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SUBSISTENCE CULTIVATION IN THE CARIBBEAN¹

INTRODUCTION

Subsistence cultivation on small plots is a marked characteristic of rural life in the Caribbean islands, as it is in most areas in the American tropics. It closely resembles the subsistence cultivation systems of neighboring areas and has been classified as a subcategory of American tropical forest agriculture (Denevan 1980; Katz, Hediger & Valleroy 1974: 769). Yet its practitioners are not natives of the American tropics, but the descendants of Africans who often grew their own food and a small market surplus on the unused lands near the plantations on which they worked as slaves. These provision grounds were important in their adaptations to slavery and to the changes later brought by emancipation (Mintz & Hall 1960). That they are still an essential part of rural land use, economy, and household survival has been recognized in an abundant literature.²

Most of the studies in this literature are local and particular. Few attempt any intra-regional comparison or generalization (Hills & Iton 1982, 1983; Momsen 1972; Paquette 1968, 1982; Rashford 1982), and none attempt extra-regional comparison or systematic synthesis. This is surprising when we consider the synthesizing and explanatory efforts applied to some other important Afro-American cultural features with multi-cultural origins, such as religion or creole languages (e.g., Alleyne 1980; Bickerton 1975; Carrington *et al.* 1983; Simpson 1978; Taylor 1977).

This paper uses both intra-regional and extra-regional comparison to test a working hypothesis developed in the field. It asks whether a

characteristic subsistence cultivation system can be identified in the Antilles, what distinguishes it from tropical cultivation elsewhere in the Americas, and what the sources of these distinguishing features might be. The field research was aimed at discovering crops and gardening techniques that transcend environmental differences within the Antilles and that appear to be characteristic of Antillean gardens in diverse physical, social, and economic settings. The search for these crops and techniques was necessary precisely because the great range of physical and cultural conditions within so small a land area has led to many studies of Caribbean cultivation that imply purely local systems with local characteristics. From the field study we derived a complex of features that we use to organize the comparative data gleaned from the literature. Finally, we test the set of Antillean features synthesized from field data and literature against the subsistence cultivation systems described for other areas of the American tropics, and offer some explanations for the differences.

This method reverses the more common practice of deriving hypotheses from the literature and testing them in the field, yet its fitness and workability are clear. There exists no generalization or theory that might be tested in a particular locale; rather, we must use the particular locale as a laboratory and compare our results with the results of other particular research that has been done in the region. The generalizations that emerge may then be modified and supplemented by future field research.

FIELD STUDY IN MONTSERRAT AND BARBUDA

The field study of subsistence plots, crop assemblages, and cultivation techniques was carried out on Barbuda and Montserrat, two islands of the Leeward group that share a British colonial history but are otherwise quite different. These were chosen because together they present a range of the gross physical environments that are found in the island Caribbean, and because their economies, social structures, and histories contrast in important ways. They constitute a small-scale laboratory of the variety of conditions under which Caribbean subsistence gardeners work.

Barbuda, about 160.5 square kilometers in area, is a flat coral island with a high point of only 38 meters above sea level. The shallow soils are limited by factors of erosion, poor drainage, salinity, and stoniness (Vernon & Lang 1966). There are recurrent, long-term droughts during

which cultivation becomes difficult, though not impossible. The vegetation, almost all xerophytic, ranges from mesquite scrub with bare ground to evergreen scrub forest in areas secured from foraging livestock. Even in comparatively wet periods the average annual rainfall is only about 90 centimeters a year (Mather 1971: 30-31). No plantations thrived in Barbuda, and the landscape was shaped mainly by open-range grazing, wood-cutting for making charcoal and building boats, and shifting cultivation (Berleant-Schiller 1977a, 1977b, 1983).

No commercial agriculture has ever succeeded in disrupting the small plot system and its accompanying form of land tenure. Customary land tenure grants all Barbudans equal rights to the use of lands outside the village, and there are no individually owned plots, grazing grounds, or timber stands. Only houses, house plots, and fruit trees are individually owned. This tenure system, rooted in eighteenth-century land use, is correlated with low population density (9 per square km.) and physical conditions that favor shifting cultivation and unconfined grazing rather than permanent plots and paddocks. Today the population is about 1400, all of whom live in or around Codrington, the only village. Since emancipation, the traditional pursuits have been supplemented by small amounts of wage labor and by remittances from emigrants.

Montserrat, by contrast, is a mountainous volcanic island of 83 square kilometers, with a population of 11,000 at a density of 133 per square kilometer. For two hundred years, until the mid-nineteenth century, plantations and plantation slavery shaped its economy and society, although small plot cultivation has always existed (Pulsipher 1977). Three volcanic structures dominate the island, increasing in height from 300 meters in the north to 900 meters in the south. This topography encourages great physical diversity in a small area. Whereas the north is dry and sparsely covered with xerophytic vegetation, the high mountains just a few kilometers to the south support a rainforest. Between these two extremes there is a range of moisture conditions and plant communities.

Biotic variations among the Caribbean islands are linked both to their land use histories and to differences in moisture and topography. Subsistence cultivation, plantation agriculture, and stock-keeping have all marked the islands, whatever their size, terrain, and geologic origin. Increasing elevation is in general associated with increasing moisture and moisture-loving plant communities, yet only a few researchers have used this wet-dry, high-low continuum to explain or organize island differences, even though its usefulness in the Pacific

suggests Caribbean applications (Barrau 1965; Burrows 1956; Murphy 1949). Differences in physiography and humidity have been used to explain the presence or absence of plantations, and Bonham Richardson has shown the importance of highland and lowland adaptations in the nineteenth century (1984), but aside from the work of Charles Wright (1979), these physical differences do not figure in discussions of small plot cultivation. J.S. Beard's vegetation study classified the Caribbean climate into four categories that imply, but do not elaborate, a dry-humid contrast related to elevation (1949). Helmut Blume's standard geography tabulates the vegetation of the Antilles according to an elevation-moisture scheme consisting of the three major zones commonly used for Latin America (1974: 26, 44-48).

Our purposes were better served by four moisture-elevation zones, which we identified by the vegetation complexes surrounding garden plots.³ These zones were not intended to classify vegetation (see Beard 1949; Graham 1973; Harris 1965; Howard 1973; Loveless 1960; Watts 1966), but to serve as field indicators of moisture conditions and as devices for interpreting similarities and differences between gardens. Barbuda and Montserrat together include all four zones. We describe the basic vegetational features of these zones as simply as possible. A more complete and technical description of Caribbean moisture-elevation zones can be found in Blume (1974: 40-48).

Large areas of Barbuda and the extreme northern and southwestern areas of Montserrat fall into zone 1, the driest zone, characterized by a low thorn and cactus scrub. *Acacia* species and mesquite (*Prosopis chilensis*) dominate, accompanied by columnar cactus (*Lemaireocereus hystrix*) and, in Barbuda, dagger (century plant; *Agave karatto*), which colonize abandoned gardens. There are very few tall tree species except the occasional coconut palm (*Cocos nucifera*). Zone 1 conditions occur in areas that lack orographic rainfall, or are exposed continuously to the drying tradewinds.

Zone 2 includes those places affected by recurrent periods of drought. The plant communities are complex and varied, and differences are related to soils, land use history, and location in relation to sea winds and rain shadow. In Montserrat, open grassland is the characteristic vegetation, with a few tall tree species in low places that are shielded from wind and that receive slope drainage. Elsewhere, especially in karst areas, xerophytic scrub forest is the diagnostic vegetation, as in Barbuda, where turpentine (*Bursera* sp.) and loblolly (*Pisonia* sp.) are common. Some of the trees may be non-native economic trees, such as tamarind (*Tamarindus indica*), mango (*Mangifera*

indica), and breadfruit (*Artocarpus communis*). The dryness of zone 2 may be a consequence of location in a rain shadow or along the fringe of orographic rainfall. On the windward sides of many islands the combination of sea wind and sparse tree cover encourages high evaporation rates. In Montserrat, zone 2 lies between 150 and 180 meters above sea level. In Barbuda, a few swampy areas and some areas protected from grazing show the features of zone 2, but the rest of the island is zone 1.

In zone 3, moisture deficiency is only an occasional problem. Orographic rainfall supports a lush cover of tall trees, epiphytes, shrubs, vines, and grasses. The silk-cotton tree (*Ceiba pentandra*), elephant grass (*Pennisetum purpureum*), and various Araceae, especially many *Philodendron* species, are characteristic. There are also abundant breadfruit (*Artocarpus communis*), cashew (*Anacardium occidentale*), and mango (*Mangifera indica*) trees. Organic detritus from the heavy vegetation protects soil moisture, plant roots anchor the soil, and leaf canopies inhibit both erosion and evaporation. The tall trees and surrounding hills shelter gardens from drying winds, and air descending from the higher slopes holds moisture that retards evapotranspiration. Droughts occasionally affect crops, but do not usually kill well-established trees and the plant communities they protect. Zone 3 lies between 215 and 335 meters on leeward slopes in Montserrat. On windward slopes it is higher. The range of zone 3 can be altered by forest clearing.

Zone 4 occupies leeward slopes above 335 meters and windward slopes above 460 meters, where there is ample orographic rainfall and where clouds enveloping high peaks supply additional moisture. The many-canopied tropical rainforest is the natural vegetation, and many species of the American humid tropics are found here, but tree ferns (various Cyatheaceae) are always diagnostic.

In order to derive a working hypothesis with which to approach the literature, we studied fourteen subsistence plots distributed along these four zones in the two islands. These plots were not a statistical sample of all plots, but a series of plots in ascending elevations that met the following criteria:

1. They are subsistence gardens designed for and essential to the household economy, supplying the major portion of its food and sometimes allotting minor space to a cash crop.⁴
2. They are worked by household labor only.

3. They are not kitchen gardens in the sense of small plots meant to supply special cooking needs and to receive special attention.
4. They include all of the crops found in neighbouring gardens that met the foregoing criteria and that were surveyed but not studied in detail.

We concentrated on crops and gardening techniques, excluding questions of productivity and yield. Our object was to discover whether a core of common elements in seemingly diverse gardens would transcend the physical differences of moisture and topography on the one hand, and the differences in social structure, history, and population density between the two islands on the other. We found a core of common elements and associated clusters of features. Testing these against the literature suggested modifications and new bases for distinguishing the Antillean system from the cultivation systems of adjacent tropical regions.

Table 1 lists all of the crops grown in the study plots at the time we inventoried them. These are not of course all of the crops grown in Antillean subsistence gardens, nor even all of the crops grown in the study gardens, which we did not observe over a full year of continuous planting and harvesting. Table 1 also shows the number of zones in which each crop occurred. Table 2 lists gardening techniques derived from observation of the plots and from gardeners at work. Almost all of the crops and techniques listed on these tables are found elsewhere in the American tropics. Our task now, therefore, is to discover whether any complex of these is particularly characteristic of the Antilles, or whether any individual features mark Antillean gardens in a distinctive way.

Table 1 shows that seven crops were found in every zone: banana/plantain (*Musa paradisiaca*), maize (*Zea mays*), beans of the *Phaseolus* species, pigeon peas (*Cajanus cajan* or *Cajanus indicus*), squash/pumpkin (*Cucurbita* sp.), sweet potato (*Ipomoea batatas*), and yam (*Dioscorea* sp.). We also discovered that four of these seven crops occupied major allotments of space in every garden: maize, beans, pigeon peas, and sweet potatoes. In fact these four crops were, along with two banana trees, the only crops in one Barbudan garden observed at the end of a twenty-year drought, which suggests that they may constitute a minimum survival complex in drought-prone areas. The environmental range of this seven-crop complex suggested to us that it be tested as a Caribbean island cultural commonality and regional complex of core crops.

Table 2 shows that 30 out of a total of 36 techniques are used in all four zones. This distribution suggests that the techniques of subsistence cultivation are mostly independent of physical and social environment, and that small variations are probably related to local and individual factors. The fact that these techniques are all found elsewhere in the American tropics also suggests that any non-crop features that distinguish Antillean gardens must come in characteristic clusters or must be discovered by methods other than observing gardens and gardeners. This issue, as well as the question of a regional complex of core crops, is taken up in the following section.

The appendix to this paper documents the ways that the features listed in Tables 1 and 2 are incorporated into living gardens. It includes a description of one garden in each of zone, three garden maps, and, in Table 4, a comparative summary of some basic garden features.

COMPARISON AND INTERPRETATION

Of all the studies of Caribbean food gardens, surprisingly few proved useful for our comparative purposes. One problem was the diversity of their goals and methods. Yankey's study of Dominican small plot cultivation, for example, includes no complete crop lists; it concentrates, rather, on factors such as farm size, farm tenure, and the economic and demographic characteristics of farmers (1973). His statistical analyses are potentially very useful, but few researchers provide comparable information. Further, where we sought analyses of intercropping and the spatial arrangement of plots, such as those provided by Rashford (1982) and Brierley (1974), we often found judgmental descriptions of plots as "haphazard," with no "proper systems of plant spacings" (Yankey 1973: 186).

Besides disparate perceptions and methods, we found a babel of common names, a disregard for scientific names, muddled crop classifications (e.g., "squash, melons, and pineapples"), failure to distinguish between similar food plants (such as *Colocasia* and *Xanthosoma*, or different leguminous genera), and the absence of information on the relative importance of crops. Nor have studies been done in a representative range of islands. Nevertheless, using both cultivation studies and studies with other emphases that included cultivation information, we were able to assemble information from the Greater and Lesser Antilles, from volcanic and coral islands, and from higher, wetter and lower, drier environments. The following comparison of our field data

TABLE 1. CROP LIST SHOWING CORE CROPS AND MAJOR CORE CROPS

Crop List Showing Core Crops and Major Core Crops		Map Code	Zone Occurrence				Number of Zones in which Crop Occurs			
			Zone 1	Zone 2	Zone 3	Zone 4	4	3	2	1
Coconut	<i>Cocos nucifera</i>	Cc		x	x				x	
Mango	<i>Mangifera indica</i>	Mg		x	x				x	
Breadfruit	<i>Artocarpus communis</i>	Br		x	x				x	
Sugar apple	<i>Annona squamosa</i>	Sa		x						x
Soursop	<i>Annona muricata</i>	Ss	x	x					x	
Cashew	<i>Anacardium occidentale</i>	Cw	x	x					x	
Lime	<i>Citrus aurantifolia</i>	Li	x	x					x	
Orange	<i>Citrus</i> sp.	Or	x	x					x	
Guava	<i>Psidium guajava</i>	Gv		x						x
Genip	<i>Melicoccus bijugatus</i>	Gp	x							x
Avocado	<i>Persea americana</i>	Av		x	x				x	
Cocoa	<i>Theobroma cacao</i>	Co			x					x
Banana;										
Plaintain	<i>Musa paradisiaca</i>	* Ba	x	x	x	x	x			
Sugar cane	<i>Saccharum officinarum</i>	Sc		x	x				x	
Guinea grass	<i>Panicum maximum</i>	Gg		x	x				x	
Sorrel	<i>Rumex acetosa</i>	So			x					x
Maize	<i>Zea mays</i>	§* M	x	x	x	x	x			
Okra	<i>Hibiscus esculentus</i>	Ok		x		x			x	
Hot pepper	<i>Capsicum frutescens</i>	Hp			x	x			x	
Sweet pepper	<i>C. frutescens grossum</i>	Sp		x						x
Tomato	<i>Lycopersicon esculentum</i>	To			x					x
Eggplant	<i>Solanum melongena</i>	Ep		x						x

TABLE 1.

Crop List Showing Core Crops and Major Core Crops			Map Code	Zone Occurrence				Number of Zones in which Crop Occurs			
Cabbage	<i>Brassica oleracea</i>		Cb		x	x				x	
Bean	<i>Phaseolus</i> sp.	§*	Ph	x	x	x	x	x			
Groundnut	<i>Arachis hypogoea</i>		Gn	x	x	x			x		
Pigeon Pea	<i>Cajanus cajan</i>	§*	Pp	x	x	x	x	x			
Blackeyed pea	<i>Pisum sativum</i>		By				x				x
Pumpkin;											
Squash	<i>Cucurbita</i> sp.	*	Pk	x	x	x	x	x			
Watermelon	<i>Citrullus vulgaris</i>		Me	x							x
Cucumber	<i>Cucumis sativus</i>		Cu			x	x			x	
Arrowroot	<i>Maranta arundinacea</i>		At			x					x
Cassava	<i>Manihot esculenta</i>		C		x	x				x	
Sweet potato	<i>Ipomoea batatas</i>	§*	Sw	x	x	x	x	x			
Tania	<i>Xanthosoma saggitifolium</i>		Ta		x	x	x		x		
Dasheen	<i>Colocasia esculenta</i>		D		x		x			x	
Tout-les-mois	<i>Canna edulis</i>		T		x	x	x		x		
Shallot	<i>Allium ascalonicum</i>		Sh				x				x
Yam	<i>Dioscorea</i> sp.	*	Y	x	x	x	x	x			
Cotton	<i>Gossypium barbadense</i>		Ct		x	x				x	
Total number of crops:				14	29	25	15	7	3	17	12

* Core Complex: crops found in every study plot in each zone: banana, maize, bean, pigeon pea, pumpkin, sweet potato, yam.

§ Major Core Crop: crops of the Core Complex occupying major space in every study plot in each zone: maize, bean, pigeon pea, sweet potato.

|| Cash crop planted among subsistence crops.

TABLE 2. TECHNIQUES

Technique List	Zone Occurrence				Number of Zones in which Technique Occurs			
	Zone 1	Zone 2	Zone 3	Zone 4	4	3	2	1
Plot Arrangement								
1. Sections or patches	x	x	x	x	x			
2. intercropping	x	x	x	x	x			
3. border plants	x	x	x	x	x			
4. trees on plot	x	x	x	x	x			
5. use of natural features	x	x	x	x	x			
6. fencing	x							x
7. fallow areas in plot	x	x	x	x	x			
Land and Moisture Management								
8. moving soil (mounding and ridging)	x	x	x	x	x			
9. mulching (green)	x	x	x	x	x			
10. mulching (soil)	x	x	x	x	x			
11. land rotation (fallowing)	x	x	x	x	x			
12. crop rotation	x	x	x	x	x			
13. burning	x	x	x	x	x			
14. fertilizing	x	x	x			x		
15. addition of water		x	x				x	
Wind Management								
16. live windbreaks	x	x	x	x	x			
17. plant placement	x	x	x	x	x			
18. plot placement	x	x	x	x	x			
Weed Management								
19. removing	x	x	x	x	x			
20. ignoring	x	x	x	x	x			

TABLE 2. TECHNIQUES

Technique List	Zone Occurrence				Number of Zones in which Technique Occurs			
	Zone 1	Zone 2	Zone 3	Zone 4	4	3	2	1
21. using Livestock (part of system)	x	x	x	x	x			
22. food or sale (fowl, pigs, rabbits, cattle, goats, sheep); burden (horse, donkey)	x	x	x	x	x			
23. tethering on fallow	x	x	x			x		
Tools								
24. cutlass, hoe, fire	x	x	x	x	x			
25. fork and mattock		x						x
Labor Supply								
26. Household only	x	x	x	x	x			
Planting and Harvesting Techniques								
27. dibbling	x	x	x	x	x			
28. hoeing	x	x	x	x	x			
29. continuous harvesting	x	x	x	x	x			
30. seeds saved	x	x	x	x	x			
31. cuttings saved	x	x	x	x	x			
32. surplus planting	x	x	x	x	x			
33. ground storage	x	x	x	x	x			
34. occasional small-scale cash cropping	x	x	x	x	x			
35. continuous planting		x	x	x		x		
36. strategic plant placement	x	x	x	x	x			
Total techniques and strategies 36	33	35	34	31	30	3	1	2

with the data we gleaned from the literature bespeaks an Antillean sub-system of tropical American subsistence cultivation.

Of the writers cited, Momsen, Rashford, and Hills & Iton recognize such a system. Hills & Iton identify twenty crops and a complex of techniques with spatial and temporal persistence in the region. Their twenty crops include our seven core crops, and the complex of techniques they identify as particularly Caribbean contributed to our own formulation (1982: 2-5). Rashford recognizes a Caribbean system constituted from aboriginal, African, and colonial sources (1982: 87). His list of crops grown by tenant farmers, whose assemblage is distinguished from that of owners by the absence of all trees except *Musa* (compare the zone 4 rented garden described in the appendix), includes the seven core crops, but does not indicate their relative importance (308-22). Momsen's study of the gardens of Barbados, St. Lucia, and Martinique includes no inventories of crops or techniques, but argues that a common structure emerges from factor analysis of survey information (1982). Her approach is quite different from our own, yet it yields the same conclusion of common structure in three disparate islands.

Table 3, derived from crop lists, garden maps, garden descriptions, and less systematic mentions of important crops in the literature, confirms in general the core complex that emerged from our field study, but suggests some important modifications. The first concerns cassava, also called manioc (*Manihot esculenta*). Table 3 indicates that cassava should be added to the core complex. The literature does not permit us to distinguish between bitter and sweet, if such a distinction can truly be made (Sturtevant 1969), but one or both are found on every island listed in the table. It is ubiquitous in the islands rather than dominant in most plots, and its use is probably declining, as the preparation of cassava flour is a lengthy process (cf. Kreiselman 1958: 130). On Montserrat today only a few people prepare cassava bread as a Christmas specialty, but in the seventeenth century Montserrat supplied cassava bread for the British fleet and army in the Leeward Islands (Rawlinson Ms. 1656: 426). It is also grown in Barbudan dooryard gardens, although it did not appear in our study plots, but the processing equipment for the bitter type has almost disappeared from the island. (For a general discussion of cassava in the Antilles, see Sturtevant 1969.)

The second change involves *Xanthosoma* and *Colocasia*, which may be regarded as complementary partners. Observers frequently merge or confuse them, but where moisture permits, *Colocasia* will be grown

TABLE 3. CORE CROPS IN THE CARIBBEAN ISLANDS

Island		Pigeon pea	Sweet potato	Yam	Maize	Phase- olus	Musa	Cucur- bit	Cassava	Xantho- soma	Colo- casia	Sources and data rating*
Lower drier	Barbados	\$	\$	\$	\$		\$		\$		\$	Handler 1964 [2]
	Bequia	\$	\$		\$				\$			Adams 1976 [2]
	Carriacou	\$	\$	\$	\$				\$	†	†	Richardson 1975 [3] Smith 1962 [3]
	Caymans	\$	\$	\$	\$	\$		\$	\$	\$	\$	Buchler 1963 [2]
	St. Maarten	\$	\$	\$	c	\$	\$	\$	\$	\$	\$	Keur & Keur 1960 [2]
Higher wetter (may have dry leeward coast)	Dominica	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	Layng 1983[3] Myers 1985 [2]
	Grenada	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	Brierley 1973 [1]
	Martinique	\$	\$	\$	\$	\$	\$		\$	\$	\$	Horowitz 1967 [2] Kreiselman 1958 [3]
	Nevis	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	Merrill 1958 [2] Richardson 1983 [3]
	Providencia	\$	\$	\$	\$	\$	\$	\$	\$			Wilson 1973 [3]
	St. Kitts	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	Mills 1974 [1]
Mixed	Guadeloupe	\$	\$	\$	\$	\$	\$	\$	\$	\$		Hoy 1961 [1]
	Hispaniola: Haiti	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	Herskovits 1971 [2] Wood 1973 [1]
	Hispaniola: Dominican Republic	\$	\$	\$	\$	\$	\$	\$	\$	\$		Werge 1975 [1]
	Jamaica	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	Rashford 1982[1]
	Puerto Rico	\$	\$	\$	\$	\$	\$		\$	\$	\$	Doerr 1955 [1] Beischlag 1955 [1] Naley 1955 [1]
	Tobago	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	Niddrie 1961[1]
	Trinidad	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	Herskovits & Herskovits 1947[2]

Crops considered by sources cited to be important are marked by \$.

*Data rating: [1] - source cited is specifically concerned with cultivation; crops identified by scientific names; work includes detailed lists, maps, descriptions. [2] - focus on gardens is part of larger work, or shorter paper on gardens excludes scientific and descriptive detail. [3] - Crops are mentioned in work on different subject.

c. Omitted in source(s) consulted. || Imported. † Not specified but probably included in root crops.

as well as *Xanthosoma*. Table 3 shows that neither is reported for three of the eighteen islands. Of these, Providencia may be a case of incomplete reporting by an observer primarily interested in other things (Wilson 1973), while Bequia imports the two roots as necessary foods (Adams 1976), and both Carriacou and Bequia are in a state of economic decline (Adams 1976; Richardson 1975). Nevertheless, the widespread distribution of the two crops in a range of islands and their high incidence of occurrence argue for their inclusion in the core complex at least provisionally. Research in the Caribbean on the distribution and uses of these two genera, clearly differentiated, would be most useful.

The third change concerns the cucurbits, whose absence from six islands argues for their removal from the core complex. All of the remaining crops are reported present in at least fifteen islands that include a range of wet and dry, high and low conditions. We propose, therefore, a modified core complex consisting of maize, pigeon peas, sweet potatoes, *Phaseolus* species, yams, *Musa* species, cassava, and the *Xanthosoma-Colocasia* pair.

Next we must consider the major core complex, those four crops we hypothesized to be the basic reliable complex under the most difficult physical, social, or economic conditions. Of the four original candidates (sweet potatoes, *Phaseolus*, pigeon peas, and maize), the sweet potato and the pigeon pea are reported present on every island listed in Table 3. *Phaseolus* is missing from three, among them the hard-pressed Bequia and Carriacou, and should perhaps be set aside from the major group until further research. Maize is not reported from St. Maarten, but one absence does not diminish the significance of its otherwise widespread occurrence under all conditions.⁵ Cassava, on the other hand, should be included in the major group as it is still important to every island on Table 3, even though it does not always occupy the most space and may be declining in use. The modified major core complex, then, comprises pigeon peas, maize, sweet potatoes, and cassava. The basic importance of this group is specifically corroborated: Niddrie (1961: 35) lists these four as a basic dry complex in Tobago, and Doerr (1955) groups them with beans as a "major subsistence complex" in the semiarid areas of southwest Puerto Rico.

No studies supplied lists of plot management and cultivation techniques that could be compared with Table 2. We did, however, assemble a set of practices that, as a complex, distinguishes Antillean gardening, even though some of the individual elements are found elsewhere in tropical America. Hills & Iton (1982) propose a set of uniform regional techniques consisting of nutrient supply, intercropping, a crop-live-

stock combination, drainage, soil management, and the use of pigeon peas on garden borders. Mills (1974: 72) proposes continuous harvest, hoeing into banks, intercropping, tethering animals on fallow, and swiddening.

Of these, the pigeon pea border and the tethering of animals on fallow appear to be particular to the Antilles. Several writers have noticed the special place of domestic animals in Antillean gardens (Brierley 1974: 142-43; Handler 1964: 234-40; Richardson 1975; Rubenstein 1975: 165; Wright 1979: 10; Werge 1975: 64; Yankey 1969: 201). The integration of livestock is characteristic of gardens everywhere in Latin America, but outside the Antilles the pens are rotated through the plot, and dung is hand carried (Denevan 1980: 230). In the Antilles the tethering on fallow supplements these techniques. Few outsiders have observed the significance of the pigeon pea in Antillean gardens (except Handler 1964: 229, Harris 1965: 92-93; Niddrie 1961: 37). It is notable, however, that the Caribbean regional journal of food and nutrition is entitled *Cajanus*, and that the plant has many quasi-religious and medicinal uses in the Caribbean in addition to its use as a boundary-marker (Ayensu 1981: 140-41).

Two techniques that Antillean gardeners share with other gardeners of the American tropics require some special discussion: the use of ridges or mounds, and intercropping. Intercropping has been studied both regionally and internationally and its advantages are well-known (Batra 1982; Bradfield 1970; Hills & Iton 1983; Innis 1976; Norman 1974; Rashford 1982; Risch 1980; Stelly 1976; Weber 1979). The intercrop pattern of the Caribbean islands is a function of the distinctive crop complex. The maps in the appendix show the recurrent combinations: pigeon peas with cassava; maize with cassava; sweet potatoes with any combination of *Phaseolus* beans, maize, and pigeon peas; and yams with beans. The benefits of Caribbean intercrop combinations are summarized by Hills & Iton (1983).

Ridging has also been well described (Caines 1802: 40-43; Pulsipher 1978). It is documented from colonial times, when slaves were allowed to grow provisions along the crests of cane ridges (Caines 1802: 40). The hoe was the exclusive ridging tool, and to this day some gardeners of Montserrat refer to the work of hoeing ridges as "holing", the old term for hoeing cane holes into earth banks (Deerr 1949: ch. 2). Mounding and ridging are nearly universal techniques for managing soil and water, but the use of the short-handled hoe to raise earth is not mentioned for other areas of the American tropics.

To these features we add two more that help make the system

flexible: a range of tenure forms, and a continuum in degrees of intensification. Intensification ranges from rotational bush fallow swiddens to permanently and intensively cultivated plots subject to soil and water management short of irrigation. Land may be held in usufruct, freehold, and forms of tenancy including rent and share arrangements. These features respond to intra-regional variations in population density, land quality, and the presence or absence of commercial agriculture.

One aspect of Antillean land tenure needs special mention. Family land, as it is commonly called, is impartible and customarily inalienable land that is inherited and held in common by a group of siblings and their heirs. It is a customary form of freehold tenure that may include house sites as well as garden land, but the latter need not be cultivated by everyone who has rights to it. Family land is undoubtedly an Afro-American form of tenure that developed in the New World, as Besson (1984) has ably argued, and is a characteristic part of the Antillean range of small plot tenure forms.

The particular Antillean complex of techniques and features other than crop assemblage, then, consists of the short-handled hoe as a tool for mounding and ridging; a set of characteristic intercrop partners (mapped in the appendix); flexible forms of tenure and degrees of intensification that respond to a patchwork of changing demographic, economic, and physical conditions; family land as a distinctively regional form of tenure; livestock tethered on fallow; and the pigeon pea as a symbolic and boundary-marking crop.

The next step is to contrast our hypothesized Antillean sub-system with subsistence cultivation in Amazonia, Central America, and Yucatán. We must also compare it to the cultivation of the pre-Columbian Antilles in order to understand the nature of African and European modification.

The Pre-Columbian Antilles. Before the arrival of Europeans and Africans, the staple crops of the Carib and Arawak Indians of the Antilles were manioc (cassava) first, followed closely by maize and sweet potatoes (Rouse 1948: 522; Sauer 1969a: 53; Sturtevant 1961: 70). The lesser crops included cucurbits, *Phaseolus* species, native American yams (*D. trifida*), and the native American aroid, *Xanthosoma sagittifolium* (Rouse 1948: 523; Sauer 1969a: 54). This assemblage combines the root crop and seed crop complexes identified by Sauer (1969b: 45-48; 62-72). It is distinguished from the Antillean complex of today by the absence of *Musa* species, and of pigeon peas, African yams, and the aroid of Asian origin, *Colocasia*, all introduced with the

slave trade (Harris 1965: 115; Niddrie 1974: 109). It is interesting that the staple threesome of pre-Columbian times – maize, manioc, and sweet potatoes – are still part of the major group in the Antilles.

The Amazon Basin. The staple of the Amazon basin is, of course, bitter manioc, followed by the sweet potato and, for a few practitioners of incipient horticulture, *Musa*.⁶ Maize and other seed crops are secondary (Harris 1971; Lowie 1948), and crop complexes are known to be changing (Lowie 1948: 3; Hills 1968).

Before European conquest, the Amazonian bitter manioc and sweet potato complex extended to Honduras, the east coast of Brazil, and through the Antilles, whereas sweet manioc ranged farther into Bolivia, Peru, Ecuador, Colombia, and the Caribbean and Pacific lowlands of Central America (Sauer 1950: 507-09). Some peoples of the manioc area also use maize, beans, and squash, such as the Yukpa cultivators of the Colombia-Venezuela highlands, whose staple complex consists of maize, manioc, *Musa* and *Phaseolus* (Ruddle 1974: 124-50). A maize-manioc combination is also found elsewhere in the northeastern Andes (Métraux & Kirchhoff 1948: 355; Vessuri 1978: 49, 54), and in the Orinoco region (Roosevelt 1980), as well as in the pre-Columbian Antilles.

The Circum-Caribbean and Pacific Littoral. The circum-Caribbean areas and the Pacific littoral of Central America are critical areas for comparison because they are zones of overlapping aboriginal and Afro-American occupation. They will tell us whether the distinctive system we are identifying belongs only to the Antilles, or to other parts of the Afro-American tropics as well. Both the Miskito Indians and the Afro-American Garifuna of Honduras grow manioc as a staple crop (Gonzales 1969: 24; Nietschmann 1972). On the Pacific littoral, the Indian and Afro-Hispanic complexes alike include *Musa*, maize, manioc, and “taro-like tubers” (Whitten 1974: 65). The maroon groups of the former Guianas (also called Bush Negroes), who escaped slavery and forged a new society and culture from the late seventeenth to the mid-nineteenth centuries, adopted Indian staple crops during that period (Mirot 1973: 317; Price 1983: 78). Today manioc continues to be a principal crop among some maroon groups, although it has been replaced among others by dry rice (Price 1984: 27-33). Among both Indians and maroons, assemblages of lesser crops include maize, yams, *Xanthosoma*, *Colocasia* and *Phaseolus* (Cook 1968: 76; Hills 1968; Hurault 1965; Kahn 1931: 85-87; Kloos 1971: 32-34). The presence among Indians of *Colocasia*, introduced into the Antilles with the slave trade, may suggest that the Antillean complex is spreading, but the pigeon pea is not mentioned.

In the Caribbean lowlands of Central America, maize and manioc are the dominant staples, whereas pigeon peas, yams (either African or American), and the two aroids are of lesser importance or missing altogether from crop lists (Carter 1968; Johnson 1948: 231-52; Kirchhoff 1948: 220-21; Young 1971). Therefore we should consider these crops further as perhaps the crops that most distinguish the Antillean sub-system.

The pigeon pea is only rarely mentioned outside the island region. Ruddle reports it as a dooryard perennial among the central Venezuelan Yukpa, and Vessuri includes it in her list of crops grown by Venezuelan campesinos, but Vessuri's production figures (1978: 49-55) and Ruddle's garden maps (1974: 134-50) show its comparatively minor status. Some Campa of western Amazonia and a few Central American lowland Indians also use it (Denevan 1971; Carter 1968; Johnson 1948: 231; Young 1971). The lowland Indians may simply have adopted a useful crop of their neighbours, but the adoptions in Venezuela and western Amazonia are more likely related to the drier environment, in which the pigeon pea thrives.

We should also notice that those Indian groups who adopted the pigeon pea already practiced the seed cultivation of maize and beans. Furthermore, tropical cultivation changes continuously. Maize, for example, still spreads in South America (Hills 1968), just as the use of manioc or cassava in the Antilles dwindles. Pigeon peas may also be spreading. Unfortunately the literature does not tell us whether the symbolic significance of the crop as a border plant survives its diffusion beyond the islands.

African yam species and Asian *Colocasia* are also African contributions to the Antillean core crop complex. Native American yams are known and used in Amazonia and Central America (Denevan 1971: 505; Kirchhoff 1948: 220-21; Métraux & Kirchhoff 1948: 55; Mirot 1973: 317; Murra 1948: 278), although the literature does not indicate that they are staples (Denevan 1966; Gross 1975: 527). Further, American yams are absent from the assemblages of many groups in the Amazon and Central America (Harris 1971; Kirchhoff 1948; Johnson 1948; Roosevelt 1980). Although they were not pre-Columbian staples in the Greater Antilles either, they were quite important to the Caribs of the Lesser Antilles and Trinidad (Rouse 1948). These facts suggest that the partial replacement of manioc by a starch complex consisting of maize, sweet potatoes, yams, and *Xanthosoma* had already begun in the Caribbean islands in pre-Columbian times. The African contribution of African yams and *Colocasia* (from Asia by way of Africa) intensified the trend.

Colocasia is an important staple in the Pacific, where it is associated with moist environments (Barrau 1965; Hanson 1970; Waddell 1972: 51). It is not mentioned in Amazonian crop lists, many of which include *Xanthosoma* (Denevan 1971: 507; Kirchhoff 1948; Métraux & Kirchhoff 1948: 355; Smole 1976), nor does it occur in Central America. It would be useful to know whether the "taro-like tubers" in the Afro-Hispanic gardens of coastal Ecuador and Colombia include *Colocasia*, the true taro, although these gardens are in any case dominated by maize, *Musa*, and manioc (Whitten 1974: 65, 92-93). Nevertheless, the presence of *Colocasia* as a core crop and its function as a wet-site alternative to *Xanthosoma* are distinguishing features of Caribbean cultivation.

The final testing area for the sub-system is Yucatán, where there is also a range of moisture and topographical conditions, but where the population is predominantly native American. Maize dominates everywhere. Beans and squash are also important; sweet potatoes and *Xanthosoma* are less so. Some cultivators use manioc, bananas, and American yams, but these are far less important (Nations & Nigh 1980; Smith & Cameron 1977; Steggerda 1941). All of these domesticates except *Musa* may have been present among the prehistoric Maya (Wiseman 1983: 162). Pigeon peas, African yams, and *Colocasia* were not, of course, nor are they definitively reported in the present.⁷ Other important core crops of the Antilles – yam, manioc, and banana/plan-tain – have only minor places in the subsistence gardens of Yucatán.

We must now consider why the Antillean complex we have just identified does not coincide with the distribution of Afro-American gardeners in the New World tropics. During the first years of contact in the islands, the Africans borrowed economic plants as well as cultivating and processing techniques from the Indians, but the quick and early extermination of the Indians left an opening for African innovations in cultivation. The volume of the slave trade and the proportion of Africans in the total population was greater in the Antilles than anywhere else in the New World (Curtin 1969: Tables 23, 65, 77). These conditions explain the strong African imprint on the cultivation system.⁸ Where American Indians survived in greater numbers, however, they influenced African newcomers to a greater degree, as the crop complexes of the Bush Negroes, the Garifuna, and the Afro-Hispanics of coastal Ecuador and Colombia imply. Finally, the island cultivation system is not only a repository of Indian, African, and European contributions. It is also an adaptation to a range of environmental conditions: recurrent droughts, variable topography, and a variety of

moisture and wind conditions, all within a restricted and scattered land area.

CONCLUSION

The Antillean variation on the gardening of the American tropics evolved as part of the New World creolization process. It is a syncretic adaptation worked out by African slaves who incorporated African and European elements into aboriginal systems that already existed in the islands. Mounding, for example, was a feature of pre-Columbian conucos (Sauer 1969a: 51-53). Ridging has many possible sources: British and Irish lazy beds (Fowler 1983: 154-56), plantation canefields (Caines 1802: 40; Galloway 1985: 343-44), West African gardens (Miracle 1967: 162), and a variety of American aboriginal ways of raising earth (Denevan 1980). The short-handled hoe used to raise earth is, however, a tool of African provenience. The domestic animals came from Europe, and tethering them on fallow land was an eighteenth-century plantation practice (Caines 1802: 21). The core crop complex disclosed by our research includes aboriginal domesticates, to which were added African and Asian contributions introduced by the European slave trade. The entire assemblage also has multi-cultural origins.

The basic conformation that we have described can still be refined and amplified. The total crop assemblage outside the core needs to be inventoried and systematized, and island variations explained. We need a better understanding of the place of trees (but see Rashford 1982). Mango and breadfruit seem to have a great significance in the system, even where they are not intentionally planted and where they grow outside of gardens (Blume 1974: 49; Niddrie 1974: 109).

It is also necessary to organize the factors that will predict local variations in the system. These include physical and biotic factors, such as land quality, the incidence of drought, and the prevalence of garden pests (Berleant-Schiller 1977a; Mills 1974; Momsen 1972; Rashford 1982; Richardson 1975). Land tenure, crop theft, restricted access to basic resources, and stratification are features of social organization that are linked to each other and that may be partially related to physical factors; they are certainly related to the presence or absence of large-scale commercial agriculture (Berleant-Schiller 1977a, 1977b, 1978, 1983; Mills 1974; Paquette 1968; Rashford 1982; Stone 1976). The link between population density and local gardening differences is clearly important, but it has been neglected in Caribbean research

(Turner *et al.* 1967: 384-96). The education of cultivators and the possibilities for transport and marketing influence gardening decisions and hence local variations in the system (Brierley 1974; Momsen 1972). Studies of actual diets and of food preferences are also important. Recognition of these factors has emerged from local field research. A hypothesis for regional research that synthesizes these and other factors is now both practicable and pressing.

The Antillean small plot cultivation system is a widely distributed regional phenomenon that long antedates emancipation. We have tried to synthesize its distinctive characteristics, to differentiate it from the larger American tropical cultivation system of which it is a part, to explain its origin as a syncretized Afro-American adaptation, and to propose directions for further research.

APPENDIX

TABLE 4. SUMMARY DESCRIPTION OF FOUR STUDY PLOTS

Garden Characteristics	Charles	Killeen	Smiley	Mead
Zone classification	1	2	3	4
Degree of slope	0°	20°	45°	25°
Orientation of slope	no slope	W	WNW	W
Plot size (m ²)	5574	1393	1254	1393
Plot shape	irregular	rectangle	trapezoid	rectangle
Soil	limestone	volcanic	volcanic	volcanic
Distance from house	403 m.	on site	on site	805 m.
Tenure	usufruct	owned	owned	rented
Origin of tenure	common	inherited	bought	rented
Household size	9	7	6	2

We present here a description of one garden in each zone. The zone 1 garden is in Barbuda; the other three are in Montserrat. The gardens of zones 1, 2, and 3 are accompanied by maps sketched on the site and later redrawn. The three maps illustrate intercrop patterns; spatial arrangement of natural and human-made features; crop complexes; the location of trees, animals, and fallow land; and other features discussed in the text. The descriptions provide additional information about the gardeners, their households, and their tools and techniques.

Zone 1: The Charles Garden of Barbuda

Figure 1. Barbuda, Zone 1 with Study Garden Plot

The Charles garden lies on Barbuda's flat marginal plain, at five meters above sea level. It consists of two parcels, about 150 meters apart and about 450 meters away from the dwelling. Sheet outcrops of limestone lie in the shallow greyish rendzina. The main parcel, mapped in Figure

3, has about 0.65 hectare in crop and about 0.18 hectare in fallow. A grove of trees, some planted and some volunteer, separates the fallow from the cropped. The second parcel is 0.4 hectare and planted only in sweet potatoes (*Ipomoea batatas*) and pigeon peas (*Cajanus cajan*), Barbuda's most dependable crops. Both parcels are held in usufruct. A wire fence keeps out straying livestock.

Aside from the trees – soursop (*Annona muricata*), genip (*Melicoccus bijugatus*), cashew (*Anacardium occidentale*), lime (*Citrus aurantiifolia*), sweet orange (*Citrus sinensis*), and calabash (*Crescentia cujete*) – there are just eight different crops in the Charles garden, which rarely receives more than 7 to 10 centimeters of rain a month during the growing season, September through January, and rarely more than 90 centimeters during the year. The crops are arranged in intercropped

Figure 2. Key to Garden Sketch Maps

Figure 3. The Charles Garden, Zone 1, Barbuda

clumps and patches, maize (*Zea mays*) with beans (*Phaseolus* sp.), maize with sweet potatoes, beans with yams (*Dioscorea* sp.), and pumpkins (*Cucurbita moschata*) with watermelon (*Citrullus vulgaris*). A few loblolly trees (*Pisonia subcordata*) were spared burning to provide shade. The stems of partly burned shrubs support bean vines. Melon and pumpkin vines are planted around outcrops so that they may spread over the rock and keep the fruit from ground contact.

The land is cleared with a machete and then burned. The Barbudan system of tenure that grants common rights to undivided lands favors shifting cultivation, so that cutting and burning new sites is a regular procedure. Once the ash is spread, planting is done by dibbling and hand-setting. Mounds for sweet potatoes loosen the soil and encourage the retention of moisture.

Nutrient management includes spreading of burn ash and pen manure, mulching with green manure, intercropping, and rotational bush fallow. The parcel devoted to pigeon peas and sweet potatoes, for

example, will be abandoned after its third year of use. The fallow section of parcel number 1 has not been used for three years, although some cattle are occasionally tethered there, enriching the soil with their droppings. Moisture management consists of placing sensitive crops in the shade and in deeper soil pockets that catch runoff from rocks. Weeds are hoed and pulled.

Except for a few cows tethered on the fallow, livestock stay elsewhere: fowl, pig, and donkeys in the house yard and goats, sheep, and cattle on open range. These animals are for food and sale, cattle being an especially important source of income (Berleant-Schiller 1977). Household labor is sufficient for this garden and for another located elsewhere. The gardens supply a large part, though not all, of the subsistence for nine people.

Zone 2: The Killeen Garden

Figure 4. Montserrat, Zones and Study Garden Plots (planimetric map)

Figure 5. Montserrat, Zones and Study Garden Plots

The Killeen garden is in Gerald's Bottom, 150 meters above sea level in the north of Montserrat. The rectangular, 0.16 hectare plot faces west on a leeward slope of about 20° . The soil is volcanic, as are all the soils in Montserrat. The plot is clearly bounded by a seasonal stream on the west, the house and yard on the east, a line of coconut palms on the south, and a line of pigeon pea bushes on the north (Figure 6). Despite the threat of drought, zone 2 gardens are the most complex. This one has an assemblage of 29 crops, including twelve species of trees.

The garden falls into sections linked with natural features such as slope and outcrops, and with cultural features such as paths, shower stall, and rabbit hutch. For example, the area that benefits from shower runoff supports fruit trees, whereas a rock pile keeps pumpkin vines from ground contact. About one quarter of the garden is fallow, although the fallow part yields a second bearing of sweet potatoes. These are more than the household can eat, but such surplus planting secures genetic variety for propagation and insures against crop failure. Goats and donkeys occupy the fallow.

Garden techniques include cutting and burning followed by hoeing soil into ridges about 36 centimeters high and a meter apart. Pen manure, green manure, and household refuse enrich the soil; intercropping and rotation preserve fertility.

Moisture management is especially important. Location on a leeward slope inhibits desiccation by sea breezes. Ridging traps water in troughs and inhibits evaporation by capillary action (Pulsipher 1978). Green mulch also reduces moisture loss. The small part of the garden that receives household runoff is planted with crops that need extra

Figure 6. The Killeen Garden, Zone 2, Montserrat

water, such as dasheen (taro, eddo; *Colocasia* sp.), sugar cane (*Saccharum officinarum*), and fruit trees.

The rabbits and pig housed in the garden supply fertilizer and eat weed cuttings and scraps from house and plot. Goats and donkeys occupy the fallow, while cattle and fowl are kept on a more distant parcel. These animals supply food, money, and transport.

Mrs. Killeen, age 45, works the plot with household help, using the ordinary tool complex of hoe, fire, and machete, and adding fork and mattock hoe for breaking soil. The garden provides subsistence for eight people.

Zone 3: The Smiley Garden

The Smiley Garden at Baker Hill lies 215 meters up the north face of the Centre Hills on a 45° slope facing west northwest. It is 0.13 hectare in area, completely ridged, and bounded by a road at the top, a watercourse downslope, and plantings of pigeon pea, sugar cane, banana (*Musa* sp.) and coconut along the sides.

Twenty-four crops are arranged in intercropped patches (Figure 7). Trees clustered in the northeast corner and lined along the downslope watercourse include avocado, breadfruit, mango, and cocoa. Other trees dot the garden.

Techniques that help maintain soil nutrients are intercropping, crop rotation, and the application of pen manure, green manure, and household refuse. Small parts of the plot are fallowed for a few months at a time on a rotating basis. Burning adds few nutrients because it is used only on small areas of herbaceous plants.

Figure 7. The Smiley Garden, Zone 3, Montserrat

Water control requires management of both excess moisture and lack of moisture on a steep, easily eroded slope. Ridges check runoff and hold water in the troughs where moisture-loving crops are placed. Excess water is drained through a cross-ridge trench. As in the Killeen garden, plants that need regular watering are planted near household drainage.

Despite its location on a leeward slope, the garden needs protection from the continuous wind. Dense grasses and clumps of sugarcane on the upper border intercept some breezes. Sensitive plants are placed in the lee of trees, outcrops, and buildings.

Weeds that do not threaten crops are ignored. They hold soil and provide ground cover. When necessary, they are pulled or chopped, and used for mulch and animal feed. Garden scraps also feed the goats, rabbits, and fowl that are housed in the yard and garden, for sale or food as necessary.

Excess planting is seen here too, and equally turns out to be purposeful. There must be enough for the inevitable pests as well as for the household. The seemingly disproportionate numbers of breadfruit and mangos in the garden tempt pests away from other valuable crops and supply abundant pig feed.

Hoe, machete, and very limited fire are the only tools. Household labor accomplishes daily and seasonal jobs and provides subsistence for six people.

Zone 4: The Mead Garden

This plot, at Upper Galways in southwestern Montserrat, typifies the moist conditions of zone 4. It lies at 335 meters on a 25° slope that faces west. The rectangular, 0.16 plot is rented for EC\$10 a year (about US\$4), supplies subsistence for a couple past eighty, and is located 800 meters above their house.

The plot is typically ridged and arranged into intercropped and single-cropped patches. Pigeon peas, maize, and red peppers (*Capsicum frutescens*) are planted separately; sweet potato, dasheen, pumpkin, tania (*Xanthosoma sagittifolium*), and cucumber (*Cucumis sativus*) are intercropped. Border plants mark the boundaries.

The soil is cultivated with hoe and machete. No pen manure is applied because no animals are housed on the plot, but daily weed cuttings add green manure. Nutrients are also managed by crop rotation, intercropping, periodic burning, and fallowing of about one sixth of the plot at any given time. Long term fallowing will effectively take

place when declining fertility drives Mrs. Mead to rent elsewhere.

Ridging answers most requirements of water management, aided by mulching, crop placement, and hoeing. Although there is frequent rainfall, the slope sheds water without eroding quickly. Wind desiccation is not a problem either, because air descending from the Soufriere Hills almost always carries moisture.

The plot is too far from the house for Mrs. Mead to keep animals on it conveniently. However, garden maize feeds the fowl in her houseyard and helps support the draft donkey.

As in Zone 3, weeds are useful in holding soil, and are removed only if they interfere with the crop. Mrs. Mead works the plot with only minimal and occasional help from her husband, using hoe, fire, and machete.

NOTES

1. The field research for this paper was done jointly in Montserrat in 1979, and separately in Montserrat (Pulsipher) and Barbuda (Berleant-Schiller) from 1971 to 1983. The paper itself is also the product of both joint and individual work. The original versions of the appendix and the report on field study were jointly drafted; the revisions published here are the work of Berleant-Schiller. The sections on comparison, interpretation, and conclusions are the complete responsibility of Berleant-Schiller. Pulsipher assumed responsibility for revising the maps and tables and supervising their final preparation. We are grateful to the Cartography Laboratory of the University of Tennessee Geography Department for executing the maps and tables.

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2. This abundant literature includes: Antonini 1971; Brach 1964; Brierley 1974; Buchler 1963; Caribbean Commission 1954; Demas 1970; Edwards 1961, 1973; Friedrich 1975; Henshall & King 1966; Hills & Iton 1982, 1983; Hoy 1961, 1971; Innis 1961; Iton 1970; Jolly 1956; Keur & Keur 1960: 59-101; Kimber 1966; Merrill 1958; Mills 1974, 1976; Momsen 1972, 1973; Niddrie 1961; Paquette 1968, 1982a, 1982b; Pulsipher 1978; Rashford 1982; Stone 1976; Werge 1975; Winters & Miskimen 1967; Wood 1963; Wright 1979; Yankey 1973.

3. Annual rainfall averages for each island are available, but regular, accurate records of intra-island variations are not.

4. It is difficult to distinguish absolutely between cash and subsistence crops because gardeners must be flexible. Market prices, transport, household economy, and other factors influence the disposal of the harvest no matter what a gardener's intentions at planting.
5. The absence of maize from the list of crops reported for St. Maarten is very puzzling. Keur & Keur may have accidentally omitted it (1960: 71), especially since they mention maize as one of the crops grown by the freed people after emancipation (70).
6. Many authorities may be cited to show the dominance of manioc in the Amazon basin, including Basso 1977: 13; Carneiro 1964; Chagnon 1968: 249-50; Denevan 1966, 1971; Grigg 1974: 10; Gross 1975: 531; Harris 1971; Leeds 1961; Meggers 1973: 311; Moran 1979: 143-44; Smole 1976. Good summaries of Amazon subsistence cultivation may be found in Lowie 1948 and Sauer 1950.
7. Smith & Cameron report the presence of the *garbanzo*, which is the Spanish term for chickpea, *Cicer arietinum*. But they mistake its binomial, assigning *Cajanus indicus*, which properly refers to the *gandule*, or pigeon pea. Nations & Nigh do not further specify the genus *Dioscorea*.
8. Although the total number of slaves imported during the trade was as great in Brazil as in the Antilles, the proportion of slaves both to total population and to land area was lower.

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