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14
The Complementary Roles of Homegardens, Upland Fields, and Rice Fields for Meeting Nutritional Needs in West Java

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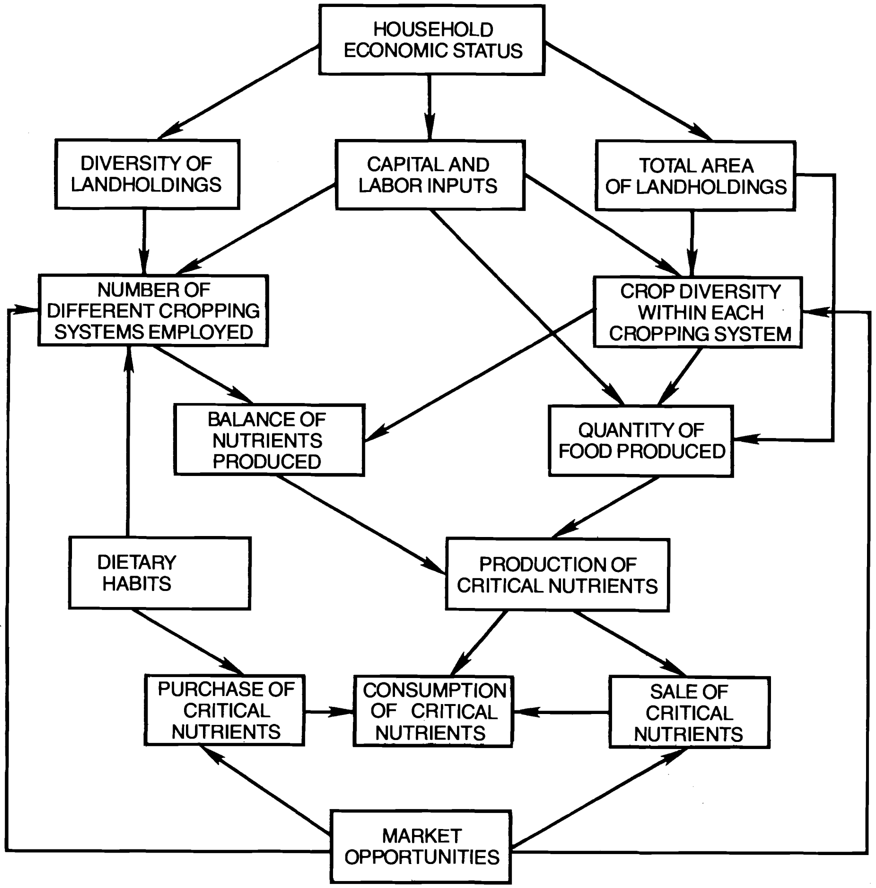
The prevailing trend in Southeast Asia is from traditional, subsistence agriculture, based on a diversity of crops for meeting a diversity of household needs, to a market-oriented agriculture based on fewer crops to take advantage of market opportunities. What are the nutritional consequences of these changes? Agroecosystem analysis with a human ecology perpective can help to answer this question. By way of the interactions between social factors and cropping system structure outlined in Figure 14.1 it is possible to trace the impact of changes in human population density, social stratification, dietary habits, and market opportunities upon human nutrition. This chapter describes food production in the sophisticated mixed cropping agriculture of Java, where the population density is high, individual landholdings are small, and food production must therefore be highly efficient. The chapter is based on a field survey conducted in the Jatigede area of West Java (Figure 14.2). The survey has been described in detail by Abdoellah et al. (1982) and Abdoellah and Marten (1985).

Most food production in the Jatigede area occurs in three agricultural systems: (1) homegardens *(pekarangan)*, (2) upland fields *(kebun, huma, talun)*, and (3) rice fields *(sawah)*. Figure 14.3 shows the typical location of these agricultural systems in a landscape profile, and Table 14.1 shows the average amounts of land that are farmed. Irrigated rice fields are generally planted continuously to rice, but rainfed rice fields can be planted to rice only once each year and are planted to tobacco, beans, or vegetables the rest of the year. Homegardens and upland fields have already been described in Chapter 6. As various crops have different proportions of nutrients (e.g., calories, vitamins, minerals, amino acids), it has been most effective for subsistence households to employ a mix of crops to meet their nutritional needs. This

Figure 14.1. Interacting Factors That Influence the Nutrient Consumption of Small-Scale Farming Households



is achieved not only by mixing different crops in a single field but also by employing agricultural systems that complement one another nutritionally.

RESEARCH METHODS

The field survey consisted of a random sample of 148 village households. Information on household food consumption was based on 24-hour recall of consumption by each family member. Interview information on crop production during the previous year was tabulated for each household's homegarden, upland field, and rice field. All crops and other plants in the homegarden of every household were enumerated by direct observation.

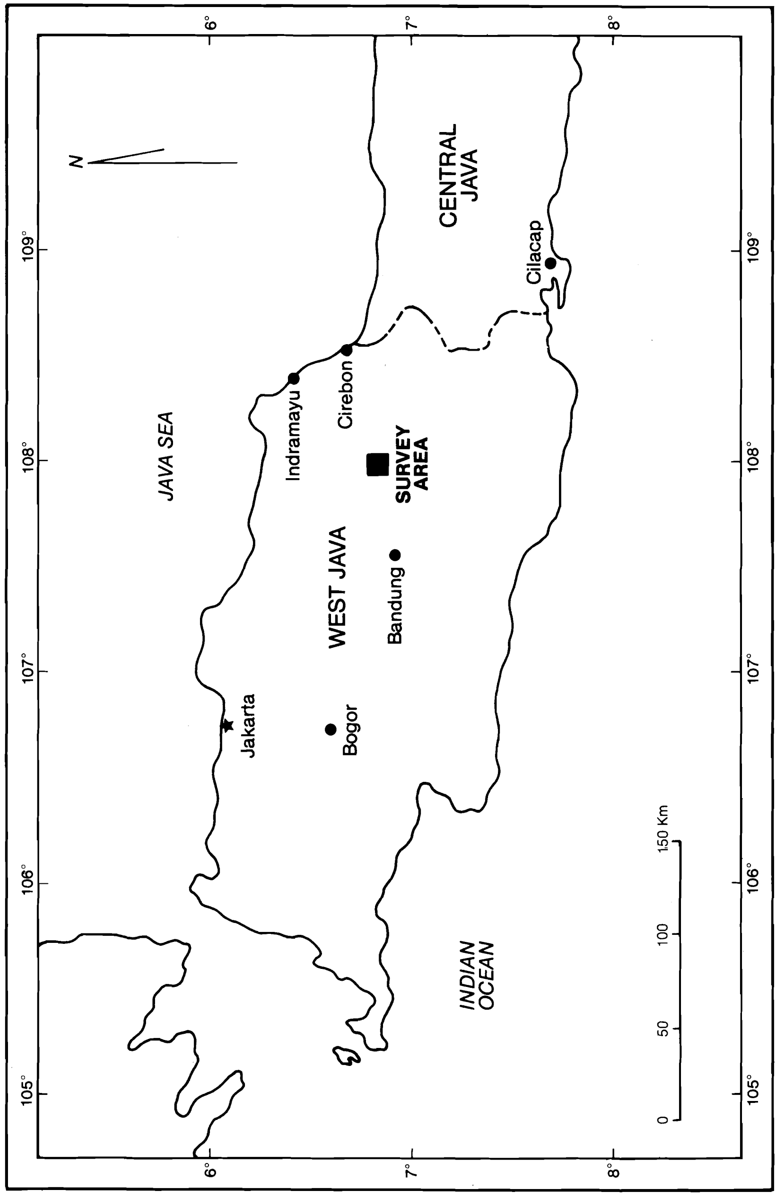


Figure 14.2. Location of the Jatigede Field Survey in West Java

The quantity of calories, protein, vitamins, minerals, and amino acids produced in each of the three agricultural systems (homegarden, upland field, and rice field) was calculated for each household by using food composition tables (Direktorat Gizi Departemen Kesehatan 1967) to sum the nutrient content of all crops produced in each agricultural system. The consumption of nutrients was calculated in a similar fashion, based on all sources of food consumed as tabulated in twenty-four hours and recalled by household members. Consumption and production of each of the nutrients was then compared with the household's nutritional requirements, based on minimum daily requirements for each family member according to sex and age. It is recognized that minimum daily requirements are not absolute, but they should at least assist in identifying nutrients that are in seriously short supply.

The households were divided into two groups: poor and well-off (Table 14.1). A family was considered to be well-off if its total income from all sources—including off-farm income, income from sale of farm produce, and the value of crops retained for home consumption—was greater than 70,000 rupiah per capita per year. About 25 percent of the households in the survey were poor by this measure. In addition, the survey was divided into two areas, one within 5 km of a market town and the other farther than 5 km from a market town. The purpose of the two areas was to see if market opportunities had an impact on the crops that were grown and the extent to which they were retained for home consumption or sold for market.

To evaluate the effectiveness of existing cropping systems in the Jatigede area, we asked the question, "What mix of crops can meet all nutritional needs with the least amount of land?" This question can be framed as a formal optimization problem, where the optimal crop mix is expressed as x_i, the amount of land devoted to the ith crop:

$$\text{Minimize } \sum_i x_i$$

subject to the constraints

$$x_i \geq 0$$

$$\sum_i c_{ij} x_i \geq y_j$$

y_j = household requirement for the jth nutrient

c_{ij} = production efficiency of the jth nutrient by the ith crop.

Details of the optimization methodology have been described by Marten (1984). In brief, household nutrient requirements (y_j) were based on standard Indonesian and World Health Organization tables, and coefficients for the production efficiency (c_{ij}) of each crop were estimates for the production of each nutrient per unit area of land. Coefficients (c_{ij}) for the calories,

Figure 14.3. Typical Position of the Three Agricultural Systems in a Landscape Profile

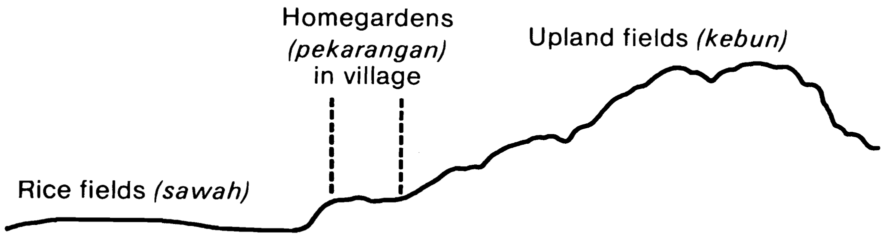


Table 14.1. Landholdings, Crop Diversity, and Income Characteristics of Households in the Survey

	Poor		Well-off	
	Near Market	Far from Market	Near Market	Far from Market
Percentage of households with homegardens	97	100	99	97
Percentage of households with upland fields	57	89	82	97
Percentage of households with rice fields	73	100	91	97
Average size of homegardens (m^2)[a]	223	297	417	394
Average size of upland fields (m^2)[a]	1,120	2,604	3,995	7,174
Average size of rice fields (m^2)[a]	2,050	2,426	6,853	5,240
Total area farmed (m^2)	2,254	5,037	9,962	12,366
Average number of plant species in homegardens	14.3	20.4	20.0	21.9
Average number of plant species in upland fields	4.1	10.8	10.7	11.4
Average annual cost of farm inputs (X1,000 rupiah)[b]	48	78	156	223
Average annual gross farm income (X1,000 rupiah)[b]	114	143	654	508
Average annual off-farm income (X1,000 rupiah)[b]	108	103	550	236
Average family size	4.6	4.8	4.9	3.9

[a] Average based only upon households having that agricultural system.

[b] One U.S. dollar = approximately 670 rupiah.

Table 14.2. Production Efficiencies (c_{ij}) of Major Crop Groups (Expressed as the Quantity of Calories and Nutrients They Produce per Unit Area of Land)

	Calories	Protein Thiamine Niacin	Vitamin A Iron Calcium	Riboflavin Vitamin C
Root crops	Very high	High	Medium-high	High
Legumes	Medium-high	Very high	Medium-high[a]	High[b]
Rice	High	High	Low	Low
Corn	Medium	Medium	Low	Low
Green leafy vegetables	Low-medium	Medium-high	Very high	High-very high
Other vegetables	Medium	Medium	Medium[a]	Medium-high
Fruit	Low-medium	Low	Low-medium[a]	Low-high

[a] Vitamin A variable (very high in yellow fruits and vegetables but low or absent in some fruits, legumes, and other vegetables).

[b] Riboflavin high but vitamin C low or absent in most legumes.

protein, vitamins, minerals, and amino acids produced by sixty-five Javanese crops were based on (1) estimates of typical yields and (2) nutrient contents listed in standard food composition tables (Direktorat Gizi Departemen Kesehatan 1967). Typical production efficiencies of the major crop groups are summarized in Table 14.2.

IDENTIFICATION OF CRITICAL NUTRIENTS

Figure 14.4 shows the average quantity of nutrients consumed in the Jatigede area. Well-off households consumed all nutrients (except vitamin A and calcium) in somewhat larger quantities than the poor, but the general pattern of consumption was similar for both categories of households. Thiamine, niacin, vitamin C, and the amino acids (except methionine) were consumed in more than adequate amounts, while protein and vitamin A were consumed in lesser, though apparently adequate, amounts. Although well-off households consumed sufficient quantities of calories, this was not the case for poor households, and poor households were slightly low for methionine. Both categories of households were deficient in their consumption of iron, calcium, and riboflavin.

Well-off households were providing a greater quantity of their nutrients from food they grew themselves. Although well-off households also consumed more of some nutrients (e.g., protein, amino acids, and vitamin C) from purchased food, poor households consumed as much or more of other

Figure 14.4. Average Nutrient Consumption with Regard to Economic Status and Market Involvement

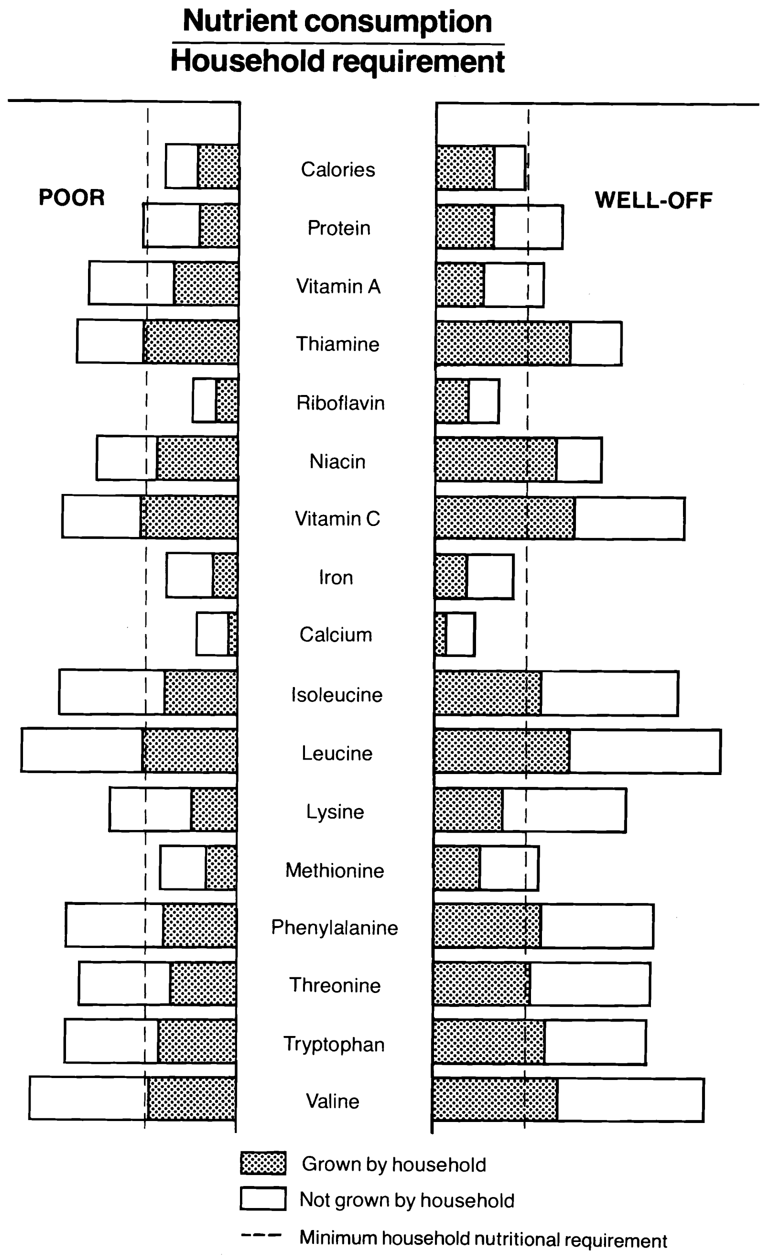
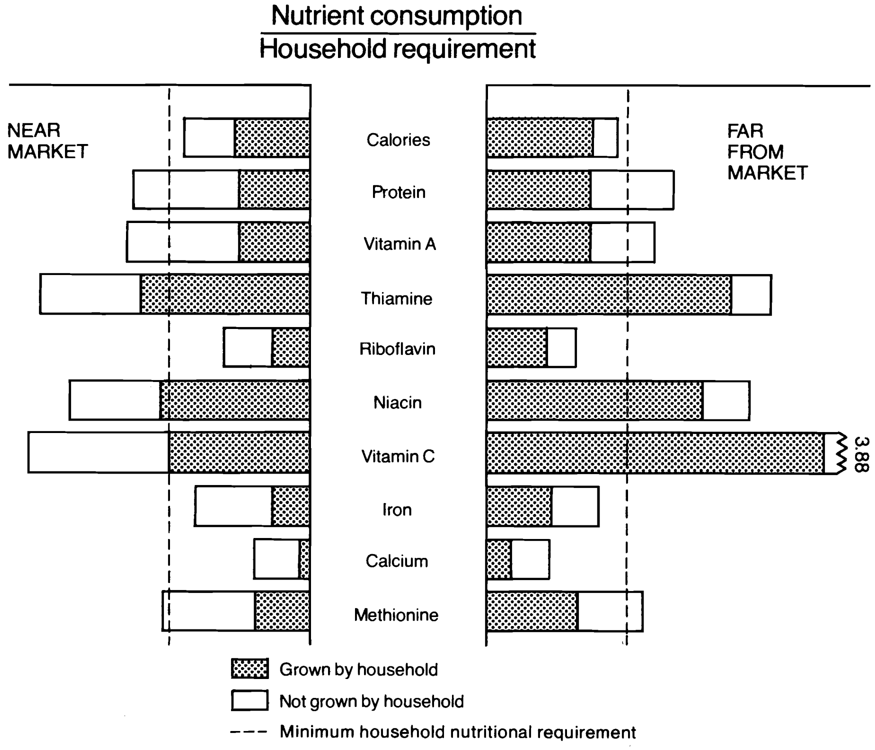


Figure 14.4. *(continued)*



nutrients from purchased foods, thereby tending (with the exception of calories) to compensate for deficiencies in what they consumed from their own production.

Animal products made a significant contribution to the protein intake, particularly for well-off households (Table 14.3). The higher consumption of animal products by well-off households is particularly conspicuous in the case of poultry and meat (the poor consuming no meat whatsoever). Fish provided a significant quantity of calcium for the poor in the form of small bones. There was a difference in the consumption of animal products with regard to proximity to a market town. Households near a market consumed somewhat more animal products than those far from a market. The difference was due to poultry and meat (those far from a market consuming no meat); households far from a market consumed slightly more fish than those near one.

NUTRIENT PRODUCTION

The general pattern of annual nutrient production (Figure 14.5) was similar to the pattern of nutrient consumption in Figure 14.4. Figure 14.5

Table 14.3. Nutrients Consumed Through Animal Products (Expressed as a Percentage of Household Nutrient Requirement)

	Poor				Well-off			
	Fish	Meat	Poultry	Total	Fish	Meat	Poultry	Total
Calories	2	0	1	3	3	1	3	7
Protein	16	0	3	19	25	4	10	39
Vitamin A	1	0	2	3	1	13	8	22
Thiamine	2	0	1	3	3	1	4	8
Riboflavin	4	0	2	6	6	3	8	17
Niacin	11	0	2	13	9	3	8	20
Vitamin C	0	0	0	0	0	1	0	1
Calcium	15	0	1	16	7	0	2	9
Iron	5	0	2	7	7	3	5	15

shows that thiamine, niacin, vitamin C, and most of the amino acids were produced in relatively large amounts compared with nutritional needs, while calcium, riboflavin, iron, and vitamin A were produced in smaller amounts. The well-off people produced large surpluses of all nutrients except vitamin A and calcium, whereas the poor produced insufficient or barely sufficient amounts of many nutrients. The poor produced and retained for household consumption sufficient amounts of thiamine, niacin, vitamin C, and most amino acids to satisfy nutritional needs, but the production of a number of other nutrients was distinctly short of their needs. Most conspicuous was calcium, but the poor also produced vitamin A, riboflavin, iron, and methionine in short supply, and calories, total protein, and lysine were produced in barely adequate amounts.

The particular strengths of each agricultural system are reflected by their production of different nutrients on a square meter basis (Figure 14.6). For example, the production of calories, protein, and amino acids per square meter was five times greater in the year-round-irrigated rice fields than in the rainfed homegardens and upland fields. Rice field production of riboflavin and iron was only twice as great as the other two agricultural systems. At the other extreme, rice fields produced only a small quantity of calcium, vitamin A, and vitamin C compared with the other two systems, with homegardens producing substantially more vitamin A per square meter than the other systems. The three agricultural systems complemented one another in the total quantities of nutrients they contributed to an average household nutrient budget. Rice dominated the diet, but homegardens and upland fields provided the major portion of nutrients (e.g., vitamin C, vitamin A, and calcium) for which rice is weak.

Cash was an important agricultural product, one that could be used to purchase food, among other things. The value of production per unit area was considerably greater from rice fields and well-off homegardens than

Figure 14.5. Average Nutrient Production by Poor and Well-Off Households

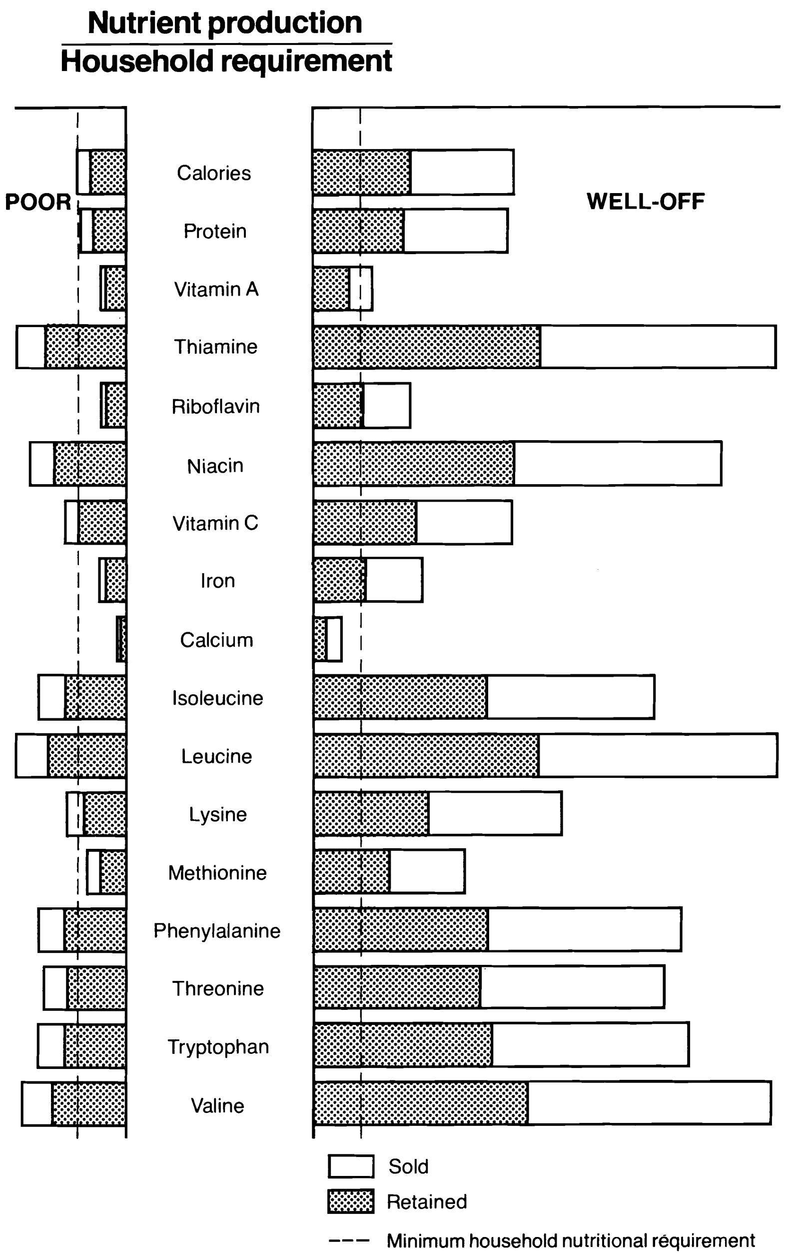
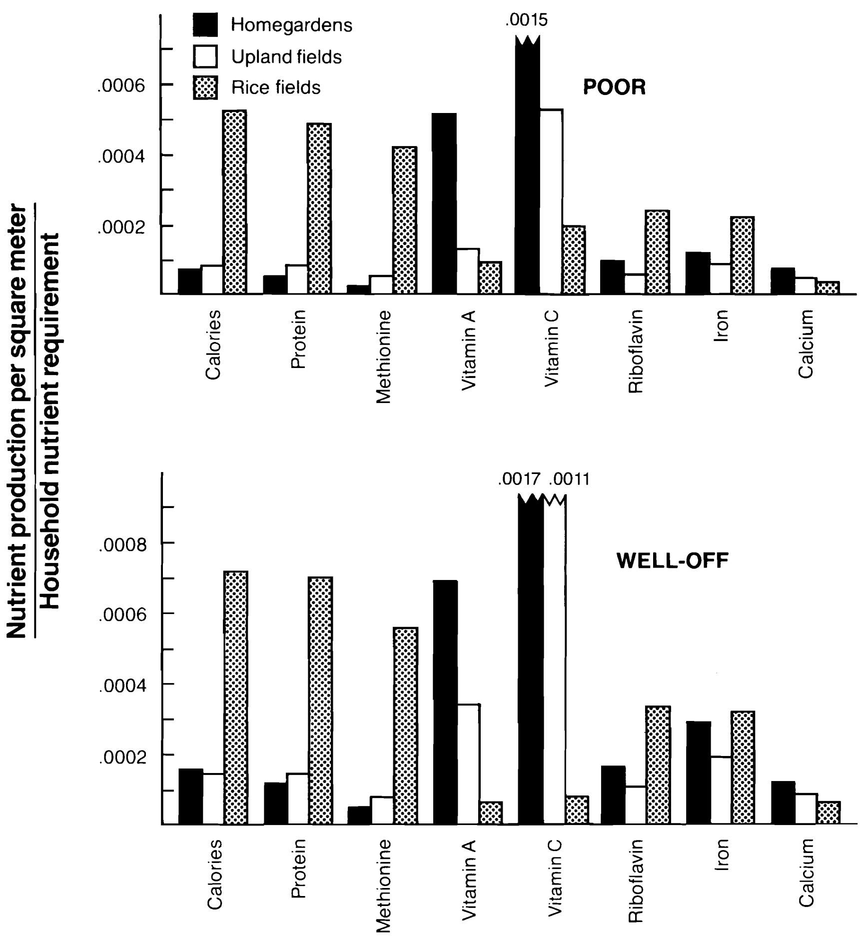


Figure 14.6. Average Nutrient Production (per unit of land) in the Three Agricultural Systems

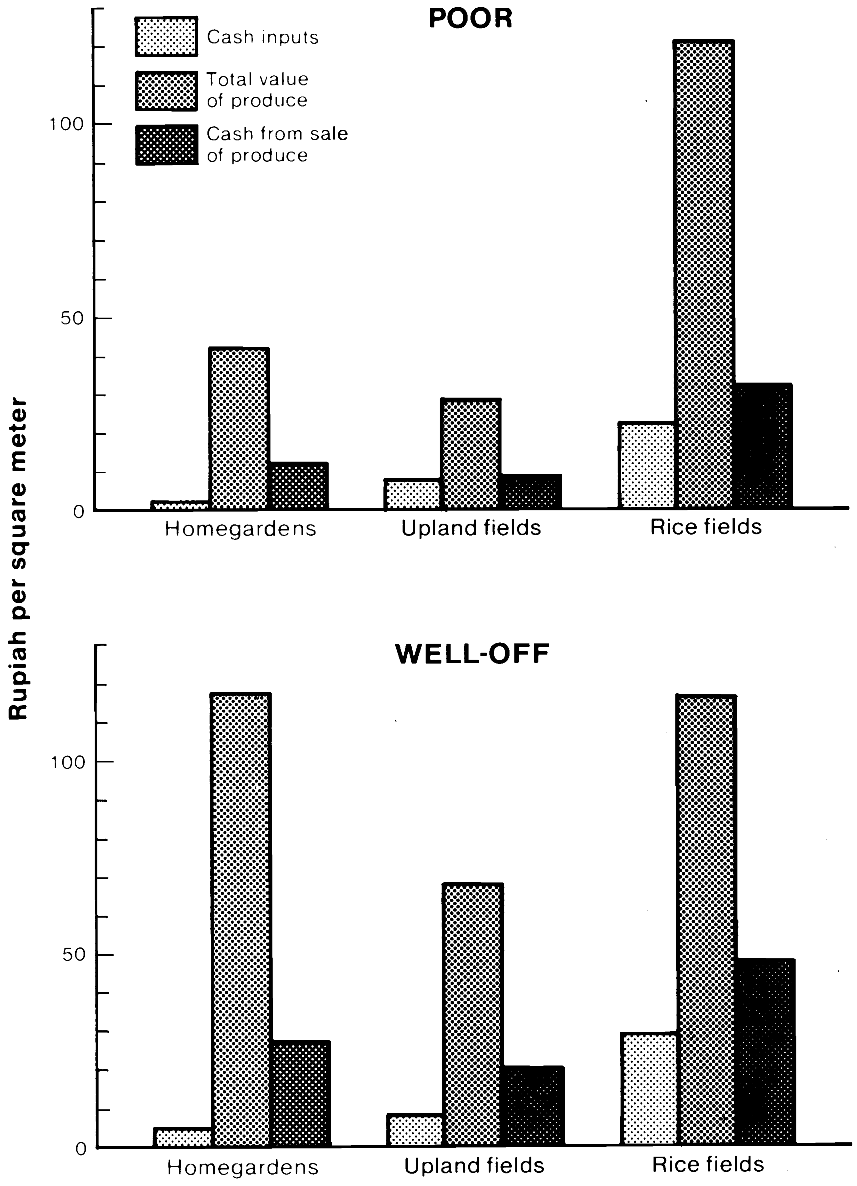


from *kebuns* and poor homegardens (Figure 14.7). The cash output per square meter of rice fields was more than twice the cash output from the other two agricultural systems, in part because more of the rice was sold for cash. However, the ratio of cash outputs to cash inputs was highest in homegardens because homegarden products had a high value despite relatively low cash inputs.

Factors Affecting Nutrient Production

The main reason that poor households in the Jatigede area do not produce enough nutrients seems to be they simply do not have enough

Figure 14.7. Cash Inputs and Outputs of the Three Agricultural Systems



land. Poor households near markets farmed only a quarter hectare on average, and poor households far from markets averaged only a half hectare ("total area farmed," Table 14.1). In contrast, well-off households averaged a hectare or more. Most well-off households had land in all three agricultural systems and virtually everyone—well-off or poor—had a homegarden. A substantial number of the poor lacked land for rice fields or upland fields, however, particularly the poor nearer to market towns, where the population density was higher and land was scarcer. The total nutrient production per household was generally less for all households (well-off and poor) near markets than for households far from markets, primarily because households near markets had less land on the average.

Household production of various nutrients per unit area of landholdings is not only a reflection of effectiveness of land use but also of the mix of crops employed by the household and the crops' relative strengths for providing different nutrients. Production per unit of land is high for all households in West Java compared to many other parts of the world, but poor households in the Jatigede field survey used their land somewhat less efficiently than well-off households in the same area (Figure 14.6).

Regression analysis was used to evaluate the impact of the following five factors on the production of nutrients per square meter of homegarden: garden size, cash inputs per square meter, number of crop species in the garden, proximity to market, and household per capita income. Only the first four factors were associated with homegarden nutrient production (Table 14.4). The number of crop species in the garden was the most significant factor, vitamin and mineral production being particularly high where there were more kinds of crops. Garden size also was significant, nutrient production per square meter tending to be lower in the larger gardens. This effect pertained to all nutrients but was particularly pronounced for calcium, iron, and riboflavin. Cash inputs had a significantly positive effect on some nutrients, vitamin C being the most conspicuous. Proximity to market was associated with lower production of nutrients, primarily nutrients other than vitamins and minerals (i.e., calories, protein, amino acids, thiamine, and niacin).

In a regression analysis of upland field production per square meter, cash inputs were the most significant factor associated with the production of all nutrients (Table 14.4). The number of crop species in the field also was significant, particularly for vitamins and minerals. Larger fields tended to have a lower production of all nutrients per square meter, though the effect was not so strong.

The use of land for nonfood crops competed with food production to some extent. Food crops accounted for more than 90 percent of the monetary value of homegarden and rice field production, but only about 70 percent of upland field production. This appeared to be the same regardless of economic status.

IMPACT OF MARKET INVOLVEMENT

The sale of food products can reduce the amount of food available for home consumption. Well-off households with a large production surplus sold a large percentage of their crop (about 50 percent), whereas poor households sold only 25 percent of their food on average (Figure 14.5). That 25 percent, however, can have a decisive impact on the nutrition of poor households. Vitamin A, riboflavin, iron, calcium, and methionine, which already were produced in insufficient amounts, were retained for home consumption in even lesser amounts. Although the total production of calories, protein, and lysine by poor households was barely adequate, the average quantities of those nutrients that were retained for home consumption were less than adequate.

Households near market sold more of their rice field produce than households far from market (Table 14.5). Households near market were also purchasing a much larger percentage of their food than households far from market, twice as much calories, thiamine, and niacin and 50 percent more of most other nutrients. The net result of food sales and purchases was that the average quantities of each nutrient consumed by households of the same economic status near market and far from market were virtually identical (Figure 14.4).

There was some association between proximity to a market town and the kinds of crops that were cultivated. Whereas guava, *cikur*, *mahoni*, and spinach were generally more common in the homegardens of well-off households, clove trees, *suji*, and coffee were more common in the homegardens of only well-off households near market. Coconut trees, *pete*, taro, *huimanis*, turmeric, and *pomelo* were generally more common in homegardens far from market. The upland fields of well-off households generally had more *cikur*, mango, ginger, turmeric, and sugar palm than those of poor households, but soursop, coconut trees, *pete*, *jengkol*, and *sawo* were more common in the upland fields of only well-off households near market. Sweet potatoes, chili peppers, cassava, corn, taro, turmeric, onions, and beans were generally more common in upland fields far from market.

MIXED CROPPING SPECIES COMPOSITION

The chapter appendix lists 235 species of crops (including medicinal and ornamental plants) observed in the survey. The average homegarden contained twenty species of useful plants, and the average upland field contained eleven species. The number of crops that a household had in its homegarden or upland field was the same for well-off households regardless of proximity to markets. Poor households in more remote areas had the same crop diversity as well-off households, but poor households near a market town averaged significantly fewer kinds of crops than other households (Table 14.1).

Table 14.4. Impact of Various Factors on Nutrient Production per Square Meter

	Homegardens		*Kebun*	
Factors	Staple Nutrients	Other Nutrients	Staple Nutrients	Other Nutrients
Household income	0	0	0	0
Cash inputs	0	+	++	++
Number of crop species	+	++	+	+
Total area of garden or field in household	–	–	–	–
Proximity to market town	–	0	0	0

Note: Staple nutrients = calories, protein, niacin, thiamine, iron. Other vitamins and nutrients = vitamin A, vitamin C, riboflavin, calcium.
++ = highly positive impact.
\+ = positive impact.
0 = no significant impact.
– = negative impact.

Table 14.5. Sales of Household Food Production[a]

	Poor		Well-off	
	Near Market	Far from Market	Near Market	Far from Market
Homegardens	10	26	16	34
Upland fields	8	30	30	34
Rice fields	29	16	41	30

[a] Percentage of total value of produce from each agricultural system.

There was a noticeable tendency for different crops to be found together in different gardens. These groupings, or "constellations," can be regarded as multi-crop modules within the larger agricultural system.

Following are homegarden constellations, showing the percentages of homegardens with more than half the plants in the constellation:

- *Huimanis* yam, taro, arrowroot, *ganyong* (*Canna edulis*, a crop that produces a starchy fruit), coconut, pineapple, turmeric, and kapok (15 percent) have a strong representation of starchy crops that are needed particularly by households with insufficient rice field or upland-field land to meet their carbohydrate needs.

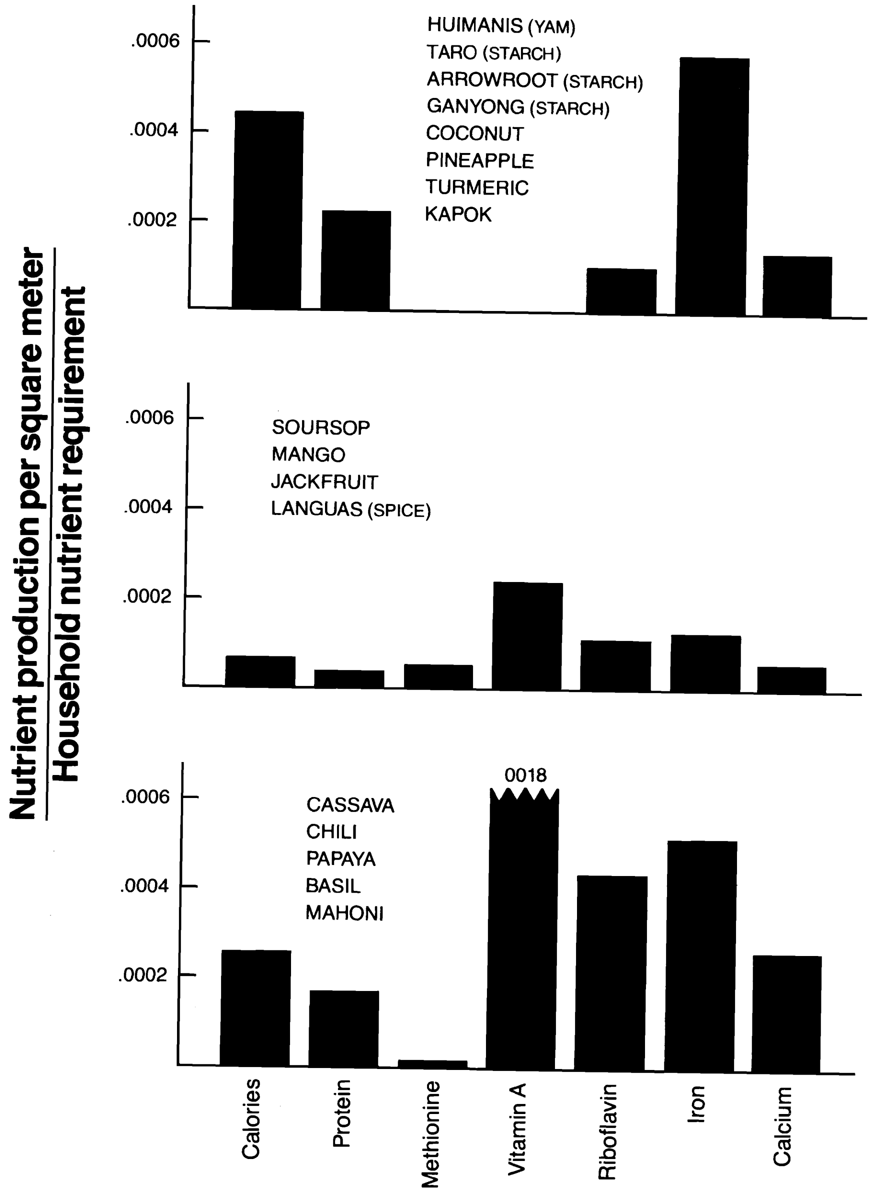
- Soursop, mango, jackfruit, and *languas* (spice) (42 percent) are three common fruit trees because they are hardy (disease resistant) and provide a good source of year-round income by fruiting at different times of the year. These three fruit trees tend to be found in the same gardens because they survive well together. The people say that not one of them has roots that squeeze out the roots of the others, and canopy competition is reduced because they are trimmed for firewood.
- Cassava, chili, papaya, basil, *mahoni* (a tree for construction material and fuelwood) (28 percent) and chili, eggplant, spinach, ginger, *cikur* (spice), and impatiens (ornamental) (8 percent) include common foods and spices in the local diet.
- Coconut, soursop, pomelo, and *pete* (vegetable) (26 percent) include three fruit trees that appear to function well together.
- *Mangkokan* (medicinal), *katuk* (vegetable), *kedongdong pagar* (vegetable), *puring* (vegetable), clove trees, and *suji* (spice) (10 percent) include three vegetables that are customarily cooked together. It is a matter of taste whether a particular household likes these vegetables or not.
- Caladium, mirabilis, duranta, and pedilanthus (8 percent) are all ornamentals, common in only some villages. Ornamentals tend to be more prominent in the gardens of wealthier families.

Homegarden constellations vary considerably in their nutritional profiles (Figure 14.8). The constellation of starchy crops is high in calorie and protein production but completely lacks vitamin A and methionine. The vegetable constellations are high in vitamin A and minerals but low in calories or completely lacking in methionine; the fruit constellation is not very high for any nutrient other than vitamin C. Homegarden constellations that have a mixture of starchy, vegetable, or fruit crops tend to have a better balance of nutrients. They tend to have a higher nutrient production per square meter if they are dominated by field crops and a lower production if dominated by tree crops.

The following are upland-field constellations, showing the percentages of upland fields having more than half the plants in the constellation:

- Ginger, turmeric, *languas*, *cikur*, and jackfruit (20 percent) is a group of spices that, except for *cikur*, prefer very wet soil conditions. These spices occur in upland fields where jackfruit is present, because they are shade tolerant.
- Coconut, *pete* (vegetable), *jengkol* (vegetable), and *sawo* (fruit) (11 percent) include crops that tolerate the semishade conditions created by coconut trees and are useful for both home consumption and sale.
- Cassava, sweet potatoes, taro, and chili peppers (33 percent) include starchy crops that are major alternatives to rice.
- Sweet potatoes, bananas, peanuts, corn, and beans (25 percent) are basic foods that grow compatibly together. The group does not include cassava because cassava will crowd out other crops in this group.

Figure 14.8. Nutrient Production from Homegarden Constellations



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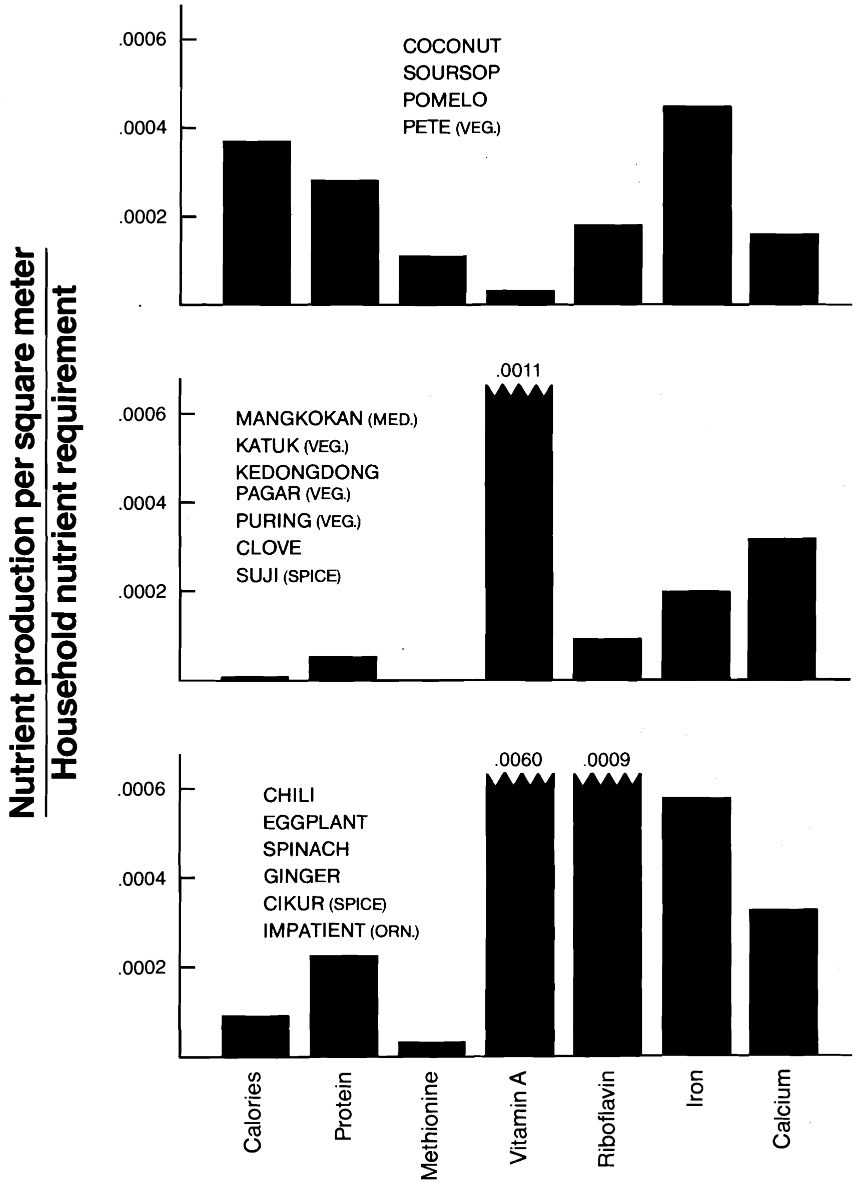
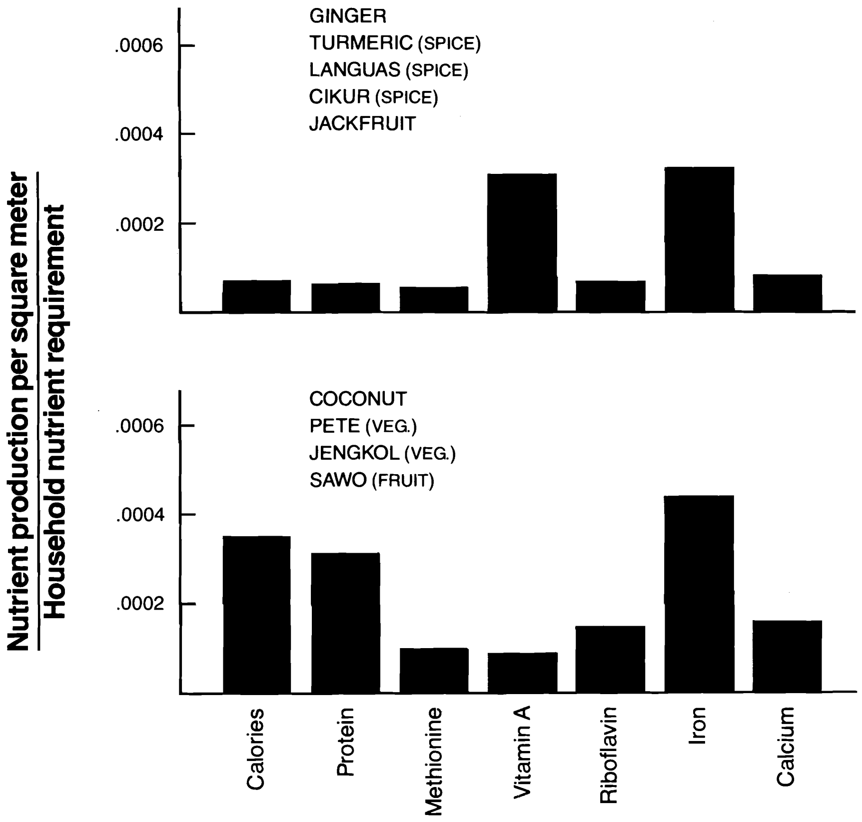


Figure 14.9. Nutrient Production from Upland-Field Constellations

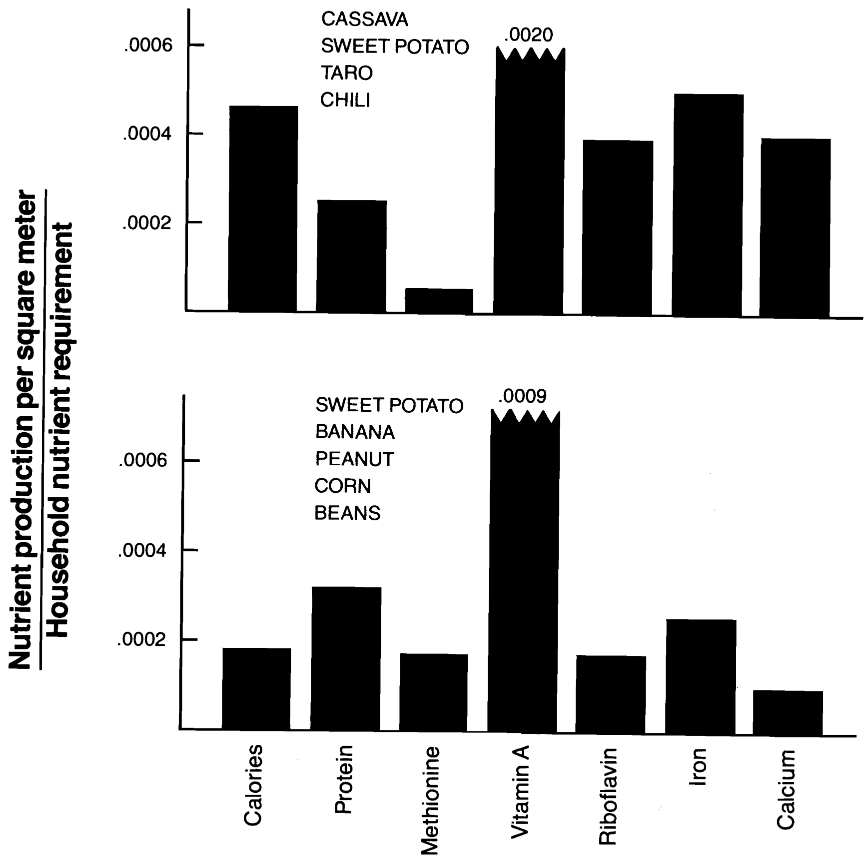


> Bananas are considered to shade the soil and keep it moist for sweet potatoes, but peanuts must not be grown immediately beneath the bananas or they will rot.

Upland-field constellations (Figure 14.9) tend to have a higher and more balanced production of nutrients than homegarden constellations. This is particularly true for the cassava-sweet potato-taro-chili constellation and also to a large extent for other upland-field constellations that have a mixture of crop types, particularly when legumes are well represented. Upland-field constellations consisting primarily of nonfood crops (e.g., spices), however, have a lower level of nutrient production than homegarden constellations.

Most fields or gardens contained two or three of the constellations, though a few gardens and fields had none of the constellations fully represented. The particular constellations to be found in a household's

Figure 14.9. *(continued)*



homegarden or field seemed to depend in part upon the socioeconomic status of the household and in part upon personal preferences.

OPTIMAL CROP MIXES

The optimal mixes (i.e., for meeting nutritional needs with the least amount of land) consisted of crops in three major food groups:

1. Starchy root crops (e.g., sweet potato, cassava, taro) or functionally similar crops (e.g., squash);
2. Legumes (e.g., beans or peanuts) or other high-protein crops (e.g., coconuts); and
3. Green leafy vegetables (e.g., unchoy or spinach).

Rice was never part of the optimal mix, nor were other grains (e.g., corn), fruits, or vegetables other than green leafy vegetables. This basic optimal crop mix is the tendency shown by poor families who lack rice fields and must therefore cover as many of their subsistence needs as possible from their homegardens and a small quantity of upland fields.

When interpreting these results, it is useful to keep in mind how the major food groups differ in their nutrient production (Table 14.2). Root crops tend to have high production efficiencies for most nutrients because root crop yields are high. Fruits tend to have low production efficiencies because fruit yields are generally low per unit area of land. Other crops, with intermediate yields per unit area, have production efficiencies that reflect their nutrient contents.

Some nutrients are easier to provide than others when adjusting a mix of crops to meet nutritional needs. The quantities of total protein, methionine, and riboflavin in the optimal mix are just sufficient to meet household needs, the quantities of calcium, iron, and niacin are only slightly in surplus, and the quantities of all other nutrients (including vitamin A) are greatly in excess. This means that a household with insufficient land to satisfy all its nutritional requirements can expect to satisfy its vitamin A requirements and possibly its calcium and iron requirements by proper crop selection, even though it is impossible to fully satisfy its total protein, methionine, and riboflavin requirements.

A household takes into account many considerations in addition to nutrition when deciding on a mix of food crops, with dietary tastes being particularly important. Rice is the preferred staple food crop in West Java, and starchy root crops are considered inferior. If rice and animal products are included in the optimal mix to fill nutritional needs, the total amount of land required for production of animal products, rice, and other crops—when rice and animal products are consumed at the level observed for well-off households in this survey—is three times the land required to meet nutritional needs when the diet is restricted to starchy root crops, legumes, and green leafy vegetables (Marten 1984).

IMPLICATIONS FOR DEVELOPMENT

Nutritional deficiencies in West Java are in large measure a consequence of insufficient land and a heavily rice-based diet. The particular nutrients that fall short of nutritional needs are precisely those that are low or absent in rice. The only exception is vitamin C, which is absent in rice but supplied sufficiently from other sources (particularly fruits from homegardens). Some nutrients (calcium and vitamin A) are produced in short supply by nearly everyone in the Jatigede area, but the production of calories, protein, riboflavin, iron, and methionine is deficient primarily among the poorest 25 percent of the population. The poor produce insufficient nutrients primarily because of insufficient land. Nutrient production by the poor who live near markets is particularly low because people near markets tend to have less land than those in more remote areas.

It does not appear that market pressures are responsible for nutritional problems. Households nearer to markets sell more of some nutrients but compensate by purchasing more food than the more remote households do. The poor tend to make up for their deficiencies in protein and vitamin A production through food purchases, but their consumption of three other nutrients (calcium, riboflavin, and iron) is not adequate. Well-off households also consume inadequate amounts of these same three nutrients, though not so severely.

Crop diversity has a highly significant impact on production of the deficient nutrients. A higher crop diversity is generally associated with higher levels of production of all nutrients but is particularly significant for the nutrients in shortest supply (i.e., calcium, iron, and riboflavin). Proximity to market is associated with a lower crop diversity for the poor. The net effect of the smaller landholdings and lower crop diversity of poor households near market is to make this group particularly vulnerable to nutritional problems.

The main possibilities for dealing with nutrient deficiencies in West Java seem to lie in adjusting the crop mixtures in upland fields. Upland fields are dominated by annual field crops, occupy large amounts of land, and already provide the major part of most critical nutrients. Certain field crops have high contents of the critical nutrients, and annual field crops generally lend themselves better than perennials to producing the greatest quantity of nutrients on a small amount of land. The optimizations do not suggest radical changes in upland fields, because the crop groups in the optimal mix are already a prominent part of upland fields. They do suggest a shift in the emphasis given to particular crop species, however, especially green leafy vegetables with high contents of vitamin A, calcium, riboflavin, or iron.

Javanese homegardens are intricate agricultural systems that are highly adapted to providing a variety of human needs on a small area of land with relatively low inputs of cash and labor. Annuals may be generally more efficient from a nutritional point of view, but perennials that perform numerous functions besides nutrient production (e.g., shade, fuelwood, and construction materials) should continue to be important in homegardens. Different styles of homegardens will undoubtedly continue to be appropriate for families with different circumstances.

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Rachmawati Rachman, B. Sudarma, and M. Taufiq. Carolina conducted an additional field survey to explore the functional significance of homegarden and upland-field constellations. Daniel Saltman contributed to data analyses, Valerie Uechi did computer programming, and Prahlad Kasturi and Francine Daniggelis prepared graphs.

Appendix. Plants Observed in Homegardens and Agricultural Fields Surveyed in Jatigede Area, West Java[a]

Latin Name	Local Name	English Name
GRAINS, STARCHY ROOTS, AND SUGAR		
* *Amorphophallus campanulatus*	*Suweg*	Elephant yam
* *Amorphophallus variabilis*	*Iles-iles*	Elephant yam
* *Arenga pinnata* *A. saccharifera*	*Aren* *Kawung*	Sugar palm
* *Canna edulis*	*Ganyong*	—
*+ *Colocasia esculenta*	*Taleus* *Keladi*	Taro
* *Colocasia nigrum*	*Talas*	Taro
*+ *Dioscorea alata*	*Ubi manis* *Ubi tiang*	Yam
*+ *Dioscorea bulbifera*	*Ubi atas*	Yam
*+ *Dioscorea esculenta*	*Gembili* *Ubi kamayung*	Yam
*+ *Dioscorea hispida*	*Gadung*	Yam
Glycine max	*Kedele*	Soybean
+* *Ipomoea batatas*	*Ketela rambat* *Ubi jalar*	Sweet potato
+* *Manihot glaziovii*	*Singkong karet*	Manicoba
+* *Manihot utilissima*	*Singkong* *Ubi kayu*	Cassava
Maranta arundinacea	*Sagu patat* *Arut*	Arrowroot
+ *Oryza sativa*	*Padi*	Rice
Oryza sativa var. glutinosa	*Beras ketan*	Sticky rice
Saccharum officinarum	*Tebu*	Sugar cane
Sorghum vulgare	*Gandrung* *Cantel*	Sorghum
+ *Zea mays*	*Jagung*	Maize, corn

* Found in more than 10% of homegardens in the survey.

\+ Found in more than 10% of upland fields in the survey.

*+ More frequent in homegardens.

+* More frequent in upland fields.

a Correspondences between Latin, Local, and English names were compiled by Daniel Saltman, Aseng Ramlan, and Edhimartono. Functional groupings of the plants are not intended to specify the only use, as many of these plants have multiple uses. For example, many of the plants listed as spices are also medicinals and vice versa.

Appendix. (*continued*)

Latin Name	Local Name	English Name
FRUITS		
Achras zapota	*Sawo*	Sapodilla Naseberry
* *Anacardium occidentale*	*Jambu monyet*	Cashew nut
* *Ananas comosus*	*Nenas*	Pineapple
*+ *Annona muricata*	*Nangka belanda* *Sirsak*	Soursop
Annona reticulata	*Buah nona*	Sweetsop
Annona squamosa	*Sarikaya*	Custard apple
Artocarpus communis	*Keluwih*	Breadfruit
Artocarpus champeden	*Sukun*	Breadfruit
*+ *Artocarpus integra*	*Nangka*	Jack fruit
* *Averrhoa carambola*	*Blimbing*	Star fruit
*+ *Carica papaya*	*Pepaya*	Papaya
Citrus aurantifolia	*Jeruk nipis*	Lime
* *Citrus aurantium*	*Jeruk manis*	Tangerine
* *Citrus maxima*	*Jeruk bali*	Pomelo
*+ *Cocos nucifera*	*Kelapa*	Coconut palm
Durio zibethinus	*Durian*	Durian
Erioglossum rubiginosum	*Kilalayu*	—
* *Eugenia aquea*	*Jambu air*	Rose apple
Eugenia cumini	*Juwet*	Java plum Teste foure
Eugenia cymosa	*Kōpo*	—
Eugenia malaccensis *Syzygium malaccensis*	*Jambu bol*	Malay rose-apple
Fragaria xananasa	*Arben*	Strawberry
Garcinia mangostana	*Manggis*	Mangosteen
Lansium domesticum	*Duku*	*Lanseh*
Lansium sp.	*Pisitan* *Langsat*	—
Mangifera foetida	*Limus* *Bacang*	Horse mango
*+ *Mangifera indica*	*Mangga*	Mango
Mangifera odorata	*Kuweni*	Mango
Morus alba	*Murbai*	Mulberry (white)

* Found in more than 10% of homegardens in the survey.

*+ More frequent in homegardens.

Appendix. *(continued)*

Latin Name	Local Name	English Name
*+ *Musa paradisiaca* *M. sapientum*	*Pisang*	Banana
* *Nephelium lappaceum*	*Rambutan*	Rambutan
Persea americana *P. gratissima*	*Apokat*	Avocado
Phyllanthus acidus	*Cereme*	Gooseberry
Zalacca edulis	*Salak*	Salacia
Spondias dulcis *S. eytherea*	*Kedongdong*	Otaheite-apple
VEGETABLES (INCLUDING LEGUMES)		
+ *Allium fistulosum*	*Bawang daun*	Green onion
Allium sativum	*Bawang putih*	Garlic
+ *Amaranthus hybridus*	*Bayam*	Spinach
Apium graveolens	*Seledri*	Celery
+* *Arachis hypogaea*	*Kacang tanah* *Suuk*	Groundnut Peanut
Benincasa hispida *B. cerifera*	*Beligo*	Wax gourd
Cajanus indicus *C. cajan*	*Kacang kayu* *Hiris*	Pigeon pea
Cucumis sativus	*Bonteng* *Ketimun*	Cucumber
Cucurbita moschata	*Waluh*	Squash
Cucurbita pepo	*Waluh* *Labu besar*	Sweet gourd Pumpkin
Dolichos lablab	*Kara*	Hyacinth bean Bonavista bean
Gnetum gnemon	*Belinjo*	—
Ipomoea reptans	*Kangkung*	Unchoy
Kaempferia rotunda	*Temu kunci*	—
Lagenaria leucantha	*Kukuk* *Labu air putih*	Bottle gourd
Limnocharis flava	*Genjer*	Hermit's water
Luffa acutangula	*Emes, Oyong* *Gambas*	Raggourd Wild petola

* Found in more than 10% of homegardens in the survey.
\+ Found in more than 10% of upland fields in the survey.
*+ More frequent in homegardens.
+* More frequent in upland fields.

Appendix. *(continued)*

Latin Name	Local Name	English Name
Momordica charantia	*Paria* *Pare*	Bitter melon
Moringa oleifera	*Kelor*	Horseradish
* *Nothopanax scutellarium* *N. fruticosum*	*Mangkokan*	False panax
Pangium edule	*Picung* *Keluwak*	Pangi
*+ *Parkia speciosa*	*Pete* *Petai besar*	Locus bean
Phaseolus lunatus	*Kacang uci*	Rice bean
Phaseolus radiatus	*Kacang hijau*	Mung bean
Planchonia valida	*Putat*	Planchonia
Polyscias fruticosa	*Kedongdong pagar*	Hedge panax
Psophocarpus tetragonolobus	*Kecipir* *Jaat*	Wing bean Goa bean
Raphanus sativus	*Lobak*	Chinese radish
Sauropus androgynus	*Katuk*	Sweet shoot
Sechium edule	*Labu siam*	Chayote
* *Solanum lycopersicum*	*Tomat*	Tomato
* *Solanum melongena*	*Terong*	Eggplant
Solanum nigrum	*Leunca*	Black nightshade
Solanum torvum	*Takokak* *Cepoka*	Eggplant
+ *Vigna cylindrica*	*Kacang panjang*	Cowpea
Vigna sinensis	*Kacang panjang*	Cowpea
SPICES		
Aleurites molluccana	*Kemiri*	Candle nut Indian walnut
Allium cepa	*Brangbang* *Bawang merah*	Onion
* *Allium schoenoprasum*	*Bawang kucai*	Chive
Amomum kepulaga	*Kapulaga*	Cardamom
Capsicum annum	*Cabe* *Lombok*	Chili Red pepper

* Found in more than 10% of homegardens in the survey.
\+ Found in more than 10% of upland fields in the survey.
*+ More frequent in homegardens.

Appendix. (*continued*)

Latin Name	Local Name	English Name
*+ *Capsicum frutescens*	*Cengek* *Lombok rawit*	Little pepper
Chysopogon nardus *Cymbogon citratus*	*Sereh*	Lemon grass
*+ *Cocos nucifera*	*Kelapa*	Coconut palm
*+ *Curcuma domestica*	*Koneng* *Kunir*	Turmeric
* *Eugenia aromatica*	*Cengkeh*	Clove tree
Ocimum canum	*Surawung* *Kemangi*	Hoary basil
Phaeomeria speciosa	*Honje*	–
Piper nigrum	*Lada* *Pedes* *Merica*	Black pepper
Sesamum indicum	*Wijen*	Sesame
Syzygium polyanthum *Eugenia polyantha*	*Daun salam*	Bay leaf
Tamarindus indica	*Asam*	Tamarind
* *Zingiber officinale*	*Jahe*	Ginger
MEDICINALS		
Areca catechu	*Jambe* *Pinang*	Betel palm
Blumea balsamifera	*Sembung*	Camphor plant
Cassia fistulosa	*Ketepeng*	Golden shower
C. sappans	*Trengguli*	Indian laburnum
Citrus hystrix	*Jeruk purut*	Bitter orange
Coffea arabica *C. robusta*	*Kopi*	Coffee
Costus speciosius	*Pacing*	Ginger lily
Erythrina lithosperma	*Bintinu* *Dadap*	–
+* *Kaempferia galanga*	*Kencur* *Cikur*	–
+* *Languas galanga*	*Lengkuas* *Laja*	Galangal

* Found in more than 10% of homegardens in the survey.
*+ More frequent in homegardens.
+* More frequent in upland fields.

Appendix. (*continued*)

Latin Name	Local Name	English Name
Morinda citrifolia	*Mengkudu*	Fish-eye wood Noni
Mucuna pruriens	*Coas*	Florida velvet bean
Nicotiana tabacum	*Tembakau*	Tobacco
Orthosiphon stamineus	*Kumis kucing*	Cat's whiskers
Piper betle	*Sirih*	Betel vine
+ *Pithecellobium lobatum*	*Jengkol* *Jiring*	–
Ricinus communis	*Jarak*	Castor oil plant
Strobilanthes crispus	*Keji beling*	–
Thea sinensis	*Teh*	Tea
Tinospora tuberculata	*Bratawali*	–
Zingiber aromaticum	*Panglay*	–
Zingiber odoriferum	*Lempuyang*	–
TREES (BUILDING MATERIAL)		
+ *Albizia falcata*	*Sengon laut* *Albasia*	–
+ *Albizia* sp.	*Jeungjing* *Sengon tarisi*	–
Canangium odoratum	*Kenanga*	–
Dalbergia latifolia	*Sonokeling*	–
Dixolylon caulostachyum	*Kedoya*	–
+ *Gigantochloa apus*	*Bambu apus*	Bamboo
+ *Gigantochloa verticillata*	*Bambu gombong*	Bamboo
* *Swietenia mahogani*	*Mahoni*	Mahogany
Tectona grandis	*Jati*	Teak wood
TREES (FUELWOOD)		
Acacia auriculiformis	*Akasia*	–
Albizia lebbeck	*Tarisi*	–
Albizia procera	*Kihiang*	–
Bridellia monoica	*Kanyere*	–
Cassia bicapsularis	*Bungur*	–
Cassia siamea	*Johar*	Senna
Casuarina equisetifolia	*Cemara laut*	Ironwood

* Found in more than 10% of homegardens in the survey.
\+ Found in more than 10% of upland fields in the survey.

Appendix. (*continued*)

Latin Name	Local Name	English Name
* *Ceiba pentandra*	*Kapok* *Randu*	Kapok
Ficus virens	*Bisoro*	–
Hibiscus macrophyllus	*Tisuk*	Hibiscus
Hibiscus tiliaceus *H. semilis*	*Waru*	Hau tree Hibiscus
Kleinhovia hospita	*Bintinu*	–
Lanea grandis	*Kedongdong* *Jaran*	–
Lantana camara	*Sahari* *Temblekan*	Hedge flower
* *Leucaena glauca*[b]	*Lamtoro* *Petai cina*	Leucaena
Melia azedarach	*Mindi*	Persian lilac
Piper aduncum	*Kiseureuh*	–
Sansevieria trifasciata	*Lidah mertua*	Bowstring hemp
Semecarpus sp.	*Renghas*	–
Sesbania grandiflora	*Turi*	–
Toona sureni *Cendrella toona*	*Suren*	–
ORNAMENTALS		
* *Acalypha wilkesiana*	*Dawalong*	Copper leaf
Agave americana	*Agave*	Sisal hemp
Aglaonema cordifolia *A. costatum*	–	–
Aglaonema marantaefolia *A. oblongifolium*	*Sri rejeki*	Elephant's tongue
Alocasia macrorhiza	*Jente* *Birah negri*	Giant taro
Aloe vera	*Lidah buaya*	Aloe
Alternanthera ficoidea	*Rumput kriminil*	–
Andrographis panculata	*Sambiloto*	–
Anthurium crystalianum	*Kuping gajah*	Anthurium
Antigonon leptopus	*Bunga pengantin*	–
Asparagus racemosus	*Sangga langit*	Asparagus
Bambusa vulgaris	*Bambu kuning*	Yellow bamboo

* Found in more than 10% of homegardens in the survey.

b *Leucaena* fruits are consumed as food.

Appendix. (*continued*)

Latin Name	Local Name	English Name
Begonia isoptera *B. rex*	*Begonia*	Begonia
Belamcanda chinensis	*Suliga*	Chinese herb
Bougenvilla spectabilis	*Bougenvil*	Paper flower
* *Caladium bicolor*	*Keladi hias*	Caladium
Canna orientalis	*Bunga tasbih*	–
Celosia argentia	*Bunga bludru*	Fowl's wattles
Chlorophytum bichetii	*Es lilin*	–
Cissus repens	*Arej harecang*	–
Clerodendron thomsonii	*Nona makan sirih*	–
* *Codiaeum variegatum*	*Puring*	Garden croton
Coleus atropurpureus	*Jawer kotok*	Coleus
Cordyline fruitcosa	*Hanjuang*	Ti plant
Cosmos caudatus	*Kenikir*	Cosmos
Crescentia cujete	*Berenuk*	Calabash tree
Crinum asiaticum	*Bakung*	Gold flower
Cupea hysophifolia	*Sicantik dari taiwan*	Taiwan beauty
Cyclea barbata	*Cincau*	–
Cyperus killinga	*Papayungan*	–
Diefenbachia fournerii	*Kasintu*	–
* *Duranta erecta*	*Si anak nakal*	–
Epiphyllum hookeri	*Wijaya kusuma*	–
Erythrina fusca	–	Coral bean
Erythrina variegata	*Dadap*	–
Euphorbia pulcherrima	*Kastuba*	Poinsettia
Ficus benjamina	*Beringin*	Benjamin fig
Ficus septica	*Karet kebo*	–
Gardenia augusta	*Kacapiring*	–
Gendarusa vulgaris	*Gandaria*	–
Gerbera jamesonii	*Herbras*	Barberton daisy
Gladiolus gandavensis	*Gladiol*	Gladiolus
Helianthus annuus	*Bunga matahari*	Sunflower
Heliconia indica *H. hihai*	*Heliconia*	–
Hemigraphis plicata	*Keji beling* *Sambung darah*	–
Hibiscus rosa-sinensis	*Kembang sepatu*	Shoe flower
Hipeastrum puniceum	*Bakung*	Red lily
Homolomena cardifolia *H. sagittifolia*	*Semunyong*	–

* Found in more than 10% of homegardens in the survey.

Appendix. (*continued*)

Latin Name	Local Name	English Name
* *Impatiens balsamina*	*Pacar air*	Impatiens
Ipomoea crasicaulis	*Kangkung pagar*	–
Ipomoea fistulosa	*Kangkung pagar*	–
Ipomoea quamoclit	*Rincik bumi*	–
Irisine herbstii	*Irisin*	Blood leaf
Ixora coccinea	*Soka*	–
Jasminum sambac	*Melati*	Jasmine
* *Kalanchoe laciniata*	*Cocor bebek*	Kalanchoe Duck's footprint
* *Malvavicus arboreas*	*Wera*	–
Mimusops elengi	*Tanjung*	Headland flower
* *Mirabilis jalapa*	*Bunga pukul 4* *Kembang pk. 4*	Four-o'clock Marvel-of-Peru
Mussaenda phillipica	*Nusaindah*	–
Omalanthus populneus	*Karembi*	–
Ophiopogon adscendens	–	–
Ophiopogon glaucescens	–	–
Ophiopogon humetes *O. japonicus*	–	–
Pandanus amaryllifolius	*Pandan*	Pandanus
Pandanus sp.	*Pandan duri*	Pandanus
Pedilanthus bracteatus	–	–
* *Pedilanthus tytimoloides*	–	–
* *Pleomelle sandersonii*	–	–
Pleomelle elliptica	*Suji*	–
Pluchea indica	*Beluntas*	–
Portulaca grandiflora	*Bunga pukul 8*	Purselane
Premna corymbosa	*Cincau*	–
Rhoeo discolor	*Adam dan hawa* *Dalam perahu*	–
Rosa hybrida	*Mawar*	Rose
Salvia hookeriana	*Salvia*	Mint
Spathoglotis plicata	*Anggrek*	Land orchid
Syngonium podophyllum	*Kihurip*	–
Tagetes erecta	*Narjis* *Kenikir*	African marigold
Yucca angustifolia	*Yucca*	Yucca
Zephiranthes roseus	*Kembang coklat*	Cacao flower

* Found in more than 10% of homegardens in the survey.

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