat), with valuable nutrients derived from homegrown vegetables which, otherwise, would not be purchased on the meager family budget. The production of animals in this survival system

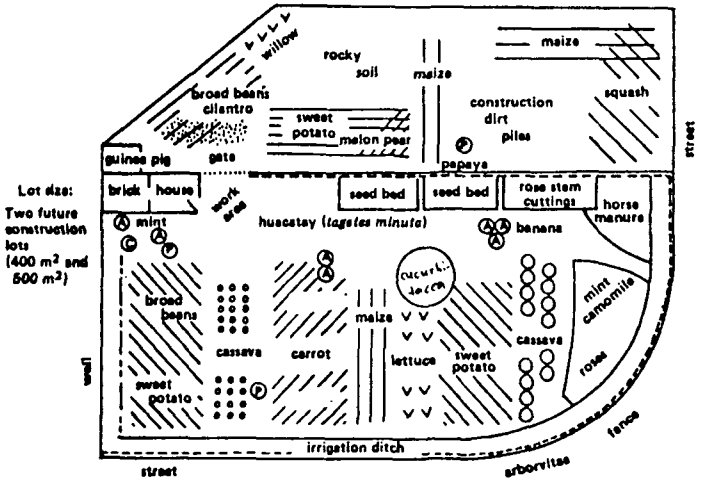

FIGURE 5

Peruvian "Native" garden (Lima) tropical - urban

adds probably the scarcest food resource –animal protein– to low-income urban households' diets.

CONCLUSION

In order to holistically understand a farming household, it is essential to consider all units of production comprising the household economy. The household garden production unit has traditionally been neglected by developers concerned with increasing world food output and improving family nutritional standing. Especially in poor countries, household-level food production can be essential in providing high-quality carbohydrates and micro-nutrients which cannot be purchased by low-income families.

Therefore, it seems a sad irony that it is precisely the hidden but rudimentary function of supplying food and nutrition direct to the family, at low cost, on marginal lands, with marginal labor, but not accounted for in government statistics, which has placed household gardens in poor standing with development programs.

Although this paper offers no quantified production data, its intent is to move household food production in its proper perspective as a valuable resource for low-income families in a variety of rural and urban settings. It also offers policy makers a theoretical guideline by which to orient future small-scale food production projects at the household level.

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