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AGRICULTURAL DEVELOPMENT: PRESENT AND POTENTIAL

ROLE OF EDIBLE WILD PLANTS

PART I

CENTRAL AND SOUTH AMERICA AND THE CARIBBEAN

November 1980

REPORT TO THE DEPARTMENT OF STATE

AGENCY FOR INTERNATIONAL DEVELOPMENT

AID/OTR-147-80-87

AGRICULTURAL DEVELOPMENT: PRESENT AND POTENTIAL ROLE OF EDIBLE WILD PLANTS

PART 1

CENTRAL AND SOUTH AMERICA AND THE CARIBBEAN

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TABLE OF CONTENTS

TABLES

INTRODUCTION

Before domestication of plants and animals all humans lived as hunter-gatherers. The agricultural revolution, first in China and Southeast Asia at least 20,000 years ago, radically altered human economic systems and food patterns, permitting the development of agricultural, pastoral, and ultimately urban societies. While domesticated plants allowed expansion of human activities, with associated social and technological developments, domestication also initiated a basic human nutritional paradox. As reliance upon domesticated foods increases, dietary diversity and food selection diminishes -- as food selection diminishes, the probability that all essential nutrients can be obtained from the diet also diminishes.

While principle efforts in agricultural development, heretofore, have been directed toward improving productivity -- not the diversification of domesticated plants and animals -- a major question may be posed: can nutritionally important wild plants offer a legitimate focus for development research? Recent reports by Doughty (1979a; 1979b), National Research Council/National Academy of Sciences (1975; 1979), Nietschmann (1971), Pirie (1962; 1969a; 1969b), Robson (1976), von Reis (1973), and Wilkes(1977) suggest that substantial economic and nutritional gains can be achieved by increasing dietary utilization of wild plants.

Such suggestions form the objective of this report, to explore the role wild plants already play in human diet in Central and South America and the Caribbean. To accomplish this objective three goals are established: 1) document dietary uses for wild plants, using published accounts of the past 150 years, 2) identify the relative dietary-nutritional importance of selected species, and 3) examine the research potential for such species within the con-

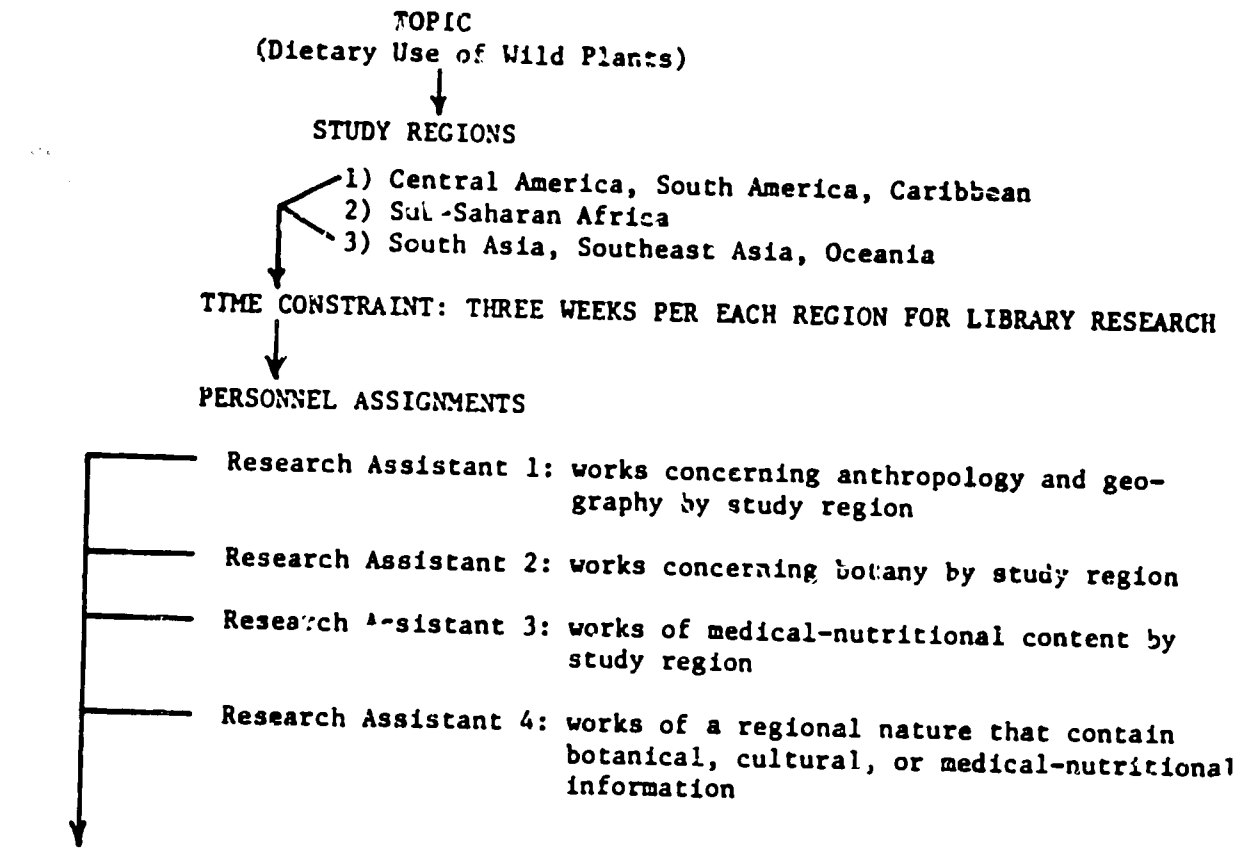
text of agricultural development as part of existing USAID themes of improving agriculture and nutrition in Third World nations.

Basic study questions associated with these objectives may be identified. In regions or societies where wild plants are used as human food, are the plants central or peripheral to maintaining dietary quality? Is their use seasonally important, or is utilization common throughout the agricultural year? Do wild species complement or duplicate energy and nutrients obtained from domesticated field crops? What role do wild plants have in maintaining nutritional quality of diet during drought and periods of associated social unrest? Should research on dietary wild plants be sponsored directly by USAID within the context of agricultural development, or be assigned a low USAID priority?

METHODS

This contract, awarded September 1980, was designed for library research only; no field surveys or correspondence with appropriate governmental agencies were initiated due to time and financial constraints. Four assistants trained in library research-retrieval methods were employed to assist the principal investigator. Two computer literature-retrieval searches were coordinated using DIALOG/AIRS systems available through the Peter J. Shields library, University of California, Davis. This system, drawing from a publication data base exceeding 12 million articles, is a cross-tabulation process whereby key words associated with wild plant use in diet were matched with respective countries of Central and South America and the Caribbean (Appendix 1). The literature search using the DIALOG/AIRS system was disappointing, yielding less than twenty suitable references. Accordingly, a standard literature search on dietary wild plants was initiated using a methodology outlined in Table 1. Basic anthropological, botanical, geographical, medical, nutritional, and sociological journals appropriate to each country were scanned for the years 1975-1980. Any journal

TABLE 1. Library Research Organizational Plan



1. General journals (multi-disciplinary)
2. General books (multi-disciplinary)
3. Specific journals (by discipline, study region, and country)
4. Specific books (by discipline, study region, and country)
5. Bibliographies (by discipline, study region, and country)
6. Dissertations/Theses (by discipline, study region, and country)
7. Abstract services (by discipline)

   Anthropology Abstracts; Food Science Abstracts; Geographical Abstracts; Nutrition Abstracts; World Agriculture, Economics, and Sociology Abstracts
8. Current Contents (natural sciences and social sciences)
9. Science Citation Index (examination by key word; key word selected by topic, sub-theme, region, and country)
10. Index Medicus (examination by key word; key word selected by topic, sub-theme, region, and country)

containing one article appropriate to the topic of human utilization of wild plants as food during the most recent five years was scanned chronologically back to volume 1; if no suitable article appeared within the survey period, the journal was not further inspected.

Each article identified was read, reference cards prepared, and coded for region, country, ethnic group, and specific plants utilized. Information was summarized on index cards to permit rapid assembly of data. Information presented in subsequent sections of this report is arranged by general regional data, then by specific reports on plant use within each country. The accounts are quite diverse and time of publication is not the criterion of quality; some accounts are merely passing reference to human dietary use of wild plants while others provide detailed botanical documentation by Latin terminology. Still others give nutritional information on the vitamins and minerals by plant species.

Following the presentation of information on wild plant use as human food in Central and South America and the Caribbean will be a summary and recommendations.

WILD PLANTS AS HUMAN FOOD IN CENTRAL AMERICA AND THE CARIBBEAN

Introduction to Mexico and Central America

The question of food production within the tropics and the interrelationships between domesticated and wild species has long attracted botanists and social scientists (Anderson, 1952; Gourou, 1955). At first inspection it appears easy to distinguish wild from domesticated species; cultivated from uncultivated species; dietary from non-dietary species. On close examination, however, these semantical boundaries become blurred. Numerous wild plants are carefully cultivated; former domesticated species may dot long abandoned human settlements; and many medicinal plants are ingested, providing important nutritional returns.

Thus, any approach to understanding the interrelationships between dietary roles of wild or domesticated species must be carefully documented. A number of general references to human use of wild plants throughout the study region may be identified that outline basic information for both botanist and non-specialist. Bukason (1930, pp. 470-553) and Wagner (1964, pp. 231, 233, 237, 257-258) provide a sound basis for the ethnobotany of human diet in Central and South America by identifying the genera most utilized as food, noting the archaeological importance of examining abandoned settlement sites. Palerm (1967, pp. 41-45) presents a clear identification of Pre-Colombian plants utilized widely throughout Central America as human food, many of them wild (Table 2). A basic overview of plant science in Central America specifically the sub-field of ethnobotany, was completed by Hill (1945, pp. 176-181) and Dozier (1958) considered indigenous tropical agriculture and the interplay between tending wild and domesticated plants. Important work by Harris and Mursell (1950, pp. 629-631) documented more than twenty-six species of wild plants used as human food, providing nutritional composition data (Table 3). Reports by Aylward (1953, pp. 48-58) and Flores (1961, pp. 23-27), respectively, treated indigenous foods of Mexico and Central America and their important role in diet.

Other researchers have turned their attention to specific wild resources with distribution within Mexico and Central America. Van Ureen (1939, p. 766) documented the nutritional value of young wild cassava leaves as a dietary resource and Nassar (1978, pp. 311-320) has presented an overview of the geographical distribution of wild manioc (cassava, and calls for a careful examination of these wild species to prevent their botanical extinction, a problem already seen in certain varieties of wild wheat and rice elsewhere, in the world. Sauer (1950, pp. 561-632), world expert on the grain amaranths,

provides the best information on botanical classification of these important species while Devadas and Murthy (1978, pp. 159-161) have considered Beta-carotene availability from wild amaranths common throughout Central America.

Van Etten et al. (1967, pp. 1077-1089) present the amino acid composition of 379 species of wild and domesticated plants common to Mexico and Central America, and Liao and Konlande (1973, pp. 219-223) investigated teosinite (Euchlaena mexicana), wild form, common within Central America and report high protein values for this ancient cereal. Heiser and Nelso (1974) present a historical and contemporary overview of cultivated wild chenopods, especially Chenopodium pallidicaule, C. nuttalliae, and C. quinoa, tracing their ancient use and commenting on their contemporary botanical and dietary distribution within the Americas. Brucher (1976, pp. 71-106) examined semi-cultivated legumes, their protein content, and potential nutritional significance to societies in Central America.

Margin and Nakasone (1970, pp. 333-343) review the edible species of the genus Passiflora, noting there are sixteen nutritional but little utilized species with high caloric value (25-53 calories per 100 grams edible portion) and exceptionally high values of vitamins A and C. Martin and Cabanillas (1976, pp. 249-256) review the plant leven (Calathea allovia), a starchy staple with modest protein value (6.6%), and trace its nutritional role today in rural Puerto Rico, the Lesser Antilles, and throughout much of South America.

Mexico

There is a long heritage of wild plant use as human food in Mexico. Archaeological data summarized by Callen (1973, pp. 29-49) outlines the sequence of domestication for human utilization of wild cereals, fruits, and

vegetables. Bancroft (1876, pp. 265-308) describes the domesticated and wild foods common to Aztec diet while Farrar (1966, pp. 341-342) documents Aztec use of the food tecuitlatl, a single cell blue-green algae (Cyamophyta) of unknown genera (probably Spirulina), that was collected from lake Texcoco, prepared as cakes, and marketed as human food.

Modern ethnographies on rural Mexican societies contain numerous references to human use of wild plants as food. Latorre and Latorre (1977, pp. 340-357), writing on the Kickapoo Indians of Mexico, identify more than fifty species of wild plants commonly consumed (Table 4). Another excellent account is by Messer (1972, pp. 325-332) who described wild plant use in the region of Oaxaca and demonstrated the delicate balance between dietary patterns based on both domesticated and wild species and the important role played by edible greens during periods of crop failure (Table 5). Bye et al. (1975, pp. 83-112) and Cerqueira et al (1979, pp. 905-915) have recorded foods of the Tarahumara Indians of northern Mexico and have given special attention to Indian use of wild greens that provide excellent sources for vitamins, and to the role that Agave plays in Tarahumara diet as a beverage plant. Beals (1945, pp. 10-11) wrote on the Canita Indians (Yaqui) of northern Mexico and their utilization of mesquite seeds to make pinole during famine, their use of cactus fruits from species of Pitahayas and Tuna, from the Maguey, and gave special attention to Canita use of wild greens (unidentified by species).

Other northern Mexican Indian groups intensively studied for wild plant use are the Seri of Sonora. Felger and Moser (1976, pp. 13-27) identified more than seventy-five wild species and provided descriptions of the portions used (seed, fruit, root-tuber, stem flower, leaves) and methods of preparation (Table 6). Augmenting these data Felger and Moser (1974, pp. 414-436) provide lists

of ninety-four genera used medicinally, many consumed internally or prepared as dietary beverages. Other accounts of the Seri are provided by Bahre (1980, pp. 197-209) who briefly mentions gathering of wild plants as food but presents the important statistic that as much as 57% of Seri diet may be obtained from wild species at critical periods of the year.

Other accounts on wild plants as food in Mexico are based on general regional and market surveys. One study conducted by Whittaker and Cutler (1966, pp. 6-16) at Tehuacan market, Puebla, identified eighty-three domesticated and wild species available in the market and noted that many wild types had prominent dietary roles, especially wild plum (Acrocomia mexicana), cactus (Hylocereus undatus; Opuntia spp.), pigweed (Amaranthus spp.; Chenopodium nuttalliae), water cress (Nasturtium officinate), lemon grass (Cymbopogon citratus), and pine nuts (Pinus spp.). Whittaker and Cutler also document utilization of wild flowers as food, especially those from Yucca aloifolia. Elsewhere in Mexico in the region of Tlaxcala, ecological surveys of the valley by Wilken (1970, pp. 286-295) documented complementary use of wild and domesticated species, noting more than 200 wild species of plants are gathered regularly and used as food! In Tepoztlan, Morelos, Redfield (1929, pp. 167-197) identified dietary use of Acacia pods, pine nuts, Maguey, and numerous other unidentified wild greens (Spanish term collectively used is bledo). But one of the most important accounts of human use of wild plants as food in Mexico is by Caballero et al. (1978, pp. 103-144) who identified 255 primary and secondary wild species from the tropical rain forests of the Uxpanapa River, Veracruz, noting more than seventy of these species were regularly used as human food (Table 7).

The modern Mayan Indians of Mexico, ethnically associated with peoples in adjacent Guatemala and Honduras, have been extensively studied by Berlin et al (1974, pp. 103-124). Their account, a classic of modern ethnobotany, outlines modern Mayan terminology for wild and domesticated plants, providing English, Latin, and Mayan terminology for all foods utilized, the portions of the plant sought, and ecological data on Mayan gathering and tending of wild species.

A number of publications on plants common to Mexico also may be documented. General studies by Krochmal et al (1954) on wild plants of the American southwestern deserts also extends into Mexico and they identify several with marginal nutritional value. Felger and Nabhan (1976, pp. 34-39) identify species already climatically and ecologically adapted to arid zones that could be exploited commercially and nutritionally (Table 8). Bemis et al. (1978, pp. 87-95), building on arid zone ethnobotany, focus on the feral buffalo gourd (Cucurbita foetidissima), noting its high protein composition (31%) and fat content (32%) and stating that if the seeds are decorticated (oil and fiber removed), the protein value rises to a range of 42-75% making this species attractive for further research. A monograph by Nabhan et al. (1980, pp. 68-85) on two wild species of bean, Phaseolus metcalfei and P. ritensis, document their potential as human food throughout the arid regions of northern Mexico.

Williams (1978, p. 104) provides a brief botanical note on the wild tuber Tropaeolum tuberosum, a starchy staple native to the Andes of South America, but presently growing in Mexico and used as human food. But perhaps the most interesting plant identified with nutritional potential is eelgrass (Zostera marina), used regularly as a dietary resource by the Seri Indians of Sonora and identified by Felger and Moser (1973, pp. 355-356) as a plant with high potential nutritional reward. Seeds from eelgrass are harvested in Spring and contain 13.2% protein and are very low in fat (1.01%). The Seri mix the eelgrass seeds with other seeds from the cactus Pachycereus pringlei to form a dietary staple.

Felger and Moser also document that seeds of eelgrass might be cultivated and also note that the protein content of Pachycereus seeds is 22.6%.

Guatemala, Honduras, Belice

While separate countries, Guatemala, Honduras, and Belice share an ancient historical past linked with the Mayan civilization. Numerous accounts clearly document the important dietary role played by wild plants in ancient Mayan diet (see Gann, 1918, pp. 20-21, 38-39; Wiseman, 1978, p. 63, 86-87; Lundell, 1938, pp. 37-56; Brouson, 1966, pp. 251-279; Ghidinelli, 1971, pp. 23-32; Roys, 1976, pp. 346-348; and Harrison and Turner, 1978). It is with the present descendents of the ancient Maya, however, that the most significant information on wild plant use may be documented. Four works are most important when considering foods used by the modern Maya, that by Benedict and Steggerda (1937, pp. 55-188) and those by Breedlove and Hopkins (1970, pp. 275-298; 1971a, pp. 107-128; and 1971b, pp. 189-203), who describe more than 395 food plants (both wild and domesticated) used by the Chuj Maya, providing information on herbs, trees, vines, grasses, and fruits.

Other societies investigated include the Jacalteca as noted by the work of LaFarbe and Byers (1931, p. 74) who identified extensive use of wild plants but did not provide identification for the species encountered. Carter (1969, pp. 62-71, 95) described the Kekchi of the Guatemalan lowlands and reported on eleven semi-domesticated plants (wild plants cultivated or tended in household gardens) and their use in diet (Table 9). Wisdom (1940, pp. 53, 55, 83-84, 94-95) investigated the Chorti, and presented information on seasonal use of wild plants, providing local dialect terms.

Inventories by Popenoe (1919, pp. 125-138) of the useful plants of Copan in Honduras reveals more than thirty important species with important dietary

roles, especially wild fruits such as Brysonima crassifolia, Psidium molle, and Spondias spp. (Table 10). Rosengarden (1978, pp. 277-295) studied the plant Euphorbia lancifolia, found throughout Guatemala, Honduras, Belice, and tropical Mexico, and noted that its leaves are eaten as a salad and are believed to have the property of increasing production of human breast milk. Chemical composition of its leaves reveal values high in calcium, iron, phosphorous, and ascorbic acid.

Perhaps most valuable in understanding the potential nutritional value of edible wild leaves are nutrient composition tables prepared for Guatemala and Honduras by Munsell et al. (1950a, pp. 421-437; 1950c, pp. 439-452; and 1950f, pp. 16-33) documenting vitamin, mineral, and energy data for more than 300 samples of local foods, noting high nutritional importance of the wild species Astrocarium standleyanum (high in vitamin A), Elaeocarpus serralus (high in vitamin C), Sandoricum indicum (high in vitamin C), and miscellaneous nutritional data on Amaranth leaves and numerous wild greens, palm flowers, water cress, even squash buds (the latter high in calcium, iron, and B-complex vitamins).

Nicaragua, El Salvador, Costa Rica

One past and present focus of research on wild plants in Costa Rica has been investigation of the nutritional-economic value of the pejibaye palm (Guilielma gasipnes). Studies on pejibaye by Popenoe and Jimenez (1921, pp. 154-166) reveal a fruit with high energy value (41% carbohydrate) and a kernel that is also consumed; a nutritional composition superior to maize that can be produced under similar ecological conditions. Hunter (1969, pp. 237-244) suggests that pejibaye palm could be intercropped with maize, bananas, manioc, even rubber.

Other research interests have been directed towards understanding the nutrient composition of wild plants. Munsell et al. (1950b, pp. 379-404; 1950d, pp. 355-365; and 1950e, pp. 263-296) report values for more than 300 species of wild and domesticated foods common to Nicaragua, El Salvador, and Costa Rica, noting particular interest in Crotalaria longirostrata (local Spanish term Chipilin), that contain high values for calcium and iron.

Caribbean

Nutritional reports by Torres (1959, pp. 349-355) state that few wild greens are used in Puerto Rico, a position contested by Santini et al. (1962, pp. 562-567) who investigated folic acid activity in Puerto Rican wild and domesticated food resources. Indeed, Kennard and Frepn (1957, pp. 235-243) identified twenty-seven species of wild bamboo, noting their use and potential for dietary development, especially for Bambusa polymorpha and Guadua angustifolia.

Other Caribbean studies have been on ethnic groups, especially the Caribs, by Hodge (1942, pp. 189-201) and Harris (1965), noting a relative low utilization of wild plants as human food. The work of Kimber (1966, pp. 97-118) on doorvard gardens of Martinique presents a systematic approach to understanding tending and dietary utilization of wild plants.

TABLES 2 - 10

TABLE 2. Pre-Colombian Wild and Domesticated Plants Used as Food Resources Throughout Mexico and Central America

Common Name	Latin Name
corn/maize	Zea mays
tepari bean	Phaseolus acutifolius
ayecotl/cimatl bean	Phaseolus coccineus
haba bean	Phaseolus lunatus
common bean	Phaseolus vulgaris
pumpkin	Cucurbita
chile	Capsicum annuum; C. frutescens; C. pubescens
tomatoe	Physalis ixocarpa; Lycopersicum esculentum
alegria/huauhtli	Amaranthus leucocarpus; A. cruentus
pineapple	Ananas comosus
white haba bean	Canavalis ensiformis
epazote/huauhzontli	Chenopodium nuttaliae
quinoa	Chenopodium quinoa
sunflower	Helianthus annuus
lime sage	Hyptis suaveolens; Salvia hispanica
camote	Ipomoea batatas
manioc/yucca	Manihot esculenta; M. dulcis
jicama	Pachyrrhizus erosus
chayote	Sechium edule
vanilla	Vanilla planifolia
maguey	Agave spp.
pitahaya	Hylocerus undatus
nopal	Opuntia ficus-indica
pitayo	Pachycereus emarginatus
mezquite	Prosopis spp.
chirimoya	Annona cherimolia
ilama	Annona diversiflora
achiote	Bixa orellana
ox/ramon	Brosimum alicastrum
nanche	Nyrsonima crassifolia
sapota (sweet)	Calacarpum mammosum
sapota (green)	Calacarpum viride
sapota (white)	Casimiroa edulis
sapota (brown)	Dyospiros ebenaster
matasano	Casimiroa sapota
chicozapote	Manilkara zapotilla
papaya	Carica papaya
tepejilote	Chamaedorea tepejilote
tejocote	Crataegus pubescens
avocado	Persea americana
capulin	Prunus serotina
guava	Psidium guajava
jocote	Spondias purpurea
cacao	Theobroma cacao; T. angustifolium; T. bicolor
izote	Yucca elephantipes
chalahuite	Igna paterno
leleke	Leucaena glauca

Source: Palerm (1967, pp. 41-45)

TABLE 3. Edible Plants of Central America with Widespread Distribution

Common Name	Latin Name	Milligrams per 100 gram edible	
		Calcium	Ascorbic Acid
Tampala	Amaranthus gangeticus	578	86
Bledo extranjero	Chenopodium berlandieri	156	109
Chipilin	Crotalaria longirostrata	229	110
Malva	Malva parviflora	413	119
Moray/Macuy	Solanum nigrum	199	62
Culantro	Coriandrum sativum	185	147
Epasote	Chenopodium ambrosioides	342	99
Yierbabuena	Mentha citrata	176	---
Bledo	Amaranthus hybridus	288	64
Hojas de ayote	Cucurbita pepo (leaves)	115	64
Puntas de chayote	Sechium edule	---	---
Puntas de guicoy	Cucurbita pepo (vines)	104	---
Motate	Bromelia pinguin	115	---
Laurel	Litsea guatemalensis	803	---
Puntas de camote	Ipomoea batatas (vines)	111	56
Hojas de yucca	Manihot esculenta (leaves)	206	311
Chaya	Cnidoscolus aconitifolius	223	203
Engorda cavallo	Desmodium cinereum	227	164
Pacaya	Chamaedorea graminifolia	506	---
Flor de Isote	Yucca elephantipes (flower)	---	425
Cogollo de Itabo	Yucca elephantipes (heart)	341	---
Guapinol	Hymenaea courbaril	---	---
Cacahuete	Arachis hypogaea	---	---
Frijol de arroz	Phaseolus calcaratus	400	---
Perejil	Petroselinum crispum	224	182

Source: Harris and Munsell (1950, p. 630)

TABLE 4. Edible Wild Plants Utilized by Mexican Kickapoo Indians

Common Name	Latin Name
anaqua	Ehretia anacua
chilequipin	Capiscum annuum
agave/maguey	Agave americana
croton	Croton leocophyllus; C. incanus
hackberry	Celtis lindheimeri; C. spinosa variety pallida
hawthorn	Crataegus mexicana; C. pubescens
hog-plum/coma	Colubrina texensis
honey mesquite	Prosopis juliflora
tecomblate	Condolia spathulata
agarito	Mahonia trifoliata
laurel	Chiococca phaenostemon
sumac	Rhus microphylla
capulin	Ziziphus obtusifolia
oak	Quercus spp.
oreganillo	Lippia graveolens
pecan	Carya illinoensis
pennyroyal	Hedeoma drummondi
quebradora	Aloysia lycoides
smooth-leaf sotol	Dasylirion leiophyllum
black walnut	Juglans microcarpa
madrone	Arbutus texana
Texas palm	Sabal texana
persimmon	Diospyros texana
nopal	Opuntia lindheimeri
wild onion	Allium drummondi
white-flowered lippia	Lippia alba
winter grape	Vitis berlandieri

Source: Latorre and Latorre (1977, pp. 340-357)

TABLE 5. Examples of Edible Wild Plants from Oaxaca, Mexico

Common Name	Latin Name
quintonil	Amaranthus hybridus
pie de gallo	Anoda cristata
epazote blanco	Chenopodium ambrosioides
epazote de elotes	Chenopodium spp.
chipil	Crotolaria pumila
perejito	Galinsoga parviflora
pitiona	Lippia alba
malva	Malva parviflora
nopal	Opuntia spp.
chapiche	Porophyllum tageloides
verdolaga	Portulaca oleracea
yerba de conejo	Tridax coronopifolia

Source: Messer (1972, pp. 325-332

TABLE 6. Traditional Wild Food Plants of the Seri Indians, Sonora, Mexico

Latin Name	Portion(s) Utilized
Prosopis glandulosa	seeds; fruit
Pachycereus pringlei	seeds; fruit; flowers
Agave dentiens	stems
Agave subsimplex	stems
Zostera marina	seeds
Phaseolus spp.	seeds
Amaranthus watsonii	seeds
Chenopodium murale	seeds
Plantago insularis	seeds
Opuntia fulgida	fruit
Cercidium microphyllum	seeds; fruit; flowers
Carnegiea gigantea	seeds; fruit; flowers
Lemaireocereus thurberi	fruit; flowers
Machaerocereus gummosus	fruit
Olneya tesota	seeds
Amoreuxia palmatifida	seeds; fruit; root; flowers
Cnidoscolus palmeri	stems
Cercidium floridum	seeds; fruit; flowers
Lophocereus schottii	fruit
Agave fortiflora	stems
Agave pelona	stems
Agave chrysoglossa	stems
Lycium fremontii	fruit
Opuntia arbuscula	fruit
Opuntia bigelovii	stem
Randia thurberi	seeds; fruit
Ficus petiolaris	fruit
Ficus padiofolia	fruit
Ficus radulina	fruit
Bumelia occidentalis	fruit
Amaranthus fimbriatus	seeds; leaves
Tricerma phyllanthoides	fruit
Proboscidea altheifolia	roots
Phoradendron californicum	fruit
Sabal uresana/Washingtonia robusta	seeds
Ferocactus cf. acanthoides	seeds; flowers
Ferocactus covillei	seeds; fruit; flowers
Ferocactus wislizenii	seeds; fruit; flowers
Agave pacifica	stems
Opuntia versicolor	fruit
Lycium andersonii	fruit
Lycium exsertum	fruit
Yucca arizonica	fruit
Jacquinia pungens	fruit
Allenrolfea occidentalis	seeds
Batis maritima	roots
Physalis sp.	fruit
Setaria macrostachya	seeds
Vallesia glabra	fruit
Orobanche cooperi	stem

TABLE 6 (CONTINUED)

Latin Name	Portion(s) Utilized
Opuntia leptocaulis	fruit
Opuntia phaecantha	fruit
Opuntia violacea	fruit
Celtis tala	fruit
Oligomeris linifolia	seeds
Simmondsia chinensis	fruit
Marsdenia edulis	fruit
Matelea pringlei	fruit
Matelea cordifolia	fruit
Rhizophora mangle	fruit
Passiflora arida	fruit
Passiflora palmeri	fruit
Physallis crassifolia	fruit
Allium cf. haematochiton	bulb
Muhlenbergia microsperma	seeds
Wilcoxia striata	fruit
Triteliopsis palmeri	root
Ziziphus lycioides	fruit
Boerhaavia coulteri	leaves
Lantana sp.	fruit
Mammillaria spp.	fruit
Echinocereus fendleri	fruit
Sporobolus virginicus	stem
Sarcostemma crispum	flowers
Lippia palmeri	leaves

Source: Felger and Moser (1976, p. 15)

TABLE 7. TRADITIONAL WILD FOOD PLANTS CONSUMED IN THE UXPANAPA RIVER REGION, VERACRUZ, MEXICO

Aechmea bracteata	Lycopersicum esculentum
Alibertia edulis	Malpighia glabra
Amaranthus spinosus	Malvaviscus arboreus
Anthurium tetragonum	Momordica charantia
Astrocaryum mexicanum	Ocimum basilicum
Begonia hieracleifolia	Ocimum micranthum
Bomarea acutifolia	Omphalea oleifera
Brosimum alicastrum	Pachira aquatica
Bursera simaruba	Pachira macrocarpa
Calyptranthes schiedeana	Pachyrizus erosus
Castilla elastica	Parmentiera edulis
Ceiba pentandra	Passiflora foetida
Chamaedorea tepejilote	Passiflora serratifolia
Chrysophyllum mexicanum	Physalis pubescens
Cirsium mexicanum	Phytolacca decandra
Comocladia engleriana	Piper auritum
Cordia alliodora	Pithecellobium arboreum
Cydista aequinoctialis	Porophyllum macrocephalum
Dialium guianese	Posoqueria latifolia
Dioscorea compositae	Poulsenia armata
Dioscorea convolvulacea	Pouteria campechiana
Dioscorea macrostachya	Pouteria mamosa
Dioscorea subtomentosa	Pouteria sapota
Entherolobium cyclocarpum	Pseudolmedia oxyphillaria
Erythrina berteroana	Renealmia aromatica
Erythrina folkersii	Rollinia mucosa
Ficus glabrata	Saldanhea seemaniana
Ficus lapathifolia	Solanum nigrum
Gliricidia sepium	Spathiphyllum friedricksthalii
Genipa americana	Spondias mombin
Inga edulis	Sterculia mexicana
Inga lactibracteata	Syngonium podophyllum
Igna leptoloba	Tournefortia glabra
Inga punctata	Trophis mexicanum
Inga sapindoides	Trophis racemosa
Inga spuria	Vitis tiliaefolia
Lantana hispida	

TABLE 8. Underexploited Wild Plarts with Nutritional Value; Arid Northern Mexico

Common Name	Latin Name	%Protein	%Fat
Cardon	Pachycereus pringlei	22.6	32.2
Mesquite	Prosopis juliflora	39	7.6
Calabazilla	Cucurbita foetidissima	35.1	42.8
Tepari	Phaseolus acutifolius	32.2	1.1
Eelgrass	Zostera marina	13.2	1.0

Source: Felger and Nabhan (1976, p. 34)

TABLE 9. Wild (Semi-Domesticated) Food Plants of the Kekchi Indians, Guatemala

Common Name	Latin Name
macuy	Solanum nigrum
sal tul	Pouteria mammosa
piak	Dioscorea spp.
mococh	Orbignya cohune
chiltep	Capsicum frutescens
obel	Piper umbellatum
chi	Brysonima crassifolia
pec imis	Thevetia spp.
cuachil	Dialium guianense
ses	Amaranthus hybridus

Source: Carter (1969, p. 95)

TABLE 10. Wild and Domesticated Plants with Nutritional Value, Copan Valley, Western Honduras

Common Name	Latin Name
maize	Zea mays
black bean	Phaseolus vulgaris
ayote	Pepo maximus; P. vulgaris
guisquil	Chayota edulis
sweet potato	Ipomoea batatas
isote	Yucca elephantipes
tomate	Lycopersicum esculentum
miltomate	Physalis pubescens
cassava/manioc	Manihot utilissima
name	Dioscorea alata
jocote	Spondias purpurea
jobo	Spondias lutea
guava	Psidium guajava
guayaba	Psidium molle
nance	Byrsonima crassifolia
avocado	Persea americana; P. gratissima
chucte	Persea spp.
zapote	Calocarpum mammosum
nispero	Achras zapota; Sapota zapotilla
capulin	Muntingia calabura
sunza	Licania platypus
guapinol	Hymenae courbaril
anona	Annona reticulata
suncuya	Annona purpurea
anona blanca	Annona diversifolia
guanabana	Annona muricata
matasano	Casimiroa edulis
wild grape	Vitis caribaea
papaya	Carica papaya
pitaya	Cereus spp.
pina	Ananas sativus
paterna	Inga radians
jocote-maranon	Anacardium occidentale
guineo plantain	Musa sapientum
cacao	Theobroma cacao; T. ciocarpum
patashte	Theobroma bicolor
chiltepe	Capsicum frutescens
chile	Capsicum baccatum
vanilla	Vanilla planifolia

Source: Popenoe (1919, pp. 125-135)

WILD PLANTS AS HUMAN FOOD IN SOUTH AMERICA

Introduction to South America

A number of botanical reports consider plant utilization within broad regions of South America. One major sub-division of such works are those that treat wild plants within the highland Andean region. Hodge (1954, pp. 195-221) considered the edible arracacha, a lesser known wild, semi-domesticated root used throughout the highlands, noting its caloric potential. Gross et al (1976, pp. 396-402) reviewed the genus Lupinus and its contribution to the food supply within the Andes and the protein role it plays in maintaining dietary quality. Tello (1976, p. 933) reports that one species of lupin (Lupinus mutabilis) was used by the Inca and that the species remains nutritionally important due to its high protein content (43.3 grams per 100 grams edible portion) and high calcium (56 mg) value, making it superior to soy beans. Hudson et al (1977, pp. 81-90) also examined human dietary use of lupin in the Andes and reviewed its potential for extension to other temperate climates, noting that the protein content of various lupin species varies from 27-46% with a very high digestibility rate (92-96%).

Hodge (1960, pp. 203-206) also reviewed the distribution and dietary use of sapote, noting that the plant is widely used throughout the region and is classified under three genera (Calocarpum spp., Matisia spp., and Quararibea spp.). Schery (1952, pp. 386, 520-521, 564-565, 573, and 576) provided basic botanical and distribution data on human use of Andean starchy staples collected in the wild or tended as semi-domesticates, specifically Lepidium meyenii, Oxalis tuberosa, and Ullucus tuberosus. Bennett et al. (1963, pp. 22, 39, 519, and 702) described wild plant use among a number of Andean Indian societies, noting that use of such plants has declined dramatically with corresponding more economic reliance upon domesticated plants.

Other researchers have considered the broad tropical regions of South America. Church (1912, pp. 9, 14, 231, and 261) provides the basic initial references to extensive dietary use of wild foods and herbs throughout South America while Lowie (1948, pp. 1-10) provides a general botanical overview of the cultivated and semi-domesticated species encountered throughout the region. Levi-Strauss (1950, pp. 465-486) identifies more than 50 species of grains, fruits, and beverage plants used in South America, noting special use of Cissus spp. (green leaves) and Zeyheria spp. (root), and nuts from Araucaria angustifolia, Lecythis pisonis, Bertholletia excelsa, Caryocar spp., Sophora tomentosa, Mucuna altissima, and Hymenaea courbarii (Table 11). Carter (1950, pp.73-80) presents a call for examining wild plants and their dietary and non-dietary uses to shed light on the botanical distribution of ancient and contemporary domesticated plants. Carter specifically focuses on the peach palm (Guilielma gasipaes) and its spread throughout South America, then provides extensive lists of wild grains, gourds, roots, flavoring agents, and fruits commonly used throughout the region.

Other accounts provide data on plants and their nutritional potential within South America. Berglund-Brucher and Brucher (1976, pp. 257-272) provide data on Phaseolus aborigineus as the ancestor to the common domesticated bean, reviewing the genus and identifying its geographical spread throughout South America. Gerloff et al. (1965, pp. 139-143) report amino acid composition for leaf protein for a number of wild species common throughout the region, namely Chenopodium amaranticolor, Curcubita ovifera, Onobrychis sativa, Trifolium pratense, and Tropaeolum lobianum, while Prance (1969-70, pp. 9-20) focuses on the Brazil nut (Bertholletia excelsa), reporting on its dietary and nutritional potential, revealing that the nut contains 60-70% oil (equal in potential to the olive). Cavalcante (1972) reviews the edible wild fruits

common throughout the Amazon basin, noting more than 110 species and providing data on their availability and seasonality. Schultes (1974, pp. 3-21) reviews edible palms of the Amazon basin, especially Socratea exorrhiza and Oenocarpus bacaba, noting their dietary and religious use by Indian societies.

Colombia

Armstrong and Metraux (1948, pp. 369-383) working among the Arawakan-speaking Goajiro (Guajira) report that hunting, fishing, and wild plant gathering play a minor role in dietary economy, although Goajiro diet is supplemented by yuca, cactus fruit, and few other wild plants. Gutierrez (1950, p. 46), however, noted that the Goajiro women collect wild fruits such as wild olive, iguaraya, and pods from trupillo. Elsewhere in the Colombian lowlands, Isacsson (1977, pp. 48-75) reports that the Embera peoples rely heavily on more than sixty species of wild fruits and three (Astrocaryum standleyanum, Attalea allenii, and Phytelephas seemannii) are of major dietary importance. In contrast, Eden (1963, pp. 57-58) writes that wild plants are not of major dietary significance to lowland Colombian Indians occupying the Rio Siguirisura valley, Choco district, and Schultes and Cliatrecasas (1973, pp. 129-136) report that the pulp of Patinoa almirajo is sparingly used as food within the Colombian Choco, but is considered toxic in the west Brazilian Amazon.

Turning to highland Colombia, Hernandez de Alba (1946, p. 918) worked among the Paez of the southern highlands and noted a great variety of wild plants used as food, specifically wild forms of granadilla (Passiflora ligularis), guayaba (Psidium spp.), guama (Inga spp.), avocado (Persea americana), papaya (Carica papaya), guanabana (Annuna muricata), and chirimoya (Annona cherimolia). Bernal Villa (1954, pp. 326-327), also working among the Paez, noted these Indians utilized wild mushrooms and a

number of wild fruits, among them wild granadilla (Passiflora spp.), ground cherry (Physalis spp.), and chachafruto (Erythina edulis). Elsewhere in the Colombian highlands, Eidt (1959, p. 384) studied the Chibcha Indians, noting widespread use of semi-domesticated quinoa (Chenopodium quinoa) and cubio (Tropaeolum tuberosum), both items used in abundance in local diet.

Ecuador

Stirling (1938, p. 108) worked among the Jivaro of eastern Ecuador noting general extensive use of wild fruits for food, a pattern confirmed by Harner (1972, p. 62) who noted special use of wild palms, specifically Guilielma utilis. The Cayapa Indians were surveyed by Barrett (1925, pp. 72, 109) who described their use of numerous species of wild plants and trees, especially palms and a wild legume called "guaba".

Highland Ecuador remains a focus for dietary utilization of wild Amaranths according to Heiser (1964, pp. 136-139), specifically Amaranthus quitensis, used extensively in diet and for religious festivals.

Peru

Paralleling the important reports of wild food use by Aztec and Maya civilizations of Central America, the ancient Inca of Peru have left similar records throughout the central Andes of South America. A number of reports detail the dietary role played by wild foods in Inca diet (see Harshberger, 1898, pp. 146-149; Howland, 1948, pp. 216-217; Horkheimer, 1960; and Towle, 1961) who describe the shift from wild food utilization to domestication as evidenced through archaeological remains.

Considering the highland region of Peru, Flores-Ochoa (1968, p. 41) noted that highland Paratians drink infusions made from numerous wild plants, but does not further identify the plants except through local terms. Classic work

on highland Peruvian societies was conducted by Gade (1975, pp. 70-78, 109-111, 146, 159-163) who worked in the Vilcanota valley. Gade noted that while only 4% of the dietary intake of Vilcanota was from uncultivated plants, a number were important nutritionally, especially the aquatic algae Lobelia spp. and Nostoc spp., grains from Chenopodium petiolare and Trifolium amabile, the fern Dryopteris palacea, and the bulb Nothoscordum andicola; even flowers from Cassia spp., and seeds and pulp of Inga adenophulla were widely used. Gade reports that above 2400 meters human utilization of wild plants diminishes in direct relationship to the reduced available flora; below 2400 meters, however, there is increased use of wild food resources by humans. He states further that the Indians of the Vilcanota valley reject wild mushrooms as food and that the highest incidence of wild plant use in the diet is between October-January, when food supplies from domesticated field crops is lowest.

A number of dietary surveys conducted within the highland region of Peru document information on nutritional use of wild plant resources. Mazess and Baker (1964, pp. 341-351), working among the Quechua at Nunoa, noted that wild varieties of Chenopodium quinoa and C. callidicuale were commonly used as food, and these species contained 8-9% protein per 100 grams edible portion, and 13% fat. Baker and Mazess (1963, pp. 1466-1467) also report unusual sources of calcium in highland Peruvian diet, noting that wild varieties of Chenopodium are burned to prepare ash, then the ash is mixed into a paste and chewed with coca leaves, resulting in a high calcium content. An early report by Cullazos et al. (1954, pp. 1222-1230) report that wild herbs are a significant component of highland diet on a daily basis.

Other researchers have turned their attention to specific lesser known wild or semi-domesticated plants available in the Peruvian highlands. Hodge

(1951, pp. 185-201) reports on the dietary role in ancient and modern Peru of three native tubers common to the highlands, Oxalis tuberosa, Ullucus tuberosus, and Tropaeolum tuberosum. Leon (1964, pp. 122-127) studied maca (Lepidium meyenii), a semi-domesticated tuber once widely collected throughout Peru. Gade (1966, pp. 407-415) collected data on achira, the edible canna, in the Peruvian Andes, noting that both domesticated and wild varieties are used as food. Gade (1969, pp. 47-51) also reported on a number of vanishing crops that had once sustained Incan and modern Peruvian Indians, specifically tarwi (Lupinus mutabilis) that is very high in protein. Dietary studies by Mazess (1968, pp. 109-2), permit a better understanding of both domesticated and wild plants used as food in the highlands through understanding of the hot-cold food classification systems common to South American societies.

Examining lowland Peru, Tessmann (1930) reported that Indian societies of the Peruvian northeastern region utilized palm cabbage and the fruits of Oenocarpus bataua and Mauviha flexuose. Denevan (1971, pp. 496-518; 1974, p. 105) noted the wild plants used as food by Indians of the Gran Pajonal of eastern Peru, specifically Euterpe edulis, Erythrina esculenta, Bunchosia eliptica, Caryocar glabrum, Rhus urticaefolius, Inga spp., and Ficus spp. Denevan writes that while while food use is minimal, there is abundant gathering of fruits from feral domesticated species growing near abandoned home and settlement areas.

Nutritional surveys conducted in lowland Peru also identify human use of wild plants as food. White et al. (1954, pp. 856-864) surveyed residents of the town of Yurimaguas on the Huallaga River, noting only a minor role for wild vegetables and greens, but identifying Cyclanthera pedata, a pepper-like condiment, with extensive local utilization. Bradfield and Lauriault (1961,

pp. 126-128) conducted field work on the nutritional status of the Shipibo Indians of eastern Peru, noting extensive snacking on wild foods high in vitamin C. Recent work by Berlin and Markell (1977, pp. 69-81) outlines the nutritional status of the Aguaruna Jivaro of the eastern lowlands of Peru, with extensive references to edible wild foods (Table 12).

Bolivia

Rich in botanical diversification, Bolivia has been a center for ethnobotanical research for decades. Of specific value to understanding the botanical diversification is the report by Cardenas (1969) on the economic plants of Bolivia, reporting on more than 150 species prominently used by humans. The wide range of information available extends from basic accounts by Huenemann et al. (1957, pp. 21-31) who completed a dietary survey in the Santa Cruz region noting wild plant utilization, to the detailed work of Duke et al. (1975, pp. 113-119) reporting on the nutritional potential and physiological value of coca (Erythroxylum coca), with its high protein content (18.9%), and high vitamin A value. Indeed, the human recommended dietary allowances for calcium, phosphorus, vitamins A, B_2, and E can be met through dietary use of 100 grams of coca leaves; but the leaves contain toxic alkaloids and as such cannot be recommended as a dietary resource.

La Barre (1948, pp. 18-19, 54-58) presents a botanical overview of dietary and non-food uses of wild plants of the Aymara Indians of the Lake Titicaca plateau, while Tschopik (1948, p. 519) notes that wild plants play relatively unimportant roles at high altitude, noting use of roots and shoots of totora (Scirpus tatora) and incidental use of wild greens prepared as stews. Tschopik also mentions that certain cactus fruits (unidentified) are eaten fresh and their juice used as a dietary sweetener. Steward (1948, pp. 507-533) identified

numerous important highland wild plants used as food by Bolivian Indians, especially Attalea tessmanii, Astrocaryum huicungo, A. vulgare, Guilielma ciliata, G. palma, Iriartea deltoidea, I. ventricosa, Jessenia bataua, Mauritia flexuosa, Scheelea basslerіana, and S. tessmannii.

Lowland Indians of Bolivia have also been investigated extensively for dietary use of wild plants. Ryden (1975, pp. 84-124), writing on the More Indians of the Rio Guapore region, notes that apart from maize, the Indians subsisted mainly on a species of wild growing plum-like fruit (called coquino in Spanish) and on Brazil nuts. Metraux (1929/30, pp. 362, 470), reporting on the Chiriguano Indians, states they use a leguminous wild plant that resembles yuca and turn to this and other wild plants if their crops fail. Ryden (1941, p. 34, 68) noted that the Siriono Indians exist on wild plants, especially the cabbage palm, various roots, and fruits. Metraux (1942, pp. 4-7, 18-9, 34-37, 58-59, 88-89, 110-113, 136-137, 142-145, 162-163; 1948, pp. 485-506) writing on the Indian societies of the eastern slopes of the Bolivian Andes, identifies basic wild and domesticated species used by these peoples, noting Guilielma insignis as a primary dietary staple of the Chimane, Mosetene, and Yuracare societies.

Other lowland peoples have been studied by Homberg (1950, pp. 27-28) who worked among the Siriono of eastern Bolivia, describing wild plant use of palm cabbage and social roles played by males and females in the food quest for wild species. Denevan (1966, pp. 104-105) writing on the Mojo Indians identified dietary uses of several wild palms including Atlalea princeps, Cocos batrifora, and Orbignya phalerata, while other wild plants important in Morjo diet include Ardisia spp., Bertholletia excelsa, Cecropia spp., Hymenea courbaril, and Inga edulis.

Chile

Gusinde (1961), writing on the Yamana peoples of Cape Horn, noted a number of wild mushrooms and tree fungi serving as dietary staples, especially Cyttaria darwinii, C. harioti, and C. hookeri. The Yamana also extensively use berries and nuts from a number of wild plants, for example, Berberis buxifolia, B. ilicifolia, Empetrum rubrum, Pernettya mucronata, P. pumila, Ribes magellanicum, and Rubus geoides. Berglund (1977, pp. 36-37), writing on the Mapuche Indians of Chile, noted that gathering wild plants was not a major occupation except during periods of famine when peoples of the central region have supplemented their domesticated crops with items such as the Araucaria nut. Early accounts on the Araucanian Indians by Moesbach (1936, pp. 30-31, 87-106) provide extensive lists of wild foods regularly used in the diet (Table 13). In contrast to Moesbach's report, Edlin (1967, p. 134) notes that the Araucanian Indians consume seeds of the Chile Pine (Araucaria imbricata) but provides no additional information on wild plant use. Bird et al. (1948, p. 62) describes the Alacaluf of coastal Chile, noting use of berries, fuchsia seed pods, and wild celery as dietary items.

Argentina and Paraguay

Southeastern South America has not been a region of extensive field research on human utilization of wild plants as food. Karsten (1932, pp. 2, 38) writing on the Indian tribes of the Bolivian and Argentine Chaco, report extensive use of the pods of Prosopis alba and P. juliflora, high in sugar content, and both species serve as major dietary resources during the three months prior to harvest of domesticated crops. Karsten also identifies a nutritionally important local beer prepared from pods and fruits of Acacia aroma, Gourliea decortitans, and Zizyphus mistol. Hudson (1917, p. 103) an early traveler to

the interior of Argentina mentions that apple trees originally planted by missionaries have become "wild" and serve local Indians as sources of fruit that they prepare as a nutritious "traditional" beer. Other Indian tribes of the Argentinan Chaco have been surveyed by Metraux (1963, pp. 246-250) and the principle important seasonal wild foods identified (Table 14).

Metraux and Baldus (1963, p 436, describe the Guayaki Indians of Paraguay noting that the fruit and heart of the pindo palm (Cocos romanzofhana) is a local dietary mainstay. Perhaps the most basic work on the Chaco region of Paraguay, however, stems from Nordenskiold (1919, p. 33) who considered social structure but identified a number of tools manufactured to collect wild plants (but he does not document the species of plants collected). Steward and Faron (1949, p. 47), in their classic text on native peoples of South America, describe collecting of wild rice (Oryza perennia) and its use as a dietary staple throughout much of northern Paraguay.

Venezuela

Returning to the northern portion of the South American continent, a number of ethnobotanical accounts provide data on wild plants as human food in Venezuela. Petrullo (1939, pp. 28, 172, 175) writes that among the Yaruro Indians of the Capanaparo River basin, females seek the wild root "changuango" for dietary use and that seeds called "chigua" are widely used to prepare flour. Leeds (1960, pp. 597-608) also worked among the Yauro Indians, noting extensive gathering of wild plants, specifically Marante arundinacea, and fruits from the moriche palm (Maurita flexuosa), and chigua seed (Campsiandra comosa). Kirchoff (1963, pp. 456-463), also writing on the Yaruro, identified the dietary roles of miscellaneous roots and seeds collected by females, and

the collection and preparation of palm heart and palm fruits by Yaruro males.

The Warao Indians of the Orinoco delta of Venezuela were investigated by Kirchoff (1948, p. 871) who identified extensive use of Mauritia palm starch as a dietary staple, a theme also studied by Heinen and Ruddle (1974, pp. 116-138) who identified the dietary and ritual roles played by palm starch obtained from at least nine species of Maruitia. Wilbert (1976, pp. 275-335) also worked among the Warao and identified ten genera of useful wild palms, then focused his research on Warao dietary and non-dietary uses for Manicaria saccifera.

Other studies in Venezuela have included those by Kaplan (1975, p. 38) on the Piaroa of the Orinoco basin, noting use of wild foods but providing few details. Smole (1976, pp. 157-163, 246-248, 259-265) reports on the Yanoama Indians of the Venezuela-Brazil border and lists numerous wild foods, especially fruits, but does not provide details other than mentioning the most important are Anacardium occidentale, Bertholletia excelsa, Inga spp., and Psidium spp. His major contribution, however, is to identify eleven types of wild palms used by the Yanoama as dietary staples: Acrocomia sclerocarpa, Astrocaryum vulgare, Aiphanes caryotifolia, Bactris setulosa, Euterpe oleracea, Guilielma gasipaes, Jessenia bataua, Leopoldinia piassaba, Mauritia spp., Maximiliana regia, and Messenia polycarpa.

Hernandez de Alba et al. (1948, pp. 394, 445-465, 482, 523) describes several Venezuelan Llanos societies near the Caribbean who extensively gather wild foods, specifically the Arawak who use wild arrowroot, peppers, wild coconut, and numerous fruits obtained from forest lands adjacent to the Orinoco River. Simpson (1939/40, pp. 123-125) describes the Kamarakoto Indians, a Carib tribe of the Venezuelan-Guyana region, and reports wild plant use as food is

relatively unimportant but that a number of wild mushrooms are consumed as well as species of Bixa and Bromelia. Braun (1968, pp. 48-49, 71-73), writing on the Guarao Indians, noted widespread use of Mauritia flexuosa and its pithy starch, along with consumption of wild species of Aiphanes, Bactris, Jessenia, and Mauritia. Braun notes that fruits of Jessenia polycarpa are mashed, soaked in water, and the beverage serves as a substitute for milk; the grated fruit pulp of Mauritia flexuiosa is roasted, then prepared as flour; and fruits of Bactris gasipaes are cooked in salt water or roasted to provide a flour that is used as a condiment and added to local soups. Ruddle (1970) examined the subsistence activities of the Yukpa Indians of the Venezuela-Colombia border region noting more than forty-three species of wild plants commonly utilized as food (Table 15).

Surinam and the Guianas

Major botanical reports on the dietary use of wild palms have been published by Stahel (1944) but they are in Dutch with no English summary. Coster (1866), however, provides basic insights on the dietary role of wild plants used by Surinam Blacks, noting that numerous forest greens are consumed, especially Amaranthus oleraceus and Arum spp. Kloos (1971, pp. 63-67) provides information on more than sixty domesticated and wild plants used as food by the Caribs of Christiaankondre and Langamankondre, Surinam, near the Maroni River (Table 16). Van Staaveren et al. (1971, pp. 127-132) conducted a food habit study of preschool children in Surinam noting extensive use of three wild greens with high ascorbic acid values: Amaranthus caudatus, Cestrum latifolium, and Ipomoea reptans.

Throughout the Guianas (British and Dutch Guiana), several works on wild plants have been completed. Thurn (1883, p. 267) identified seven wild species used as food throughout the Guianas, especially, Astrocaryum spp., Guilielma

speciosa, Mauritia flexuosa, Maximiliana regia, Mimusops balata, Nigritia schomburgkii, and Pekea tuberculosa. Herskovits and Herskovits (1934, p. 298) reported on the Bush Negroes of Dutch Guiana and found that nuts from the maripa palm were valued for their dietary value. Gillin (1936) worked among the Barama River Caribs and noted a number of wild foods commonly used in the diet, specifically during periods of poor harvest: Anacardium spp., Areca oleracea, Astrocaryum tucuma, Caryocar [Pekea] tuberculosa, Dimorphandra mora, Euterpe oleracea, Maranta indica, Mauritia flexuosa, Maximiliana regia, Miramusissima spp., and Nectandra rodioei.

Brazil

A basic botanical overview for Brazil may be obtained using the text by Mors and Rizzini (1966, pp. 145-147) and in their review of dietary plants they treat numerous species used as fresh fruits, juice, sweeteners, or for the manufacture of preserves, including, Annonas crassiflora, Hancornia speciosa, Platonia insignis, Psidium araca, P. guayava, Spondias tuberosa, Stenocalyx dysentericus, and Theobroma grandiflorum. Chaves (1961) identifies the protein content of selected wild plants common to the northeast region of Brazil, a zone periodically experiencing drought, and he notes that Dioclea grandiflora and Artocarpus intergrifolius are "famine foods" (used only during periods of food shortage) but have relatively high bioavailability of protein.

Numerous accounts describe the dietary role of wild plants by Indian societies of the Brazilian interior. Gardner (1849, p. 146) was among the first to document extensive use of wild plants identifying Eugenia cauliflora Mouriria spp., and Psidium pigmeum as dietary staples. Meggers (1971, pp. 101-102) writes of "hundreds of wild species" with edible roots, fruits, seeds, nuts, or berries, consumed either as snacks or as dietary staples, but she notes only

specific identification of the palmito (palm cabgage) and wild Brazil nuts.

Oberg (1949, p. 9), best known for bringing the term "culture shock" into anthropological literature, is also recognized for his excellent research among the Terena and Caduveo of the southern Mato Grosso, Bracil. He noted that from November to February, pods of algarroba and tusca, as well as fruits from the chanar and mistol trees are widely gathered and consumed by the Indians. Nimuendajú (1939, p. 94) worked among the Apinayé of the Rio Tocantins and lower Araguaya, noting that three wild palms, known locally as bacaba, babassu, and burity, are dietary staples. Basso (1973, p. 28), conducting field work among the Kalapalo Indians of central Brazil, noted their use of wild plants but did not document her work further. Fidalgo and Prance (1976, pp. 201-210), reported on the Sanama Indians and their use of wild mushrooms, especially their consumption of Favolus, with more than forty species identified as regular dietary items. Meggers (1971, pp. 101-102) writes on the Kayapo Indians, noting extensive use of nuts from wild Brazil nut trees. Prance et al. (1977, pp. 129-139) identify five species of wild plants important to Paumari Indian diet; Caryocar villosum, Euterpe oleracea, Igna spp., Pouteria spp., and Rheedia spp.

Other reports on interior Brazilian societies include those by Maybury-Lewis (1967, pp. 43-45) who identified local Akwẽ-Shavante terms for dietary roots, nuts, and fruits, and documented the important role played by wild foods between April-June during the dry season, by wild plants used to augment intakes of domesticated maize and beans. He identifies two palms as nutritionally important, Chamacrops spp., and Orbignya spp., and comments that the fruits of Mauritia spp. are high in vitamin C, and that three additional genera

(Caryocar spp., Ceretona spp., and Genipa spp.) play important dietary roles. Other work on the Shavante by Nimuendajú (1942, p. 33) briefly mentions that females gather wild fruits, but provides no additional information on type of food or seasonality. Murphy (1960, p. 60), writing on the Mundurucu Indians notes their use of palm fruit, wild brazil nut, and fruits of the caju tree (Anacardium corymbosum), wild cocoa, and miscellaneous wild berries. Levi-Strauss (1948, p. 362) states that the Nambicuara Indians of the Brazilian Mato Grosso and Goiaz region are semi-nomadic bush dwellers that forage for wild fruits, seeds, roots, and that they raise a wide variety of small bush plants for their ediole leaves.

Murphy and Quain (1955) worked among the Trumai Indians of Central Brazil and identified local names for numerous wild plants, noting that the piqui tree was the most important dietary element in the chronological period just before crops ripen and that waruwaru (wild guava) is collected and is high in vitamin C. They note that the Trumai value highly other wild plants for their ash and salt content, especially leaves of water lily species that are collected, burned, and the ash used as a dietary condiment. Carneiro (1957, pp. 114-118) worked among the Kuikuru Indians, identifying minimal use of wild plants, but specific focus on two plants, Caryocar butyrosum and Hancornia speciosa, whose fruits offer important vitamin C value.

While early work by Chagnon (1938, pp. 29-30) only briefly mentions that the Yanomano Indians gather wild plants, Prance (1973, pp. 248-250) identifies the dietary importance of wild mushrooms to the Yanomano, noting that the forms Neoclitocybe bissiseda and Polyporus spp. are most commonly consumed -- but not widely utilized elsewhere by most Brazilian Indians. Wagley (1977, pp. 52-53) worked among the Tapirape Indians and reported extensive use of wild palm

fruits, but that the majority of food resources were obtained from domesticated field crops. Wagley and Galvao (1948, pp. 167-178), however, write that the Tapirape Indians use at least two wild species, Caryocar vellosum and Carapa spp. Nimuendajú (1952, p. 32) writes that the Tukuna Indians of west-central Brazil, near the Peru-Colombia border, make extensive use of edible wild fruits as snacking items, identifying pods called arara tucupy whose seeds are covered with a thin layer of thick, sweet liquid. Nimuendaju documents that four wild palms are important to the Tukuna diet, specifically Euterpe sp., Mauritia vinifera, Oenocarpus bacaba, and O. pataua, whose fruits are soaked to make beverages.

Coldman (1963, pp. 64, 78) worked among the Cubeo Indians of the northwest Amazon and noted wild plants are cultivated among domesticated crops, identifying six semi-domesticated tubers of nutritional-dietary importance and noting that wild fruits are collected widely throughout the region and readily consumed as snacks. Guppy (1958, p. 249) conducted field work with the Wai-Wai of the Amazon basin and writes that numerous wild vegetables are collected as well as nuts, palm heart, and fruits from the genera Anacardium, Chrysophyllum, Eugenia, Moronobea, Psidium, Rheedia, and Spondias. Arhem (1977, pp. 37-54) working among the Makuna of the northwest Amazon makes passing reference to wild foods being utilized, but is not more specific. Nimuendajú (1971, pp. 72-75), reporting on the Timbiru of east-central Brazil provides extensive documentation for wild plant use (Table 17).

While reports of wild food use by Brazilian Indians of the interior greatly dominate the published accounts, work by Willems (1952, pp. 35-36) should also be noted. Willems conducted field work among the occupants of Buzios Island, southern Brazil, noting widespread use of marine algae in local diet

TABLES 11 - 17

Table 11. Dietary Wild Plants Widely Utilized Throughout Tropical South America

Common Name	Latin Name
manicoba	Manihot dichotoma, M. glaziovii, M. heptaphylla, M. piauhyensis, M. violacea
---	Protium heptaphyllum
green-heart seed	Nectandra rodioei
miriti/ite	Mauritia flexuosa
caranai	Mauritia horrida
buriti	Mauritia vinifera
uricuri/buri da praia	Diplothemium maritimum
assai	Euterpe oleracea, E. precatoria
manicol	Euterpe edulis
bacaba/turu	Oenocarpus distichus, O. bacaba
lu	Oenocarpus spp.
patua/pataua	Oenocarpus patua
kokerit/anaja	Maximiliana regia
awarra/jawari	Astrocaryum tucumoides
maraja	Bactris minor
coroxo	Acrocomia aculeata
"palmito"	Euterpe spp., Cocos spp., Iriartea spp., Copernicia cerifera
pindo	Cocos romanzoffiana
jara	Leopoldinia major
mandioquinha do campo	Zeyheria spp.
---	Cissus spp.
iba	Araucaria angustifolia
sapucaia	Lecythis pisonis
tocari	Bertholletia excelsa
piqui/sawari	Caryocar barbinerce, C. brasiliense, C. tuberculosum, C. amygdaliforme
comanda-iba	Sophora tomentosa
comanda-assu	Mucuna altissima
jatoba	Hymenaea courbaril
mora	Dimorphandra mora
greenheart	Nectandra rodiaei
dakamballi	Vouacapoua americana
wild rice	Oryza subulata
wild peanut	Arachis hypogaea
caraguata	Bromelia fastuosa
inga/shirada/pacay	Inga vera, I. lateriflora, I. bahiensis, I. fevillei
maracuja	Passiflora quadrangularis, P. alata, P. edulis
wild pineapple	Ananas sativus
algarroba/aloja	Prosopis alba
guabiroba	Myrtus mucronata, Psidium multiflorum, P. corymbosum, P. cinereum, P. guazumaefolium
guavira	Campomanesia
tusca	Acia aroma

TABLE 11 (CONTINUED)

Common Name	Latin Name
taruma	Vitex montevidensis
chanar	Gourliaea decorticans
fructa do lobo	Solanum grandiflorum
wild cashew	Anacardium occidentale, A. giganteum
umbu	Spondias tuberosa
hobo/jobo	Spondias monbim, S. dulcis, S. robe
caja-mirim/maropi	Spondias lutea
acaju/acaja	Spondias monbim
mangaba	Hancornia speciosa
cambuy/jaboticaba	Mouriria pusa
cambuca	Myrcia spp.
massaranduva/macarandiba	Lucuma procera
mucuge	Couma rigida
ubauba	Pourouma cecropiaefolia
ubacaba	Britoa triflora
murici	Byrsonima spp.
canapu	Physalis pubescens
---	Cereus spp.
---	Eugenia spp.
---	Genipa maerianae, G. edulis
---	Malpighia
banana do brejo	Mostera deliciosa
oiti coro	Couepia rufa
oiti da Bahia	Moquilea salzmannii
piquia	Macoubea guianesis
bacopary	Reehdia brasiliensis
icaco	Chrysobalanus icaco
bacury	Platonia insignis
abil	Lucuma caimito, Pouteria caimito
abrico do Para	Mammea americana
wild cacao	Theobroma cacao, T. bicolor, T. grandiflorum, T. speciosum
kakaui	Theobroma sylvestre
cacau selvagem	Pachira insignis
truli fruit	Manicaria saccifera
mistol	Sysyphus mistol
algarroba pods	Prosopis spp.
hitchia	Brysonima spicata
hlawaraballi	Protium heptaphyllum
weya/huya	Mourera fluviatilis
wild peppers	Capsicum rabenii, C. baccatum, Piper longum, Eryngium foetidum

Source: Levi-Strauss (1950, pp. 465-486)

Table 12. Semi-Cultivated Food Plants of the Aguaruna Jivaro, Amazonas, Peru

Common Name	Aguaruna	Latin Name
---	akangnum	Theobroma spp.
---	batae	Astrocaryum chambira
Inga	wampa	Inga edulis
Inga	wampushik	Inga nobilis
---	chapi	Phytelepas spp.
Mauritia palm	achu	Mauritia peruviana
Passion fruit	kistian nunchi	Passiflora foetida

Source: Berlin and Markell (1977, p. 71)

Table 13. Wild Plant Foods of the Araucanian Indians, Southern Chile

Common Name	Latin Name
liuto	Alstroemeria ligtu
lawu	Sisyrinchium spp.
huanqui	Dioscorea spp.
gadu	Conanthera bifolia
anpe	Alsophila quadripinnata
myrtle	Myrtus ugni, M. luna
"barberry"	Berberis darwinii, B. congestifolia
boldo	Boldoa fragrans, Peumus boldus
peumo	Cryptocarya rubra
maqui	Aristolelia maqui
kopiu	Lapageria rosea
kowull	Lardizabala biternata
doka	Mesembryanthemum chilense
mulu	Ribes glandulosum
nuyu	Greigia sphacelata
mulluen	Empetrum rubrum
wild hazelnut	Guevina avellana
llenque	Podocarpus andiana
lanco	Bromus stamineus, B. unioloides
nalka	Gunnera scabra, G. chilensis
graciola	Gratiola peruviana
placa	Mimulus luteus
kelp	Durvillaea utilis, Ulva lactuca, U. latissima
pine nuts	Araucaria imbricata

Source: Moesbach (1936, pp. 30-31, 87-106)

TABLE 14. Wild Plant Foods of the Argentinean Chaco

Common Name	Latin Name
algarroba	Prosopis alba, P. nigra
tuscas	Acacia moniliformis
chanar	Gourliea decorticans
mistol	Zizyphus mistol
poroto del monte	Capparia retusa
tasi	Morrenia odorata
sachalimona/naranja del monte	Capparis speciosa
sachasandia	Capparis salicifolia
tripa de zorro	Phaseolus caracalla
mbocaya palm	Acrocomia spp.
yatai-guazu	Cocos paraguayensis
caranday palm	Copernicia cerifera
wild rice	Oryza perennis

Source: Metraux (1963, pp. 246-249)

TABLE 15. Wild Plant Foods of the Yukpa, Colombia/Venezuela

Common Name	Latin Name	Part Used
ahnah'pah	Fiscus spp.	seed
arde'ste	---	flower
boohah'kah	Marauta arundinecea	root
ca..'nah	---	leaf
cepen'tra	---	root
coon'nah	---	root
kahmah'sah	Carica microcarpa (?)	fruit
kaht'sah	Inga spp.	seed
kometroo'sk	Physalis peruviana	seed
konono'perah	---	seed
ku'keah	Lantana camara	fruit
kunu're	Solanum hirtum	fruit
kuro'pea	---	fruit
mahpur'ka	---	fruit
mahsri'cie	---	fruit
maht)eah	Clavija longifolia	fruit
oahkur'ookcah	---	fruit
okooverah're	---	fruit
oone'kahrah	Cissus rhombifolia	seed
oyeah's	---	fruit
pahnah'cah	---	fruit
pah'seah	---	root
perene'nie	---	fruit
pidrinah'ye	---	fruit
poro'tooya	---	fruit
saesahs'kah	---	fruit
sahkor'ah	---	fruit
sahsah'ka	---	root
sah'm-pah'sah	Piper pavoni	fruit
sah'rah	Poulsenia armata	fruit
sah'tah	---	fruit
se'ahpah	---	root
se'kahya	---	fruit
tah'kahsah	---	fruit
time'ye	---	fruit
tohe'koo	Piper taboganum	seed
tood'rah	---	fruit
took'ruyah	---	fruit
tukmarah'rah	---	fruit
tukur'sk	---	fruit
tumah'krah	---	leaf
tu'rah	---	fruit
yah'yahs	---	fruit

Source: Ruddle (1974, pp. 335-338)

TABLE 16. Wild and Cultivated Vegetable Foods of the Caribs of Christiaankondre and Langamankondre, Surinam

Common Name	English Name	Latin Name
awa:la	awarra palm	Astrocaryum segregatum
pala:ta	bully tree	Manilkara bidentata
me:li	wild blackberry	H-miria balsamiferi
ulusu:lu	wild soursop	Annona montana
paku:li	Guiana orange	Platonia insignis
kuya:pa	wild guave	Psidium guyave
o:loi	wild cashew	Anacardium occidentale
ku:mu	turu palm	Oenocarpus bacaba
ale:miki	wild lime	Citrus aurantifolia
simi:li	courbaril	Hymenaea courbaril
ma:ngi	wild mango	Mangifera indica
mali:pa	maripa/cokerite	Maximiliana maripa
mele:kuya	wild passion fruit	Passiflora edulis
mu:lusi	mauritia palm	Mauritia flexuosa
mo:pe	yellow mombin	Spondias mombin
kaba:ya	wild papaya	Carica papaya
wa:sai	manicole palm	Euterpe oleracea
alu:ku	cocoa plum	Chrysobalanus icaco
aku:ma	wild sapodilla	Achras zapota
ta:malen	wild tamarind	Tamarindus indica
tuku:mu	cuyuru palm	Astrocaryum tucumu
wai:ke/pai:lawa	inga	Inga edulis
ulusu:lu	soursop	Annona muricata
mulu:mulu	---	Astrocaryum sciophilum
amala u	spinyclub palm	Bactris spp.
kuna:na	---	Astrocaryum paramaca
masu:si	---	Renealmia exaltata
pa:dawa	---	Oenocarpus bataua
wo:kobo:pi	---	---
aku:li wesemetabi	---	---
akala:u	---	---
ama:pa	wild star apple	Couma guianensis
mika:ya	---	Acrocomia aculeata
ataka:li	---	Duroia eriopila
sosobo:lo	stinking passion flower	Passiflora foetida
ana i	savanna pineapple	Ananas spp.

Source: Kloos (1971, table 1 following page 67)

TABLE 17. Wild Food Plants of the Eastern Timbira, Brazil

Common Name	Latin Name
jucara	Euterpe spp.
bacaba	Oenocarpus spp.
sapucaia	Lecythis spp
curiti	---
guabiroba	---
bacury	Platonia spp.
puca	---
piquy	Caryocar spp.
mocajuba	Acrocomia spp.
mangaba	Hancornia spp.
caju	Anacardium spp.
araca	Psidium spp.
coco/babassu	Orbignia spp.
burity	Mauritia flexuosa
piassava	Attalea spp.
catule	Cocus comosa
paty	Astrocaryum spp.
muricy	Brytonima spp.
anaja	Maximiliana regia
patioba	Caladium spp.

Source: Nimuendajú (1971, pp. 72-73)

DISCUSSION AND SYNTHESIS

Returning to questions posed at the outset of this report, should agricultural development within the tropical zones of Central and South America and the Caribbean consider edible wild plants as a viable research and development focus? Four types of data presented in this report document an unqualified support for such research.

1. While there is abundant information already available identifying important dietary uses of wild plants by agricultural peoples within the study regions, these data have not been systematically collected. No region within Central and South America or the Caribbean has been thoroughly examined for the potential presence of highly nutritious wild plants. Data presented reveal a high number of wild species utilized by agricultural societies within the study area; the reports presented represent an eclectic, unsystematic attempt to identify potentially useful edible wild plants.

2. It is clear that many agricultural societies focus on domesticated field crops to the near exclusion of wild species. It is also clear that other agricultural societies rely heavily on wild plants to provide important energy and nutrients under three types of conditions: A) Minimal but important use throughout the year, B) Major important use at specific periods of the year, especially in the months preceeding harvest of domesticated field crops, and C) Major importance during periods of drought. Wild plants in each region are climatically adapted to variable conditions, whereas most domesticated field crops are not. Thus during drought wild plants may become the most important determinant whether individuals, families, even villages maintain their nutritional quality.

3. The nutritional role played by wild plants includes basic components of energy (calories) for protein, carbohydrates, and fats, as well as vitamins and minerals. Few data are available, however, on the nutritional composition of most edible wild plants. With such data, important decisions could be made for agricultural development of outstanding wild plants with high potential for nutritional return.

4. The nutritional aspect of wild plant research is but one of several potential agricultural and economic focal areas. In addition to wild plants serving as food resources, wild species offer high potential for economic fiber, oil, dye, drugs/medicine, and a host of other economic possibilities.

Thus, considering agricultural development in its broadest sense, one may make a sound claim that an exciting research area with direct application for agricultural development and economic improvement exists within the theme of wild plant use. A number of recent reports build upon this theme of economic development of wild plants, especially those by Goodspeed (1953), Terra, (1966), Mondonedo (1969), Bates and Hentges (1976), and Wilkes (1977), who suggest that tropical plants have not been investigated adequately.

Approaching the question of further research from a complementary perspective is the view of the present author (Grivetti, 1976; 1978; 1979) who holds agricultural development should not be at the expense of nutritional quality of human diet and that nutritional quality is built on an association in many agricultural societies with a food pattern based on both domesticated and wild species. Parallel views have been stated by Dewey (1979; 1980) and

Doughty (1979a; 1979b) suggesting that agricultural development may not lead to direct nutritional improvement unless ecological and public health data are involved in planning. Still another parallel view is that of Calloway et al. (1974) who have documented clearly that wild plants not only augment human diet in a positive manner, but that the nutritional content of some wild species may be superior in vitamin and mineral content to widely raised domesticated field crops. Such views support the work of Clarke (1976) and others that agricultural development is important, but should also consider relationships between agriculture, human ecology, and forest-bushland-field crops.

A different argument for suggesting research on edible wild plants should be within the realm of agricultural development is presented by Leroy (1967), Gade (1972), Prance and Elias (1977), and Schultes (1979), that "extinction is forever". These writers suggest that indiscriminate attempts to push back forest margins to bring vast regions under cultivation may result in the extinction of hundreds of plants, not heretofore examined for their potential as economic products of high value. Most ecologists are realists; willing to sacrifice certain species if provided only with the choice of feeding human infants or preserving a plant. But most ecologists -- and most human nutritionists — would not be willing to expand crop acreage at the expense of "useless jungle/bushlands" -- <u>without first examining the lands for under-exploited wild plants with potential for dietary development or other economic uses</u>. Such an approach is short sighted; with perhaps initial food gains but at an unacceptable price. Without the knowledge on which to base decisions such agricultural planning would exist only in a vacuum.

RECOMMENDATIONS

Accordingly, the following four recommendations are made and develop from the data presented in this report:

1. Underutilized/exploited wild plants should be considered a research priority within agricultural development programs sponsored by the Agency for International Development.
2. Local USAID officials should be provided with limited discretionary funding in the range of U.S. $20-30,000 to sponsor systematic economic surveys in target regions whereby wild plants with potential dietary and non-dietary uses could be identified and evaluated for further study.
3. Teams of qualified Anthropologists/Geographers, Botanists, and Nutritionists should be encouraged to apply for such funding to systematically examine and review the potential for further development of wild plants within Central and South America and the Caribbean.
4. A systematic effort should be launched to develop a nutritional data base on the energy, vitamin, and mineral composition of important edible wild plants. Field collections could be returned to Federal or American university laboratories for analysis at relatively little cost -- but with enormous nutritional and economic potential.

APPENDICES

APPENDIX 1

CENTRAL AMERICA AND CARIBBEAN SEARCH REQUEST

Data Set	Country	Crossed by
1	Mexico	A. Indigenous Plants
2	Cuba	B. Wild Plants
3	Guatemala	C. Gathering
4	Dominican Republic	D. Medicinal
5	Honduras	
6	Haiti	
7	Curacao	
8	Aruba	
9	Puertc Rico	
10	Puerto Rican	
11	Nicaragua	
12	Jamaica	
13	Costa Rica	
14	Costa Rican	
15	Panama	
16	Martinique	
17	Guadeloupe	
18	Barbados	
19	Trinidad	
20	Tobago	
21	Antilles	
22	Bahamas	
23	El Salvador	
24	St. Lucia	
25	Grenada	
26	St. Vincent	
27	St. Kitts	
28	Bermuda	
29	Belize	
30	Antigua	
31	Bonaire	
32	Nevis	
33	Central America	
34	Central American	

APPENDIX 2

SOUTH AMERICA SEARCH REQUEST

Data Set	Country
1	Argentina
2	Bolivia
3	Brazil
4	Chile
5	Colombia
6	Dutch Guiana
7	British Guiana
8	French Guiana
9	Ecuador
10	Guyana
11	Paraguay
12	Peru
13	Surinam
14	Uruguay
15	Venezuela
16	South America
17	South American

Crossed by

A. Indigenous Plants
B. Wild Plants
C. Gathering
D. Medicinal

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