Jodï horticultural belief, knowledge and practice: incipient or integral cultivation?

Crença, conhecimento e prática horticultural Jodï: cultivo incipiente ou integral?

Stanford Zent[I], Egleé Zent[I]

[I]Instituto Venezolano de Investigaciones Científicas. Caracas, Venezuela

Abstract: This paper describes the Jodï horticultural system, including belief, knowledge and practice aspects. The horticultural practices of the Jodï were previously characterized as 'incipient cultivation' but such practices were poorly described and documented. The antiquity of cultivation among this group is suggested by the prominence and significance of horticultural products and techniques in myth and ritual. Our field observations uncovered a fairly sophisticated system of plant management in swiddens, house gardens, trail gardens and natural forest gaps. An inventory of 67 cultivated plant species was documented, of which 36 are utilized for food, 20 for magical or medicinal purposes, and 11 for technology. The Jodï prolong the productive phase of their gardens for five years or more through successive planting-harvesting-replanting operations. Jodï swiddens display an elaborate polycultivated appearance and they possess at least five principal crops: plantain/banana, maize, yams, sweet potato, and sweet manioc. Another distinctive feature is the extensive use of natural gaps in the forest canopy as cultivation zones. The results of this study suggest that while Jodï horticultural practice is well integrated with a nomadic, foraging-dependent lifestyle, nevertheless this system does not deserve to be labeled as 'incipient' and instead is more integral than was recognized previously.

Keywords: Horticulture. Agroecology. Incipient cultivation. Jodï. Venezuelan Guayana. Amazonia.

Resumo: O artigo descreve o sistema hortícola Jodï, incluindo aspectos de conhecimento, crença e prática. As práticas hortícolas dos Jodï foram previamente caracterizadas como 'cultivo incipiente' por outros pesquisadores, mas essas práticas foram pouco descritas e documentadas. A antiguidade da agricultura nesse grupo é sugerida pela proeminência e significância de produtos e técnicas hortícolas em mitos e rituais. Nossas observações de campo mostram um sistema bastante sofisticado de manejo de plantas em roças, pomares, trilhas e clareiras naturais de floresta. Foi registrado um total de 67 espécies de plantas cultivadas, das quais 36 são utilizadas para a alimentação, 20 para fins mágicos ou medicinais e 11 para tecnologia. Os Jodï prolongam a fase produtiva de suas roças e jardins por cinco anos ou mais, por meio de sucessivos plantios-colheitas-replantios. As roças Jodï parecem ser policultivadas e possuem pelo menos cinco principais culturas: platano/banana, milho, inhame, batata doce e mandioca doce. Outra característica distintiva é o uso extensivo de clareiras naturais de floresta como zonas de cultivo. Os resultados deste estudo sugerem que, embora a prática hortícola Jodï seja bem integrada com um estilo de vida nômade e dependente da coleta, este sistema não merece ser rotulado como 'incipiente', pelo contrário, é mais integral do que foi reconhecido anteriormente.

Palavras-chave: Horticultura. Agroecologia. Cultivo incipiente. Jodï. Guiana venezuelana. Amazônia.

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Autor para correspondência: Stanford Zent. Instituto Venezolano de Investigaciones Científicas. Laboratório de Ecologia Humana. Centro de Antropologia. Ado 20632, 1020A. Caracas, Venezuela (szent@ivic.gob.ve).
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INTRODUCTION

A near universal characteristic of the native peoples of the tropical forest region of South America is that they display a mixed subsistence pattern, in which shifting cultivation, collection, fishing and hunting are combined (Torres-Trueba, 1968; Sponsel, 1989). However, the specific resources and composition of the mixed economy are variable from group to group. Models of sociocultural evolution and ecology in the region tend to gloss over this empirical diversity by constructing classificatory schemes based on discrete economic types. One of the major categorical distinctions made in this regard is the dichotomy between hunter-gatherers and horticulturalists. The contrast between societies who forage for their food and those who cultivate it has been represented as qualitatively distinct (d)evolutionary stages which could be explained by environmental variables (e.g. resource limiting factors), historical events (e.g. depopulation, dislocation, warfare) or some combination thereof (Steward, 1947; Steward and Faron, 1959; Lathrap, 1968; Carneiro, 1968; Wilbert, 1972; Balée, 1992; Wilson, 1999).

A wealth of comparative and empirical research in the last two-three decades have advanced our understanding of the complexity of people-plant-animal interactions and raised doubts about the accuracy and usefulness of a rigid distinction between hunter-gatherers and agriculturalists. Botanical and ecological studies have shown that the distinctions between wild and domesticated resources and between unmanaged and managed landscape units are often graded or continuous rather than discrete (Posey, 1983, 1998; Denevan and Padoch, 1987; Balée, 1989; Clement, 2006). Hunter-gatherers, as well as cultivators, modify, enhance and therefore to some extent 'domesticate' their environments through ecological disturbance behaviors (Posey, 1984; Rival, 1998; Politis, 2007; Zent and Zent, 2004a). Virtually all Amazonian forager groups possess knowledge of at least some cultivated plants and practice some form of swidden cultivation, albeit casually or sporadically, along with their foraging activities (Hill and Kaplan, 1989; Viveiros de Castro, 1992; Balée, 1995; Denevan, 2001; Politis, 2007). Meanwhile, many so-called horticulturalist groups in Amazonia rely extensively on foraging activities and trekking groups oscillate between periods of greater sedentism, during which cultivated foods are the dietary staple, and greater mobility, during which wild foods usually predominate (Maybury-Lewis, 1967; Aspelin, 1976; Werner, 1983; Metzger and Morey, 1983; Good, 1995). This type of evidence advises that the distinction between foraging and farming in Amazonia should no longer be treated as qualitatively separate economic types or evolutionary stages but instead are better conceived as heuristic categories (i.e. as a convenient communicative device) that correspond to points on a subsistence continuum ranging from less to more intensive control and management of natural resources by people.

If we begin from the premise that Amazonian subsistence systems are inherently mixed, then the different component technologies and resource products are reconsidered as alternative yet interrelated strategies for satisfying nutritional goals. Viewed in this light, horticulture as well as other food-getting endeavors are better described as continuous and articulated behaviors. The creation of swiddens and resulting landscape modification may attract or augment game animal populations, for example (Zent, 1997). The propagation of useful plant species, whether by cultivation of domesticated plants or by collection or transplanting of nondomesticated plants, may entail the handling and transport of seed material and the manipulation of the edaphic or floristic conditions in the place where the seed is deposited (Posey, 1984; Zent and Zent, 2004a). In both cases the overall objective may be the same and expert knowledge may be required, but the specific techniques differ. The particular mix of different behavioral strategies in a given system will depend on a wide variety of considerations such as resource availability, technical know-how, labor forces, energetic efficiency, production needs or wants,

cultural food preferences and prohibitions, aesthetic or spiritual values, among others. These in turn may be affected by an equally impressive array of environmental variables that are subject to change, which means that subsistence systems are complex, dynamic and situated biocultural entities. This viewpoint portrays food as a 'process' as well as a product whose outcome is shaped by interacting flows of matter, energy, objects, knowledge and gestures (Lemonnier, 1992). The use of simplistic and essentialistic classifications or labeling, such as production/procurement, domesticated/wild or garden/forest, tends to obscure our grasp of such complexity and dynamism.

The present article offers an ethnographic account of the Jodï[1] horticultural system. One of the reasons why we open a descriptive case study with a theoretical discussion is to advise the reader that we approach the subject of Jodï horticulture as a delimited yet fuzzy set of cognitive and behavioral strategies within a larger set of loosely integrated strategies whose common denominator is the food quest. In that sense, we attempt to describe the content, structure and context of one crucial segment of Jodï subsistence ecology, the one involving the human management of cultivated plants and landscapes as a productive enterprise. At the same time, we are sensitive not to draw too sharp a line between horticultural and nonhorticultural subsistence activities and instead to be cognizant of the multiple connections and continuities between them. Another reason why this discussion is pertinent is because Jodï horticultural practice has been labeled as 'incipient cultivation', which is another concept inherited from an evolutionist intellectual paradigm. This type of agricultural system is defined by the following characteristics: a) low production levels as a proportion of total food output, b) simple technology, c) small capacity of surplus generation, and d) capability of supporting only small populations with simple social structures, in comparison to more 'advanced' systems (Leeds, 1961). From a technological and social standpoint, these systems are considered to be halfway between fulltime foraging and full-scale swidden agriculture. Previous ethnographic assessments of the Jodï portrayed them as being one of those rare groups situated close to the middle range of the foraging-farming continuum and, based on the available information, it was rather difficult to tell whether they leaned one way or the other. One of our objectives in this paper is to be able to answer whether this is an accurate characterization of the Jodï case or not.

In carrying out this evaluation, it will be useful to consider what incipient cultivators are not supposed to be like. Besides connoting a primitive technology or low level of productivity, so-called incipient systems of shifting cultivation are sometimes contrasted with other systems regarded as being 'integral' (Conklin, 1957; Spencer, 1966; Watters, 1971; Ruddle, 1974). Integral systems of shifting cultivation are defined as those which make up a core part of society's existence and are deeply integrated with many other aspects of the culture. Conklin (1957, p. 2) described these systems as forming "a more traditional, year-round, community-wide, largely self-contained and ritually sanctioned way of life". Integral cultivators are depicted as being very knowledgeable about local environmental conditions and skillful managers of the swidden cycle without causing environmental degradation. By contrast, incipient cultivators are seen as having inferior knowledge and skill which frequently leads to environmental damage and hence the need to move on indefinitely. We keep this categorical distinction explicitly in mind as we undertake the task of evaluating the Jodï cultivation system while maintaining our skepticism of the adequacy of such simplified and essentialistic categorical constructs in the face of enormous empirical variability and complexity.

[1] This word, meaning 'people', and all other words of the Jodï language that appear in this text are written using the alphabet developed by members of the Jodï community at San José de Kayamá, in collaboration with M. Marcelo Quatra and the authors during workshops held in Kayamá in 2002 and 2005 (see Quatra, 2008).

CULTURAL AND ECOLOGICAL CONTEXT

The Jodï are a native tropical forest society of the Venezuelan Guayana with a current population of approximately 1,100 people. They were basically unknown and isolated from western society until the end of the 1960's, when they were first contacted by missionaries and anthropologists (guided by other Indians, of course). The ethnographic reports of the Jodï during the first years after contact (1970-1975) call attention to their upland forest habitat orientation, dispersed and nomadic settlement pattern, foraging-based economy with incipient cultivation, primitive material technology, near absence of western trade goods, and phenotypic and linguistic distinctiveness from surrounding Indian groups. A phase of rapid culture change was then initiated with the establishment of two mission settlements inside the Jodï territory, the first one in 1971 at Caño Iguana in Amazonas State, by evangelists affiliated with the United States-based New Tribes Mission (NTM), and the next one in 1983 along the Kayamá River in Bolívar State, by Catholic nuns belonging to the Colombian-based Lauritas religious congregation[2]. Subsequently a large number of the formerly scattered and transient Jodï local groups migrated toward either one of these demographic poles and today an estimated 70-75% of the entire Jodï population is permanently settled there. Beyond proselytizing the mission-based Jodï in the Christian religion, the missionaries have also facilitated or promoted access to western material goods and biomedicine, Spanish language learning and literacy, new forms of social organization and the adoption of allochthonous cultigens. At the same time, the nucleation of human population and vigorous demographic growth (due to the effects of western medicine) has resulted over time in environmental impacts and economic shifts, such as intensification of agriculture, at the mission communities. In 2006, the NTM missionaries were expelled from Indian territories in Venezuela, and hence from Caño Iguana, by national government order and a platoon of army soldiers and a medical doctor were sent to take their place. In the five years since this occurred, a number of Jodï families have moved further away from the former mission base. Another 300 or so Jodï still live in small, shifting settlements outside the (ex-)missions' sphere of influence. Some of these groups have migrated downriver and maintain intermittent social and economic contacts with neighboring indigenous groups, while others remain extremely isolated from outsiders and are still very unacculturated. Thus, while one can say that the Jodï have experienced meaningful social, economic and intellectual transformations in the last four decades, these impacts are very uneven across the entire population. Furthermore, essentially all of the ~25 Jodï communities existing today continue to maintain a way of life and world view that are closely connected with the forest environment, and their subsistence economies are for the most part independent and exhibit very few if any direct economic ties to outside markets. Thus, they still share many cultural traits and similar relationships with the natural environment.

The Jodï homeland is located in and around the northern sector of the Sierra Maigualida mountain range. This sharply dissected and topographically diverse region varies in altitude from 150 to 2,400 meters above sea level (masl) and is covered by dense and high forests, except at high plateau elevations (above 2,000 masl) where tepui-like meadows and scrub prevail (Huber, 1995, p. 42-43). The macroclimate for the general region is classified under the Köppen system as wet tropical with a dry season of two months (i.e. < 75 mm/month), although this regime may be altered by local geo-ecological factors such as latitude, altitude, relief and vegetation cover. Because there was no climate data available from within the Jodï territory itself, we conducted our own measurements of pluviosity, temperature and humidity during our time in the field. According to these results, annual rainfall ranges between 2,400 and 2,700 mm, varying slightly

[2] Formally known as 'las misioneras de María Inmaculada de la Beata Laura Montoya' or 'las misioneras de María Inmaculada y Santa Catalina de Siena'.

by location, with May-August being the wettest months (> 300 mm) and December-March the driest months (< 100 mm). Temperatures throughout the region oscillate between a daily maximum of 30.8º (± 2.4º) and a daily minimum of 21.7º (± 0.5º) C (range of 18-44º C). Relative humidity was quite variable according to the season, but the average daily maximum value was 92.6 (± 1)% and the average daily minimum value was 63.7 (± 11.9)% (Zent and Zent, 2004b). The floristic composition of the Maigualida region is not well known or mapped, but it is expected that the region should harbor high levels of diversity considering the geological, geomorphological, edaphic, and climatic variation that can be observed from macro-scale maps (O. Huber, personal communication). One of our research goals was to make a floristic survey so we set up forest plots and carried out quantitative botanical inventories at four sites within the Jodï territory. The results showed that the forests of this region exhibit some of the highest levels of alpha (within-plot) diversity ever recorded in the Guiana shield region of South America (133-191 species/HA). Beta (between-plot) diversity is also unusually high, as less than 20% of the total inventory of species collected can be found at more than one site. Physiognomically, these forests display at least two clearly distinguishable arboreal strata with an irregular canopy varying in height from 18 to 30 m and with some emergent trees reaching about 35-40 m tall. The most conspicuous plant families (i.e. highest family importance values) are the Burseraceae, Moraceae and Sapotaceae. Fabaceae was the most species rich family (38 species), Burseraceae the densest (165 individuals) and Sapotaceae the most dominant in terms of basal area (Zent and Zent, 2004b).

RESEARCH PROBLEM

One of the key issues that stimulated our initial research among the Jodï was the uncertainty over the nature of their agricultural system, especially its developmental status. The written accounts of this activity and its products during the early post-contact period were very sketchy, fragmentary and seemingly inconsistent. On one hand, different authors characterized the Jodï as incipient cultivators while noting that their gardens are rather small (compared to other groups in the region) and unkempt (Dye, 1970, p. 4; Eibl-Eibesfeldt, 1973; Corradini, 1973, p. 43; Guarisma, 1974, p. 17; Coppens, 1975, p. 68; María Eugenia Villalón, personal communication). On the other hand, there are reports, often by the same authors, that they cultivate a large number of different crops, maintain several gardens per settlement group and eat cultivated foods on a regular basis (Guarisma, 1974; Coppens, 1975, p. 76). Perhaps because the pre-mission Jodï were very mobile, moving from one house or camp to another every few days, the early ethnographers tended to assume that they were primarily hunter-gatherers and secondarily horticulturalists. One possible reason for this confused picture is ecological variation from one locality to the next. Coppens (1975) found that one local group in the north ate cultivated foods in > 80% of observed meals whereas another group in the south subsisted mainly on wild resources procured by hunting and gathering. Jangoux reports similarly that one local group he encountered appeared to be almost pure foragers whereas in another he witnessed very well maintained gardens[3]. Another reason is that seasonal variation in resource availability was not taken into account. All of the field trips from this time period were relatively brief (≤ 2 months duration) and for the most part took place in the dry season.

Another major question concerned which cultigen or cultigens constitute the principal food crops. Different plant species have been identified as the dominant crop(s) by different observers: maize (Dye, 1970, p. 4; Guarisma, 1974, p. 18), maize and sweet potato (Eibl-Eibesfeldt, 1973, p. 141), plantain (Coppens, 1983, p. 256)[4] and plantain and maize (Guarisma and Coppens, 1978, p.

[3] Jangoux, J. "Observations on the Hoti Indians of Venezuela", 1971, p. 2. Unpublished manuscript.
[4] See also Jangoux, J. "Observations on the Hoti Indians of Venezuela", 1971, p. 14. Unpublished manuscript.

4). Once again, the disparate results may reflect spatial or temporal variations and simply refer to whatever the researcher saw during his or her limited observations. Due to the lack of further research on the Jodï during subsequent decades, these questions remained unanswered by the time our own research began in 1996. What was clear, however, is that the Jodï horticultural system looked somewhat different from the systems of other indigenous groups in the Venezuelan Guayana and elsewhere in northern lowland South America. The majority of these groups are dedicated bitter manioc cultivators. Although their swidden fields are typically polycultural, they actually feature bitter manioc (*Manihot esculenta* Crantz) as the dominant crop while other cultivated species are minor crops. Such groups, when maintaining a traditional lifestyle, are typically portrayed as 'integral' cultivators and agriculture forms the mainstay of their economy although it is supplemented by hunting, fishing and gathering. They often follow a short cropping-long fallow cultivation cycle involving a sequential rotation of land use areas and preference for felling secondary forests. Most fields are located close to the house or settlement (Denevan, 2001). The Jodï, by contrast, did not seem to have bitter manioc and appeared to be just as focused on foraging as farming if not more so. Their habit of having numerous small and scattered fields, and moving frequently between them (Dye, 1970; Guarisma, 1974), seemed to suggest that they practiced a form of 'nomadic agriculture' (Posey, 1982). The small size and disheveled appearance of their gardens suggested a lower level of dedication, if not an inferior technical capability.

In view of these differences as well as the other questions raised above, one of the goals of our research was to do an ethnography of the Jodï cultivation system. The present article aims to fulfill this goal and seeks an integral characterization of the topic at hand. Thus we use a variety of research methods, emic and etic, qualitative and quantitative, interpretative and descriptive, and give due consideration to belief, knowledge, language, behavior and institutional arrangements.

DATA COLLECTION AND METHODS

The data presented in this essay were collected intermittently over the past 15 years and represent three distinct phases of research[5]. The first phase was realized during the period 1996-1999 in conjunction with a broader ethnobotanical-ethnoecological research project (Zent, 1999)[6]. The data collected at that time included: (a) plant specimen collections[7], along with information about their cultural significance; (b) walk-through surveys of gardens, noting crop inventories, planting patterns and other features; (c) measurement of garden areas by surveying techniques; (d) plant censuses in randomly-located 100 m^2 plots (3 m x 33.3 m) set up in gardens of varying ages; (e) time allocation studies by the spot check method (Johnson, 1975); (f) food resource accounting (i.e. counting and weighing of food types harvested) (Zent,

[5] During all phases of research with the Jodï, the authors have obtained the required research permits and approvals (keeping in mind that the requirements have changed over time and according to our activities). These include: approval from the sponsoring research institutions, Instituto Venezolano de Investigaciones Científicas and the University of Georgia; permits to visit Indian-occupied areas from the Direcciones General y Regional de Asuntos Indígenas, Guardia Nacional and Gobernaciones de los Estados Amazonas y Bolívar; approval by the Organización Regional de Pueblos Indígenas de Amazonas (ORPIA); permits to collect plant samples from the Fundación Instituto Botánico and Ministerio de Ambiente; and, more recently, previous informed consent in writing from the members of the study communities.

[6] It should be understood that all of the data presented subsequently on these particular subjects refers to this ethnographic present (1996-1999) and not necessarily to the present day (2012). See also ZENT, S.; ZENT, E.; MARIUS, L. Informe Final del Proyecto "Etnobotánica Cuantitativa de los Indígenas Hotï de la Región Circum-Maigualida, Estados Amazonas y Bolívar, Venezuela". Informe preparado para el Consejo Nacional de Ciencia y Tecnología (CONICIT), Ministerio de Ciencia y Tecnología, Republica Bolivariana de Venezuela, 2001. 275p.

[7] Plant collections were processed and deposited at the National Herbarium (VEN) of the Instituto Botánico de Venezuela (IBV) and at the Ovalles Herbarium (MYF) of the Universidad Central de Venezuela (UCV). Some numbers were also sent to the Herbarium of the Universidad Nacional Experimental de los Llanos Occidentales Ezequiel Zamora (UNELLEZ) and the Missouri Botanical Garden (MO). All of the plant identifications provided in this paper are derived from these collections.

1996, p. 222-226); (g) focal person follow observations and timing of different horticultural activities (Zent, 1996, p. 222; Altmann, 1974); (h) classic participant observation in numerous activities and situations; and (i) unstructured and opportunistic interviews about cultivation-related subjects.

Following an exploratory survey of the Jodï territory in early 1996, four communities were selected for intensive study: Caño Mosquito, Caño Majagua and Caño Iguana in Amazonas State, and San José de Kayamá in Bolívar State (Figure 1). This sample selection was designed to encompass a representative range of eco-geographic diversity (river basin, altitude, forest type) and sociocultural diversity (community size and composition, settlement mobility, economic orientation, interethnic contacts). The Mosquito group is small (12 persons) and inhabits a very hilly, interfluvial forest zone (450 masl) in the upper reaches of the Caño Mosquito. They maintain a very nomadic residential pattern and have very little contact with non-Jodï since their village is several days travel from outsider groups. We also came into contact with other local groups in this region that were much more nomadic and claimed to not have active gardens. The Majagua settlement is located in a lowland forest habitat (150 masl) and was established within ten years prior to our arrival by a few families who migrated downriver from the Caño Iguana area. The group of co-residents is small (25 persons), highly mobile but less so than the Mosquito group, and they have intermittent contacts with neighboring indigenous groups (Eñepa, Yabarana, Piaroa) from whom they obtain western trade goods. The community at Caño Iguana is situated within a broad forested valley (250 masl) dissected by a fairly large river and surrounded by steep mountain slopes rising > 1000 masl. In 1996-1999, there were ~175 Jodï and four American missionary families living there in a nucleated arrangement around an airstrip. Kayamá is another mission settlement that has a chapel, community school, medical clinic, airstrip, and living quarters for a small contingent of nuns (two to four at a time). It is located at the confluence of the Kayamá and Moyá Rivers in a mixed forest-savanna ecotone environment. Surrounding the mission compound there are 350 Jodï and another 250 Eñepa (in 1996-1999), and they participate actively in church and school activities[8]. Most of the data from this period come from these four sites, the main exception being that some of the plant collections, garden surveys, measurements and plot censuses (a, b, c and d above) were made in the headwaters of the Cuchivero River during two trips to that area (May-June 1996 and February 1998). This area is very remote, mountainous and there are several settlements located within a range of 700-950 masl. These groups are very small (population range of 8-20), nomadic, possess few western goods and have no contact whatsoever with non-Jodï groups.

The second phase of our fieldwork took place between 2001 and 2005, and coincided with a community mapping project that we participated in (Zent *et al*., 2004; Zent and Zent, 2006/2008). As part of this larger project, we conducted extensive, free-ranging interviews about different topics that touched on aspects of agricultural belief, knowledge and practices, including notions of eco-cosmology, environmental ethics, land use patterns, migration histories, property rights, ritual practices, food taboos, and associated ideology. We also recorded myths and oral narratives, and compiled vocabulary about the cultivated and uncultivated landscape. The bulk of this work was carried out in Kayamá and Iguana, with a couple of short excursions to the Mosquito and Majagua regions.

The third phase of data collection for this paper was performed exclusively at Kayamá from November 2011 to January 2012. At this time, we carried out semi-structured interviews directed at various questions and gaps in the previous data in reference to cultivation practices and local understandings of such practices, especially with regard to the different phases of the cultivation cycle.

[8] See Zent (1999) or S. Zent and E. Zent (2004) for a more detailed description of each community.

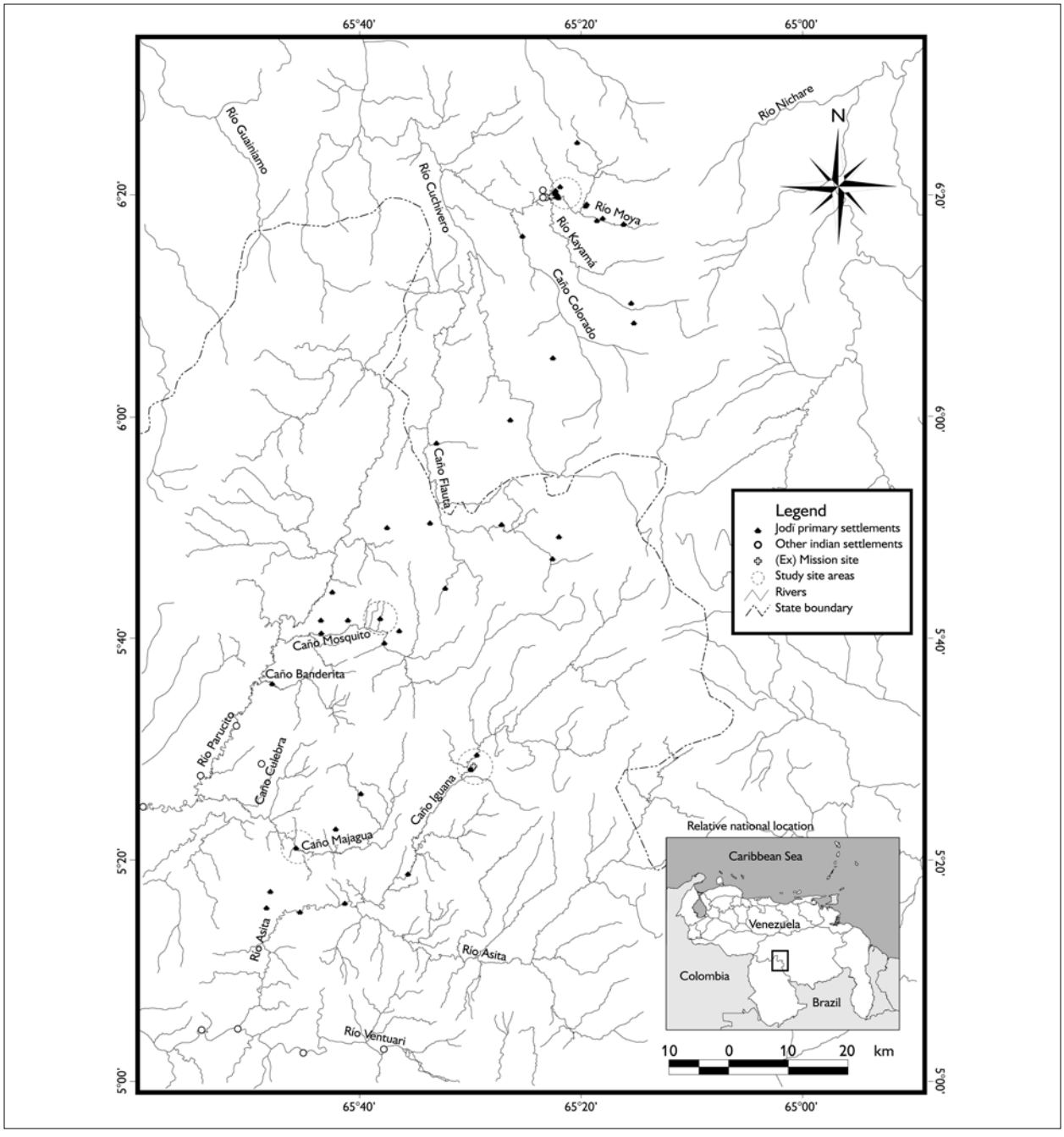

Figure 1. Map of Jodï primary settlements. All of the Jodï settlements, as well as the other Indian settlements, shown in the map were located by the authors using a geographic positioning system (GPS) electronic device during the period 1996-2002. At least three other Jodï communities located in the Caura River basin are omitted here because we were unable to visit them. Also unrepresented are possible uncontacted groups in the Caño Flauta and Río Guaniamo basins, about whom we received testimonies but were never able to confirm their existence or exact location. The small dashed-line circles represent the main study sites from which much of the data presented in the paper were collected. Prepared by Stanford Zent and Nuria Martin. Based on topographic maps NB-20-III and NB-20-IV, 1:500:000, South American Projection 1959. Instituto Geográfico de Venezuela "Simón Bolívar", Ministerio del Poder Popular para el Ambiente, República Bolivariana de Venezuela.

AGRICULTURE AND CULTURAL IMAGINATION

Our evaluation of the status and significance of agriculture among the Jodï begins with a consideration of the way it is represented in their cultural imagination. By looking at how this activity and its products are portrayed in myth and ritual, we hope to gain insight into how it fits into the larger scheme of Jodï world view. First, we consider a series of myths and tales that recount the origins and history of agriculture. Although this collection of narratives does not constitute a uniform corpus of lore, as their form and content vary somewhat by person and place, nevertheless certain basic themes stand out and this is what we have chosen to emphasize here. Second, we look at the ritual handling of cultivated *versus* noncultivated foods, especially in regards to food prescriptions and proscriptions during different life crises, and how this contrast is associated with broader notions about the way that humans negotiate and regulate their relationships with other life forms.

The antiquity and importance of cultivated foods as a crucial element of Jodï subsistence and cultural identity is suggested by the myth of the primordial 'food tree', *Jkwë jtawï jkạjkạ*. In this myth, we see that crops came to light in the biosphere at the same time as animals (and by extension modern-day humans). The story recalls that there once lived a band of Jodï 'people' in the land where the Sun sets. The band itself consisted of different animal creatures – e.g. spider monkey, howler monkey, saki monkey, tapir, deer, agouti, paca, squirrel, and woodpecker, among others – who were really 'people' – i.e. possessed human qualities. Now, because they were constantly being attacked, and in danger of being vanquished, by another group, the Eñepa[9], who possessed curare poison while they did not, they decided to leave and go to the land where the Sun rises, hoping to find peace. This is why the ancestors of contemporary Jodï became nomadic. So they set off walking toward the east, eating wild tree fruits along the way and stopping only to sleep at night along the trail. By the afternoon of the second day, they stopped to rest again when spider monkey heard a parakeet singing and decided to go investigate. When he found the parakeet it flew away but on that spot he noticed a huge tree and lying on the ground all around it were a variety of delicious food items, such as yams, maize, manioc, plantain, sugarcane, cocoyam, banana, tobacco and others. At first the spider monkey kept his discovery a secret but he did let on that this was a good place to settle down and so the group built two longhouses there. To make a long story short, eventually spider monkey got caught red-handed with the food and had to tell his companions about it. Then they all went to see the tree and decided to cut it down to get all the food it held in its branches. After the enormous trunk had fallen, liberating the rich store of food it contained, all of the animals converted into their present-day *habitus* (i.e. in Bourdieu's sense, as historically- and culturally-contingent modes of being and acting) and went off to live in their respective habitats: mountain, savanna, river or wherever.

In attempting to interpret the significance of this mythic-historical event for the Jodï self-perception of their own *habitus*, we would argue that its deeper meaning goes beyond merely explaining how people acquired the 'secret' of cultivated (and other) food products. It seems no mere coincidence that the animal-people transformed into animals at the same time as cultivated plants were discovered by people. This transformation of animal-people into animals as they are now also implies the emergence of modern humankind in the sense of being a species distinct and apart from the animals who used to be like them (i.e. as ego to the animals' alter). The foods

[9] The Eñepa, better known as the Panare in the anthropological literature (Henley, 1982), occupy lands to the west and north of the Jodï and historically they have had closer social and economic ties to the Jodï than any other indigenous group of the region. Traditionally, the two groups were economically interdependent to the extent that the Eñepa traded curare poison to the Jodï in exchange for blowgun cane. While the trading partners were close, this alliance was (and is) not always very friendly. The myth of the food tree alludes to these aspects of their relationship, leaving little doubt that the animal heroes of the story are really the Jodï themselves in the guise of their mythological ancestors.

eaten by *nï jodï* 'true humans' are precisely those inherited from the primordial food tree while the converted animals went on to adopt their own species-specific foodways. Thus it seems that for the Jodï the genesis of the modern human *habitus* is closely associated with possession of cultivated food plants[10].

The acquisition and transmission of horticultural arts and skills is explained in another set of mythological narratives, according to which the primordial creature *uli yewi* 'big jaguar' is credited with being the first 'person' to clear and plant a garden[11]. He is also the one who taught the Jodï everything associated with gardening. At the beginning of time, *uli yewi* opened up the first garden with the help of the beak-axe of *uli jkyejko* 'big toucan'. The crops that *uli yewi* planted in this garden were the same ones that came from the *jkwë jtawï jkajka*. However, he is not responsible for the spread and diversification (into varieties) of the original crops. This feat was accomplished by the *jani kwayo* and *uli jkwayo*, the smart monkey-people[12]. They took the seeds of the plants eaten by people and dropped them along the river banks and onto small openings where trees had fallen down. This narrative cycle sets the precedence for the two main venues of Jodï cultivation practice: the slashed and burned swidden plot and the natural forest gap (see Alternative venues section).

After learning how to cultivate effectively, *uli yewi* passed along his knowledge to the first *nï jodï*. He instructed them on how and when to manage each stage of the cultivation cycle, from the selection of good soils, to clearing the forest, to burning, planting and harvesting. He also taught humans about the two Suns and their importance for growing crops. First there is the Sun-Mother, who resides underground (*ne jkwa*) and dries the organic material that is slashed before planting, thus fertilizing the soil and providing nutrients for the future cultigens. Next there is the Sun-Son, who lives in the sky and provides heat and light to all living entities on the earth (*ne*), including the garden flora and fauna. The Jodï believe that the same basic farming methods that were taught by the jaguar then are still used by them today – the same work habits, the same tools, the same cultivated plants – with a few notable exceptions. For example, the toucan-beak cutting tool was replaced by the stone axe, and later on by the steel axe. For the most part, the suite of crops cultivated by the Jodï today are the same ones that *uli yëwi* planted so long ago, the main differences being a few plants that were either lost or obtained from other sources in the meantime. In this cycle, we can detect the themes of continuity as well as change in horticultural practices. Continuity is expressed in the belief that the Jodï's current crop assemblage was inherited directly from this primordial feline hero and the individual crops are potentially everlasting because they stem from the primordial food tree. Change is the underlying topic of narratives such as those describing the loss or addition of certain crops, like bitter manioc, *nuyejtu* and plantain/banana.

Manioc. The original *uli yewi* eventually met with a tragic and ironic end. He was poisoned to death by his wife (who was *nï jodï* – a true person) when she gave him bitter manioc tubers that had not been properly detoxified. Thereafter the Jodï have avoided cultivating bitter manioc (until recently, see section on Planting). This tale, considered alongside the others, points to the complex and multi-sided personality of the jaguar. On one hand, he is one of the Jodï's principal benefactors, the

[10] Some versions of the myth specifically mention that the food tree contained not only cultivated food types but also wild edible plants, animals and fungi. However, the only food types that are specifically named in reference to the tree are all cultivated ones.

[11] *Uli yewi* is considered to still be alive today and still humanlike but bigger bodied. Their kind live deep within lagoons, an environment which, just like earth above, is characterized by mountains and forests, daily and annual cycles, plants and animals, and communities made up of one's kin.

[12] Other versions tell that the *jkajo jadï* 'weightless people' were responsible for collecting the seeds from around *jkwë jtawï jkajka* and spreading them to human hands and habitats.

giver of precious food, but also one of humanity's fiercest predators, the taker of human life (for food). On the other hand, his greatest invention, agriculture, was also the cause of his demise, at the hands of his wife no less. In the end, we are reminded that the Jodï were deprived of a highly productive food crop that is possessed by many of their neighbors by the treacherous actions of one of their own.

Nuyejtu. The *nuyejtu* plant (*Cucurbita* sp.) is a cultivated vine that produces a special gourd used almost exclusively for ritual purposes. The seeds are also employed in a hand-game exercise whose purpose is to call jaguars. According to Jodï oral tradition, the *nuyejtu* gourd is a crucial ingredient in the training of a person to become a powerful shaman or holyman called *jkajo-ja̲* (weightless, wise man). The trainee is required to use the gourd at three critical moments starting when the person is less than two years old. Although the *nuyejtu-ju* can still be found in their gardens, the Jodï claim that the *nï nuyejtu* 'true *nuyejtu*' variety became extinct about two generations ago and for that reason there are no true shamans living today. Here we see the crucial dependence of a traditional cultural institution, the shaman, on the domesticated biological organism.

Banana. Some of our Jodï collaborators reported that the first generations of Jodï obtained their seeds from a big garden belonging to *Jkyo malïdëjka*, a hypostatic divinity that has also been around since the primeval epoch, and this is precisely where plantain-banana came from. According to the myth, the peccary-people *uli jkajwiyë* were eating worms despite there being juvenile plantain racemes with which to plant nearby. The peccary-people attempted to cultivate the racemes but then they were warned off by the *jkajo jadï* (weightless, wise people), who told them that the seed was bad and that eating the fruit produced from it would give them erysipelas (an acute streptococcal bacterial infection of the deep epidermis). *Jkyo malïdëjka* came to the rescue by offering some of the 'good' plantain-banana seed from his garden. Still, some people did not heed the *jkajo jadï's* warning and hence they contracted the disease, which later induced their transformation into other entities. Some of the living Jodï *jkajo jadï* allegedly knew of the whereabouts of those gardens as recently as a few decades ago. One lesson that can be drawn from this story is the importance of planting good seed from safe varieties.

Another set of tales makes clear that plant entities are not simply a natural creation but instead are the product of somebody's agency, even of the plants themselves. One of the principal metaphors of such agency is precisely cultivation. Thus many so-called 'wild' plants are considered to be the cultivated crop of spiritual or mythical figures, which in turn are viewed as the farmers of the forest. The godlike *jkyo malïdëjka* is identified as the cultivator of the *ulu* palm (*Attalea maripa* (Aubl.) Mart.) and the *jwa̲na* bamboo (*Arthrostylidium schomburgkii* (Benn.) Munro). The palm symbolizes his food and the bamboo is his house. The rodents, *uli jkyabo ajkuli* (humanoid *Agouti paca*) and *uli du̲we̲no ajkuli* (humanoid *Dasyprocta leporina*) are responsible for planting *ajkuli jtawï* (*Chrysochlamis membranacea* Tr. & Pl.), *jnema ji̲* (*Bactris gasipaes* H.B.K), and *jtali ji̲* (*Mauritia flexuosa* L.f.), as well as other undomesticated or semi-domesticated trees and bushes. At a broader symbolic level, this type of discourse ratifies that the Jodï do not make a sharp ontological distinction between the domain of nonhuman nature and the domain of human culture (see more on this below).

The ritual treatment of cultivated foods and associated beliefs regarding the spiritual regulation of trophic relationships reveals another side of the deep integration of agriculture in Jodï thought and behavior. Here we can see that the Jodï construct agriculture as more than just a material technological system. It also has a metaphysical dimension that becomes manifest if we consider its place within what Århem (1996a) refers to as the "cosmic food web". Similar to other Amerindian groups in South America, the Jodï subscribe to a cultural model of human-nature relatedness based on the moral principles of predation and exchange. According to the Amerindian model, all living beings in the biosphere have a dual constitution, consisting of a spiritual essence and a

material substance. At a spiritual level, humans, plants and animals are conceived as constant and as social equals, but at a material level they are transformative in shape and unequal in energetic terms (as prey or predator). Adequate balance and reciprocal energy flow between different classes and kinds of beings is regulated by ethical behavior and ritual observances. The consumption of animals or plants in the flesh must be accompanied by compensatory actions directed toward the spiritual side, lest the prey be converted into predator and seek revenge for negative reciprocity. This symbolic construct stems from a more basic totalizing conceptualization of human-natural relations, typical of indigenous peoples throughout Amazonia and elsewhere, which perceives just one contiguous biospheric system within which notional distinctions about which phenomena are cultural *versus* which are natural are relational and not absolute (Descola, 1986; Viveiros de Castro, 1986, 1992).

That Jodï eco-cosmology adheres to a deep logic of mystical predation is evident in beliefs about the animistic properties attributed to a broad assortment of biological species and their intangible agencies in regards to their interactions with people. For the Jodï, all natural entities, such as humans, birds, mammals, insects, plants and fungi, are attached to spirit beings known as *jkyo aemo* that protect and own them. Such spirit beings correspond closely to the concept of 'masters', 'spirit owners' or 'guardian spirits' that has been widely reported in the literature on Amerindian eco-cosmology (Reichel-Dolmatoff, 1971; Overing and Kaplan, 1988; Århem, 1996b; Whitehead, 2002; Cormier, 2003). The *jkyo aemo* are depicted as polymorphic, hypostatic, semi-divine beings; as family groups consisting of parents and their children; as powerful agents of good and bad outcomes for people. Above all, they are seen as managers and caretakers of all individual members of their kind, providing them with food and shelter, gathering them up when they leave the material world and administrating the distribution and movement of their populations in different areas (Storrie, 1999; Zent, 2006, 2009). Would-be human predators are obligated to communicate with the *jkyo aemo*, asking for their permission to be able to come into contact and interact with (i.e. hunting, gathering, handling etc.) any member of their species, for it is they who decide when, where and how such interaction will occur.

Just like other plants and living things in general, all cultivated plants also possess (or are possessed by) *jkyo aemo*. This particular class of *jkyo aemo* is considered to be especially accessible, communicable and open to facilitating the apprehension of its charges in the garden. This explains why garden products are the only safe foods that a person can eat when undergoing rituals or life-cycle liminal states (e.g. childbirth, adolescence, mortuary rituals)[13]. Eating other food types at such vulnerable times increases the risk that the person will become the target of predation by spiritual agents, in particular the *jkyo aemo* of the offensive species. Different physical and psychological ailments are perceived as being caused by predatory attack; sudden illness especially is often diagnosed as a result of being captured by a predator. It seems significant that the least dangerous food types from a predatory standpoint, precisely garden crops, are those which are generated by a heavy dose of human agency. Considering that cultivated foods are especially important sources of organic maintenance during the most critical moments of human ontogenetic and personal development, it follows that agricultural knowledge is a strategic element for defining humanity. As well, by offering low-risk dietary alternatives, the products of agricultural labor enable the human predator/prey to diversify or lessen their exposure to more dangerous predators (e.g. large animals). This in turn contributes to more stable and harmonious social relationships between humankind and other organisms inhabiting the biological community, another hallmark and

[13] During such critical periods, typically a single cultivated food, such as maize, banana or sweet manioc, is the prescribed diet.

objective of proper human behavior. Agricultural products are also the first solid food given to babies and convalescent patients since the transition to full strength or health is gradual and corresponding diets must proceed from lesser to greater predatory quotients.

In addition to the *jkyo aemo*, the Jodï also recognize another class of spirits, called *jnamodï*, that may be associated with single crop species or garden areas. People also have *jnamodï* and they are conceived as spiritual-selves that are intimately and personally attached to the individual organism or the space they inhabit (Zent, 2005, 2009). The garden *jnamodï* possess healing properties that can be counted upon to cure young children and the elderly, as the following statement describes:

> *Jnamo* lives not just in a person's heart but also in our surroundings, our houses, trails, gardens, even though we can't see or hear them. If there is a sick child we call the garden *jnamo* to heal and care for him. The *jnamo* who lives in the garden can help and heal the old man when he is sick. Every house, every garden, every piece of forest have *jnamodï*. Even when the houses are empty or abandoned, there are *jnamodï* living under the roof. Every crop plant has *jnamodï*, within each garden and also inside and alongside each single plant. It depends on each crop, some have more *jnamodï* than others. The crops brought by the clothed people [i.e. whites], orange or mango, also have *jnamodï*. The *jkyo aemodï* of plants and animals talk to the *jnamodï* to care for us… (Lojtana Jtujwojkaña, personal communication, 2002, our translation).

In sum, horticulture among the Jodï is not just a practical matter. Considering that almost every activity realized by this group represents the outward expression of an articulated set of principles for living, which incorporate technical, spiritual, moral, and even aesthetic elements, the praxis of horticulture must also be viewed as a total social fact (*sensu* Mauss, 1925). Considering also that this economic activity cannot be easily separated from ideology and sociocultural identity, we are compelled to conclude that agriculture is deeply rooted in Jodï culture and probably has a very long historical trajectory among them.

OUTLINE OF SUBSISTENCE ECONOMY

In order to understand the economic significance and state of development of Jodï horticulture, it will be necessary to take into account the wider economic context and the place of horticulture therein. The subsistence economy of the Jodï can be apprehended on two primary thermodynamic levels: (a) labor input, measured here in terms of time investment (Table 1), and (b) production output, measured here in terms of raw weight of the resource class (Table 2). While our input-output data definitely confirm the mixed and opportunistic character of the Jodï subsistence pattern, in which horticulture, hunting, collection and fishing all play a thriving role, nevertheless a descriptive statistical analysis of this data reveals the relative importance of the different activities as well as interesting variations among the different study communities[14]. The time allocation data for all communities lumped together show that hunting is the most frequent subsistence activity (27% of all time dedicated to food getting), followed by horticulture (20%), collection (16%) and fishing (9%)[15]. The prominence of hunting is greatest at Mosquito and Majagua (45% and 28% respectively). It should be noted that these are relatively small settlements and therefore may enjoy more exclusive hunting territories and hence less competition. By contrast, in the more nucleated and sedentary mission communities at Iguana and Kayamá, we can observe that horticulture (23.5% and 29% of subsistence time respectively) has supplanted hunting (19% and 18% respectively) as the

[14] A word of caution to the wise in interpreting this data: it is often difficult to separate the different activities categorized here since such activities are frequently intermingled. Thus hunting outings may include collecting or fishing, or vice-versa, and opportunistic hunting or collecting sometimes occurs on the way to or from, or even at, the garden. When more than one activity was observed or reported, or more than one type of harvest was recorded, from a single outing, the activity event was divided between the pertinent categories.

[15] This statement refers exclusively to the primary subsistence activities of hunting, horticulture, collection and fishing. The significance of camping in the Jodï subsistence system is taken up in the paragraph that follows.

number one subsistence occupation, a result which may reflect greater long-term pressure on game animal populations and the need to compensate for this decline by intensifying agricultural production. However, the level of dedication to horticulture is nearly as great at Majagua (23%), which also spends a considerable amount of time fishing (12%). The greater focus on horticulture and fishing may be associated with the more sedentary settlement pattern (in comparison with the Mosquito group) as well as the lower elevation and more extensive riverine habitat. At Mosquito, the economic focus is more strongly on terrestrial foraging while horticulture (5%) and fishing (1%) constitute minor activities at best. It seems to be no accident that this result was recorded among the most nomadic group in our study. Nearly half (47%) of the person-days recorded in our time allocation study for this group actually took place away from what was considered to be their primary place of residence[16], a level of mobility closely approximating Balée's (1994) criteria for classifying 'trekker' groups. The intervillage variations in subsistence focus, interpreted in the light of differences in settlement pattern, seem to lend some support to the hypothesis of a correlation between hunting and settlement mobility on one hand and between agriculture-fishing and residential longevity on the other hand (Carneiro, 1968).

Camping represents another important subsistence activity that is practiced by all four of the local groups included in the field study, with an average dedication of 28% of all subsistence time allocation. By camping we mean overnight trips or dislocations of subdivisions of the co-resident group – couples, nuclear families, age mates etc. – to places which may be near or far (usually within a range of 3-20 km from the principal residence) and where they construct a provisional shelter. One of the principal reasons for such logistic mobility is precisely to be able to gain access to certain wild resources, such as those which are not found in the vicinity of the main residence or have become depleted close to home. Due to the irregular distribution and seasonal variations in the availability (e.g. fruiting seasons) of many wild resources, the camping trips usually do not last very long (from a couple of days to a couple of weeks usually). Because most of these trips are motivated by resource-getting goals, we have classified this activity as a subsistence activity and included it in Table 1. One of the interesting results found here is that time dedication to camping actually rises among the more nucleated and sedentary groups (34% of subsistence time at Kayamá and 28% at Iguana) and we speculate that this is probably related to the greater depletion of wild resources around these settlements. In any case, we see that the Jodï are maintaining a form of settlement

Table 1. Subsistence activity time allocation by community.

Community	Mosquito	Majagua	Iguana	Kayamá	All
Activity					
Agriculture	5%	23%	23.5%	29%	20%
Hunting	45%	28%	19%	18%	27%
Collection	24%	11%	16%	11%	16%
Fishing	1%	12%	13%	8%	9%
Camping	25%	25%	28%	34%	28%

Table 2. Relative contribution of subsistence activities to food production.

Community	Mosquito	Majagua	Iguana	Kayamá	All
Activity					
Agriculture	59%	63%	77%	82%	70%
Hunting	17%	13%	11%	5%	11%
Collection	24%	13%	9%	11%	14%
Fishing	0.2%	11%	4%	1%	4%

[16] The primary place of residence refers to the 'relatively permanent settlement' which normally has a duration of several years. It is the place to which the co-residential group returns after temporary dislocations throughout the annual cycle and at which the group makes and maintains swidden plots during different years (Zent and Zent, 2004a).

mobility even where they are starting to live in larger, more permanent communities.

In contrast to the data presented above on the relative time allocated to different subsistence activities, the data on weighed food production displays a very skewed dependence on cultivated food resources (Table 2). The aggregate figures for all study sites shows that approximately 70% of food production comes from horticulture, followed by collection (14%), hunting (11%) and fishing (4%) respectively. Agricultural production varies from a low of 59% of the total at Mosquito to a high 82% at Kayamá, a gradient that correlates loosely with settlement size and degree of contact with outsiders and their material culture. These results appear to confirm the positive stimulus of socioecological factors such as population density and access to foreign goods and technology (especially steel tools) on the intensification of the agricultural component and concomitantly the reduction of the hunting-gathering components of the Jodï economy. The rather high levels of agricultural food production relative to the other economic components are striking considering the relatively low levels of time investment observed in horticultural work. This result provides incontrovertible proof of the high productivity (i.e. energetic efficiency) of Jodï agricultural practices in spite of the appearance that such practices are less developed than those of other indigenous groups of the region. The asymmetrical relationship between input level and output level is most exaggerated in the case of the Mosquito group. According to the data presented here, this group spends a mere 5% of their subsistence time in agricultural labors while their gardens provide nearly 60% of their gross food production. However, this surprising result may, at least in part, be attributed to sampling error because we did not record any of the labor-intensive jobs of clearing forest plots for new gardens during the study period. In this region, new gardens are not always made every year and we were not present continuously during an entire annual cycle among this group, so it is possible that our results do not reflect the real levels of time investment in the horticultural component. Another factor possibly affecting this result is that plantain/banana and peach palm harvests were classified as horticultural resources in our data set and together comprise 52% of the total assigned to cultivated foods. While these species may be cultivated, we were also told that some of the harvests came from individuals growing in the wild or planted sometime in the past by persons other than community members. Thus the status of these two species as cultivated or feral, and how much of the respective harvests came from the garden or the forest, is ambiguous and reminds us of the precariousness of maintaining a rigid distinction between agriculture *versus* foraging in a place with a long history of anthropogenic modification of the landscape (Zent and Zent, 2004a).

GARDEN SITE SELECTION (*BALO BAKE U̲ WË*)

Among the Jodï, a new cultivation cycle often begins by going on a hunting trip (*jkyo balebï dekae*). That is, when a Jo cultivator wants to make a new garden he or she will usually go walking in the forest and look for prospective cultivation areas that have favorable characteristics for making a future garden (*balo bake*). Although the specific criteria mentioned for garden suitability vary across individual cultivators as well as by primary crop choice, the main ones can be categorized in terms of topography, soil type, floristic indicators, and location in relation to other activity spaces.

Site topography makes up one of the general considerations taken into account by most cultivators. Good earth (*jti jae ne*) is regarded as being somewhat, though not perfectly, flat. The optimum relief is gently sloping ground or somewhat hilly terrain (*jwïnï*). Riverbanks (*jedä o̲neijka*) are usually avoided due to excessive insolation, thus the soil is considered to be 'too hot' (*jtowejto baebï dejae*) for most crops, or the risk of flooding, but this admonition is waived if the primary use is going to be maize cultivation. Hence it is preferable to place one's gardens in headwater or interfluvial regions at the base of small mountain ranges (*jani i̲nëwa ikyuna*).

Soil quality is one of the most important factors taken into consideration when selecting a new garden site. Above

all, the ground must be soft and pliable (*wa̲ño dejae*). This can be tested by poking the ground with a machete and lifting up a piece of sod or pulling out a small herb *in situ*. It should come out easily without breaking off at the root. Besides this, the main soil properties that are believed to influence agricultural performance are color and texture, which are taken as indicators of fertility and humidity. With regard to color, the soil types that are consensually recognized as the best ones for growing crops are reddish brown (*ne aduwëjka majae*), red (*ne duwëwe majae*) and black (*ne jwalejte majae*), in that order of preference. As for texture, both sandy (*ne ajkabaeyu majae*) and clay soils (*ne ajwa̲nejke̲ majae*) are believed to provide favorable conditions. However, most informants are quick to point out that different crops thrive in different soil types so soil preferences vary according to which ones or which crop mixes are being planned. For example, yams (*Dioscorea* spp.) do not produce well in black soils but maize does. Associations of plantain/banana, sweet potato and manioc grow reasonably well in black soils but if the first one of this series is planted alone it is not expected to have an optimum yield (some individuals produce well while others do not). By contrast, cocoyam produces equally well on black or red soils but never on river margins. For tobacco, the underlying soil color or type is irrelevant; instead it must be planted where there is plenty of ash from burned vegetal matter. Cotton is capable of producing just about anywhere, on any type of soil and in any habitat (e.g. forest, savanna, and riverbank).

Floristic factors seem to be the primary indicators used by the Jodï to identify propitious agricultural locations since more informants refer to this and the number of elements mentioned in this regard outnumbers those of the other domains. Abundant forest cover is considered a necessity for garden making which is why savanna or riverbank ecotopes are consistently ruled out for this type of use. Primary forest or high secondary forest (*uli jkyo*) that has large trees characteristic of the primary habitat (e.g. *Micropholis egensis* (A. DC.) Pierre and *Pterocarpus rohrii* Vahl) is clearly preferred over younger secondary forest, but this requirement is relaxed at the mission communities where population nucleation and sedentism have imposed new constraints. At Caño Iguana, we observed secondary growth being slashed or felled on numerous occasions, clearly indicated by the presence of *Musa* or other persistent cultivated species. Trees that have abundant branches and leafy growth are esteemed because it is expected that they will burn well and leave abundant deposits of nutrient-rich ash for healthy crop growth. Species highly rated for their combustibility include the following: *jani wejtolo jyeï* (*Pourouma guianensis* Aubl., Cecropiaceae), *jani iye* (*Trichilia brachystachya* Klotzsch ex C. DC., Meliaceae), *uli iye* (*Trichilia mazanensis* J.F. Macbr.), *moko malu jyeï* (*Trattinnickia burserifolia* Mart., Burseraceae), *jani jtelela ju* (*Coussapoa* spp., Moraceae), and the vine *joloaka ibuju* (Olacaceae).

Several plant types are identified as reliable indicators of soils apt for cultivation in general. These include canopy trees, such as *jkaile jtau* (*Micropholis egensis*), *manio jtau* (*Pterocarpus rohrii*), *mujkë jyëï* (*Tachigali guianensis* Benth.), *ae jlude jtau* (*Dacryodes* sp.), and especially *luwë jtau* (*Inga* spp.), as well as understory shrubs, such as *jtijkëwajka jele* (*Aphelandra scabra* (Vahl) Sm.) and *neina nejkana jele* (*Piper arboreum* Aubl.). Another series of plants are recognized as phyto-indicators of certain cultigens in particular. For example, the presence of *ikyu jolowajka iyë jyëï* (*Trichilia pleeana* C. DC.) reveals excellent soil for cultivating sweet potato (*iyë*). The underworld locations directly beneath such places are lush with *iyë* plants and the *jkyo ae* (spirit keeper) of *iyë* dwells there. Other examples include: *jlojkwe jtau* (*Sterculia pruriens* (Aubl.) K. Schum.), good for yams; and *jtejtewa̲na jele* (*Piptocoma schomburgkii* (Sch. Bip.) Pruski), good for manioc.

CLEARING (*BALO NAÏ, BALO JWËU*)

During the first part of the dry season (*jtuwö baedona*), in December or early January, the scarlet flowers of the *jtijkëwajka jele* come into bloom. This phenological event

signals to the Jodï that it is time for a new agricultural cycle and the clearing of swidden plots should begin in earnest. The garden-making season is ritually marked by the preparation and consumption of a medley of fermented and unfermented beverages made from different cultivated plants such as sweet potato, manioc, plantain and sweet corn root. Along with the drinking, there is much singing and dancing, and people decorate their bodies with body paint and ornaments, as a way of celebrating (and auguring) the success of the new gardens that are about to be created. Clearing a garden involves two basic stages: slashing the lighter herbaceous vegetation and small trees and lianas (≤ 5 cm dbh), usually with a machete (*balo nai*), and felling the heavier trees with a steel axe (*balo jwëu*).

The work of felling the selected garden site is initiated by the male household head and sometimes he is accompanied by his wife or other male family members. The first step is to cut a perimeter trail (*oneijka majae mana*) as a way of marking the boundaries of the area to be cut. When additional hands are available, one or two cutters clear the perimeter and someone else cuts a trail through the center (*emona majae mana*). Cutting then proceeds in piecemeal fashion out from these trails but without any other preconceived design.

The brush and small trees are slashed at around ankle height from a slightly crouching or bent standing position. In the case of small trees or woody stems, the cutter grabs the stem with one hand and slices it with the machete held in the other hand. The cutter works more or less continuously for 20-30 minutes and then pauses for a few minutes to take a breather, sharpen his blade with a steel file that is carried on his belt and refresh his tobacco wad. Then the monotonous cutting resumes again. The cut vegetation is simply left where it falls without mounding or moving it. Dedication to this operation is more or less full-time, day after day, until the job is done. According to our focal follow studies and measurements of garden areas, we calculate that the labor investment required to slash one hectare of forest is approximately 56 man hours. Although this work is not as strenuous as felling larger trees, nevertheless it is more critical in terms of establishing the nominal ownership of the garden.

After the slashing has been completed, the cutters take a break of one or two days before beginning the heavier work of felling trees. This task is performed entirely by men while women play an important supporting role by preparing and serving large quantities of sweet potato beverage (*iye jyu*) or plantain beverage (*walulë jyu*) to the woodcutters. Given the considerable manpower required to carry out this phase of work, it is customary for the owner to recruit the cooperative labor forces of extended family members or men from other households. Thus a common sight in Jodï territory during the dry season is to find work parties of five men or more laying metal to lumber in unison in the cutting fields that are taking shape. In the smaller villages of the Mosquito and Majagua river basins, men from friendly groups will be 'invited' to lend a hand (and an axe) to their neighbor's plots. Rather than being a chore, however, these work parties seem to be experienced more as gay social occasions filled with much laughter, conversation, shared meals and plentiful libations. In the nucleated (ex-)mission settlements at Caño Iguana and Kayamá, the work parties may rotate among the fields belonging to the different members. More frequently, however, the labor exchange arrangement is more generalized than direct, such that the beneficiary of such cooperative labor may or may not reciprocate with equal labor of his own. In some cases, the owner did not even participate in the felling of his own garden. Our records of this practice show that a person's garden could easily have been cut by close relatives as by more distantly related men of the community.

On the day that cutting is to begin, the cutters must prepare properly by drinking their fill of sweet potato beer or some other beverage and grinding a fresh batch of sucking tobacco. They paint their bodies with annatto and peraman using the shell of the *leibo*, or titan beetle (*Titanus giganteus*), as an applicator. This rather large beetle (up to 15 cm long)

of the longhorn family bores into trees to lay its eggs and has the capability of sawing off tree branches. The cutters ask the spiritual owner of the beetle (*leibo aemo*) for the extra strength that will be needed to chop down large trees.

The felling process proceeds by notching the smaller trees (≤ 10 cm dbh) that stand within the fall path of the larger ones or may be attached to the latter by vines or interlocking branches. This technique is a common labor-saving device used by swidden cultivators (Zent, 1992, p. 189) and involves cutting a single notch in the trunk (for the smaller stems of this class) or a double notch on both sides of the trunk (for the larger stems) without felling it. The notched trees are then brought down in a domino-like chain reaction when the larger ones are cut through. The large trees are also cut on both sides of the trunk. A deep V-shaped wedge is first cut on the side toward which the tree is expected to fall (*jkwąjkuwë ju*). Then a second wedge is cut on the opposite side but slightly higher up than the first one (*jyëï jwië ju*). Care is taken to listen for cracking and to look for swaying or leaning in order to anticipate the critical moment when the trunk will fall down. When this moment comes, the cutter will jump back or run away from the falling lumber and yell out to the others to look out and get out of harm's way. For the extremely large tree giants (≥ 100 cm dbh) with buttressed bases, a rickety scaffold of poles lashed together with vines (*jtau jele mobaekae/wąjnanï dekae*) is constructed at the level where the buttresses taper off, sometimes reaching a height of 3-4 meters above ground level. Cutting down a tree of this caliber requires a great deal of effort and thus two cutters may chop both sides of the trunk at the same time. We timed one event of this kind at Majagua in which it took two men one hour and 20 minutes of nearly nonstop chopping to fell a single individual of *Micropholis egensis* which stood 40 m tall and had a girth of approximately 1.2 meters dbh. This type of work is extremely strenuous and tiring and therefore it is normal that the cutters take frequent breaks to catch their breath or quench their thirst. Highly valued trees, like the *ulu-jį* (*Attalea maripa*) and *awajto jį* (*Attalea macrolepis* (Burret) Wess. Boer) palms, may be left standing if they are still productive and located toward the margins of the plot. Based on our field observations and measurements of this process, the labor investment needed to fell one hectare of forest is approximately 86 man hours. After the basic felling is completed no further work in the plot is required and the felled vegetation is simply left to dry out.

The land areas cleared for new gardens vary considerably across Jodï communities and regions. In part, such variation reflects the balance that is established between the labor costs of this activity and the expected benefits in terms of food production and other utilities. Other factors that affect the size of gardens are the settlement pattern, relating to household size, degree of sedentism, and habitat alteration, and the productivity of alternative economic strategies (e.g. hunting, collecting and fishing). Table 3 shows the variation of garden sizes observed in different Jodï communities according to the river basin, based on a sample of 37 gardens which the authors measured using a tape measure and compass. The overall results (bottom row in Table 3) show a mean garden size of 0.35 HA and a standard deviation of 0.25 HA. The largest gardens were observed in the Majagua region and the smallest in the Upper Cuchivero. This result may be explained by the fact that at Majagua the settlements are semi-sedentary but still relatively small and the gardens are

Table 3. New swidden areas by settlement region.

Region	Mean area (m^2)	Standard deviation	Sample size	High	Low
Caño Iguana	2,423	1,661	13	6,887	634
Caño Majagua	5,537	3,217	10	11,911	2,143
Caño Mosquito	3,890	1,678	7	5,568	1,277
Upper Cuchivero	2,062	1,578	7	5,784	393
Total	3,474	2,529	37	11,911	393

collectively created and managed. By contrast, the Upper Cuchivero communities are among the most nomadic groups we encountered and thus they probably rely more on dispersed cultivation spaces and wild food sources for dietary support. The middle range garden sizes recorded at Mosquito reflect, on one hand, greater reliance on cultivated resources and perhaps lower mobility than the Upper Cuchivero groups and, on the other hand, greater dedication to foraging activities and relative mobility than the Majagua groups. The small sizes observed at the mission settlement of Iguana can be attributed to the fact that the gardens here are managed by individual households which correspond to nuclear families.

BURNING (*BALO BUDE*)

The newly felled clearing should be allowed to dry out for about two months before it is burned. However, the tricky thing is to time it just right so that the drying period can be completed and the burning can be done soon before the first rains of the rainy season pour down over the horizon. We came across a plot that was cut but never burned or planted in the Mosquito area and were told that the reason was because the owner was not able to burn it before the rains came. On the other hand, if it is cut too soon then too much weedy growth has time to take root, which may complicate the planting process and certainly raise the labor costs (since additional weeding will have to be done). Normally this task is carried out toward the end of the dry season, during the latter part of March or the first half of April. Several bio-indicators are recognized signals that the garden burning (*balo bude*) should be done: the flowering of the *wani-jyëï* tree (*Jacaranda copaia* (Aubl.) D. Don) and *majtune-ibuju* (*Lonchocarpus* sp.) and the nighttime croaking of certain unspecified frogs (*weijlodï*).

When the day to burn the new garden arrives, the cultivator asks *ñedo̲wa̲*, a hot spirit who is considered to be the owner of fire (*jkulë ae*), for its help to ensure a good and complete burn. For best results, the fire should be set using the traditional fire drill (*jkyë̲ka-bo*). This tool is made from the wood of *jani bejkao jele* (*Pourouma guianensis* Aubl.) as the stick and anatto (*Bixa orellana* L.) as the base, and the fiber of cotton (*Gossypium barbadense* L.) or kapok (*Ceiba pentandra* (L.) Gaertn.) as the tinder. The cultivator lights the fires (*jkulë budidï*) along the outer edges of the plot so that it burns inward toward the center and does not escape into the surrounding area. If the firing result is not even or complete, there is no further attempt to re-burn it at that time but unburned trunks may be moved to the edges or onto a pile in order to clear the way for easier access during planting.

PLANTING (*BALO MAJAWA LÏDË*)

Once the new garden is fired, it is considered ready for planting immediately. The main planting season begins in late March or early April and lasts through May and early June, which corresponds to the first half of the rainy season (*bae ojkunë*). This job should be largely completed when the middle of the wet season (*o(jku)emo baedona*) arrives, by which time much of the ash left from the burn has been washed away by rain. Moreover, if one waits too long before planting, the soil becomes too humid and seeds are thus at risk of 'drowning' (*ju̲nëe̲ dekae*). The planting process is typically a family affair, encompassing the efforts of men, women and children alike. It is often carried out by individuals or married couples and their children, in brief episodes or interspersed with other activities, like harvesting or weeding, and therefore is not as visible as some of the other cultivation tasks. Among the Jodï there seems to be no strict division of planting labor by age or gender, as can be observed among other Amazonian groups (Johnson, 1983; Zent, 1992), with a few notable exceptions. Tobacco that is to be used for ritual purposes as well as some of the magical plants, for example, should be planted by older men with shamanic abilities (*jkajojadï*). Men tend to be the principal cultivators of experimental species and varieties that were recently obtained from outside sources. Although informants expressed contrasting opinions about whether social status has any impact on who

should plant which crops, in practice we could observe no such restrictions or divisions.

Planting is one of the most complex and delicate phases of the cultivation cycle. The material toolkit employed for tillage and other horticultural tasks is simple enough, consisting either of a knife, machete, pointed digging stick or metal *chicora* (a narrow spade-like instrument), depending on availability and personal preference. But this activity requires considerable knowledge, skill and planning to perform effectively. The successful planter needs to be familiar with the distinct nutrient, physical and ecological requirements of a wide variety of domesticated and semi-domesticated plant species (especially important during the critical early phases of plant growth) and be able to balance these within a limited space. For each one, he or she must know the proper steps and procedures that make up the cultivation process: how to select good seed or reproductive material; how to store or prepare it prior to planting; how to go about sowing or implanting it; where it should be located within the garden area or spaced in relation to other individuals of the same crop or other crops; when it should be planted and in what order; what kind of care or maintenance do the growing plants require. Perhaps one reason that the average Jo is able to assimilate this volume of information is that they are actively exposed to it since early childhood.

In order to appreciate the complexity and sophistication of Jodï planting practices, it will be necessary to consider first the extent of agrobiodiversity that is present in this cultivation system. According to our botanical inventories, the Jodï cultivate 67 plant species which belong to 20 different families (Table 4 includes all Latin names of cultivated plants). This number of cultigens compares closely or favorably to the numbers displayed by other horticultural groups of the Venezuelan Amazon, like the Ye'kwana and Yanomami (Hames, 1983). The inherent phytogenetic diversity of this crop complex is even more impressive if we also take into account the subspecific level, as many of the cultigens listed here display several distinct varieties[17]. The majority of cultivated species (36) are utilized mainly for food while 20 are raised for magical or medicinal purposes and 11 for technology (fiber, beads, dye, bottle gourds, fish poison).

Quite a few of the specimens listed here are obviously nonnative crops and the Jodï are fully aware of their recent importation. They recognize 40 cultigens as being native or ancestral crops (*baede jadï lidïdewa*) while 27 are considered to be introduced crops (*abalajdï jodï lië majawa lidïdewa*) which have been adopted during the past couple of generations (see column 6 in Table 4). The seeds of rice, citrus fruits (lime, orange, tangerine and grapefruit) and exotic tree crops like mango, guava, breadfruit and Amazon grape were initially brought by missionaries to Iguana and Kayamá and subsequently disseminated among the residents of these localities. Other new crops, like guamo, watermelon, peanut, lemon grass, bitter manioc and certain varieties of chili pepper, are conspicuously present in Jodï gardens at the nonmission communities in Amazonas State and were reportedly acquired from surrounding Indian groups, such as the Yabarana, Piaroa and Ye'kwana, or from residents of the criollo (i.e. multi-ethnic) town of San Juan de Manapiare. Another series of cultigens are purportedly of non-American origin and were probably introduced during a more remote time period (i.e. well before contact with non-Indian peoples), possibly by way of contacts with the Eñepa or other unidentified native groups, and therefore became widely disseminated among the Jodï. This series includes the greater yam (*Dioscorea alata* L.), sugarcane, job's tears, and possibly

[17] It was difficult to determine the exact number of cultivars or landraces for many of the cultigens listed here due to interinformant and intercommunity variations in naming practices, morphological features recognized and classification criteria. We did not carry out a rigorous investigation of Jodï landraces nor were we able to evaluate subspecific variation through anatomical or molecular analyses. For this reason, we do not attempt to quantify the cultivars pertaining to all of the cultigens that are listed in Table 4, and when we do offer figures on the number of varieties of particular species (later on in Planting section) these should be understood as tentative estimates.

Table 4. Inventory of plants cultivated by the Jodï. Table key: Food: food source; Mag/Med: magical or medicinal use; Techno: technological use. Plus sign (+) indicates the plant is considered by the Jodï themselves to be native or ancestral; minus sign (-) indicates the plant is considered to be introduced in historical time.

(Continued)

Family	Latin name	Jo name	Common name	Use category	Native
Amaranthaceae	?	*jwaïli jtujku jya*		Mag/Med	+
Amaranthaceae	*Alternanthera bettzickiana* Standl.	*walijtuño*	Red calico	Mag/Med	+
Amaranthaceae	*Alternanthera sessilis* Lem.	*ejko/nene maluwë*	Sessile joyweed	Mag/Med	+
Anacardiaceae	*Mangifera indica* L.	*mako*	Mango	Food	-
Araceae	*Caladium* sp.	*alilu jtujku*	Caladium	Mag/Med	-
Araceae	*Caladium bicolor* Vent.	*jtujku ade*	Heart of jesus	Mag/Med	-
Araceae	*Xanthosoma sagittifolium* K. Koch	*uli më*	Cocoyam	Food	+
Araceae	*Xanthosoma* sp.	*duwëno më*	Cocoyam	Food	+
Araceae	?	*duwëna maluwë*	Aroid	Mag/Med	+
Arecaceae	*Bactris gasipaes* Kunth	*jnema*	Peach palm	Food	-
Bignoneaceae	*Crescentia cujete* L.	*jlabo jyëï*	Calabash tree	Techno	-
Bixaceae	*Bixa orellana* L.	*jkulilu*	Annato	Techno	+
Bromeliaceae	*Ananas ananassoides* Baker L. B. Sm.	*jtuwë*	Curagua	Techno	+
Bromeliaceae	*Ananas comosus* (L.) Merr.	*jtineju/nanaju*	Pineapple	Food	-
Cannaceae	*Canna indica* L.	*yulë*	Indian shot	Techno	+
Cecropiaceae	*Pourouma cecropiifolia* Mart.	*uli wejkao*	Amazon grape	Food	-
Convolvulaceae	*Ipomoea batatas* (L.) Lam.	*iyë*	Sweet potato	Food	+
Capparaceae	*Cleome moritziana* Klotzsh ex Eichler	*jkwayo malo aiye*		Mag/Med	+
Caricaceae	*Carica papaya* L.	*jwaya*	Papaya	Food	+
Cucurbitaceae	*Citrullus lanatus* (Thunb.) Mansf.	*bajtiya-ju*	Watermelon	Food	-
Cucurbitaceae	*Cucurbita moschata* Duchesne	*jkujte-ju*	Squash	Food	+
Cucurbitaceae	*Fevillea* sp.	*jlabo-ju*		Techno	+
Cucurbitaceae	*Lagenaria siceraria* Standl.	*jlabo-ju*	Bottle gourd vine	Techno	+
Cucurbitaceae	*Lagenaria* sp.	*nuyejtu-ju*		Techno	+
Cucurbitaceae	?	*jlilu-ju*		Food	+
Cyperaceae	*Cyperus odoratus* L.	*uli jkalawine*	Fragrant flatsedge	Mag/Med	+
Cyperaceae	*Rhynchospora* sp.	*jani jkalawine*	White star sedge	Mag/Med	+
Dioscoreaceae	*Dioscorea alata* L.	*uli jwane*	Greater yam	Food	+

Table 4. (Continued)

Family	Latin name	Jo name	Common name	Use category	Native
Dioscoreaceae	*Dioscorea trifida* L.	*jani jwane*	Indian yam	Food	+
Dioscoreaceae	*Dioscorea* sp.	*ajtejta jwane*	Type of yam	Food	+
Euphorbiaceae	*Jatropha curcas* L.	*jtujëjka ale jyëï*	Barbados nut	Mag/Med	-
Euphorbiaceae	*Manihot esculenta* Crantz.	*ale*	Manioc	Food	+
Euphorbiaceae	*Ricinus communis* L.	*balo/jani wejtolo*	Castor oil bean	Mag/Med	-
Fabaceae	*Arachis hypogaea* L.	*mani*	Peanut	Food	-
Fabaceae	*Phaseolus vulgaris* L.	*jtuë ibojto*	Common bean	Food	-
Fabaceae	*Tephrosia sinapou* (Buc'hoz) A. Chev.	*mojto mijili*	Surinam poison	Techno	+
Fabaceae	?	*najtai*	Seed beads	Techno	+
Fabaceae	?	*jkawiyë maluwë jtawïr*		Mag/Med	+
Iridaceae	*Eleutherine bulbosa* Urb.	*jköjkö lïdïmibïr*	Lagrimas de la virgen	Mag/Med	-
Lauraceae	*Persea americana* Mill.	*awa jyeïr*	Avocado	Food	+
Lileaceae	?	*jtujku maluwë*		Mag/Med	+
Mimosaceae	*Inga edulis* Mart.	*luwë*	Guamo	Food	-
Malvaceae	*Abelmoschus moschatus* Medik.	*ejkö maluwë*	Musk mallow	Mag/Med	+
Malvaceae	*Gossypium barbadense* L.	*jnewa*	Cotton	Techno	+
Moraceae	*Artocarpus altilis* (Parkinson) Fosberg	*uli aye jyeïr*	Breadfruit	Food	-
Marantaceae	*Calathea latifolia* Klotzsch	*jtaiwe*	Sweet corn root	Food	+
Marantaceae	*Maranta arundinacea* L.	*jkö*	Arrowroot	Food	+
Marantaceae	*Maranta ruiziana* Körn.	*jkö*	Arrowroot	Food	+
Mirtaceae	*Psidium guajava* L.	*jkwayaba*	Common guava	Food	-
Mirtaceae	*Syzygium malaccense* (L.) Merr. & L. M. Perry	*jkomalajka*	Malay apple	Food	-
Musaceae	*Musa* × *paradisiaca* L.	*walule/jedala*	Plantain/Banana	Food	+
Papilonaceae	*Cajanus cajan* (L.) Druce	*lïdï jawa*	Pigeon pea	Food	-
Piperaceae	*Piper* sp.	*jtikiwili*		Mag/Med	+
Poaceae	*Coix lacryma-jobi* L.	*jkwanajka/majkyolo*	Job's tears	Techno	+
Poaceae	*Cymbopogon citratus* Stapf.	*jinine/ejwa maluwë*	Lemon grass	Mag/Med	-
Poaceae	*Oryza sativa* Stapf.	*jalo*	Rice	Food	-
Poaceae	*Saccharum officinarum* L.	*jkalala*	Sugarcane	Food	+
Poaceae	*Zea mays* L.	*jtamu*	Maize	Food	+
Rutaceae	*Citrus* × *aurantifolia* (Christm.) Swingle	*nimoa*	Lime	Food	-
Rutaceae	*Citrus* × *paradisi* Macfad.	*jtonoja*	Grapefruit	Food	-
Rutaceae	*Citrus* × *reticulata* Blanco	*manalina*	Tangerine	Food	-

Table 4. (Conclusion)

Family	Latin name	Jo name	Common name	Use category	Native
Rutaceae	*Citrus* × *sinensis* Pers.	*nanaja*	Sweet orange	Food	-
Solanaceae	*Capsicum frutescens* Rodsch.	*najte*	Chili pepper	Food	+
Solanaceae	*Nicotiana tabacum* L.	*jkawai*	Tobacco	Mag/Med	+
Solanaceae	*Solanum sessiliflorum* Dunal	*jtukë*	Peach tomato	Food	-
Zingiberaceae	*Zingiber officinale* Roscoe	*jani bulinë jköjkö*	Ginger	Mag/Med	+
Zingiberaceae	?	*duwëwe bulinë jköjkö*		Mag/Med	+

the plantain and/or banana. The special case of plantain/banana (*Musa x paradisiaca*) is especially intriguing due to the great economic and symbolic significance of this species among all of the Jodï local groups thus far encountered (see previous and following discussions) and therefore we assume that the historical date of its introduction was quite ancient (i.e. maybe a century or more). Some crops, by contrast, are commonly recognized as being ancestral crops but are only rarely cultivated nowadays. One interesting example is the unidentified *liliju* vine of the gourd family, the root of which was widely planted in ancestral times and grinded to make an edible flour but it is currently absent or minimally present in most Jodï gardens and when found is mainly put to magical uses or regarded as a strictly hunger crop. Other rare crops tend to have a magical or medicinal use value and are mainly conserved by the nonmission local groups located in the Mosquito or Upper Cuchivero regions.

Given space limitations, only a few of the most important cultigens and their associated planting practices will be described in detail here.

PLANTAIN/BANANA

Musa is arguably the most important food crop raised by the Jodï from a quantitative standpoint (see Figure 6 and Table 7) and is also one of the most genetically diverse. The Jodï classify *Musa* into two generic taxa, *walulë* and *jedala*[18], of which the former are usually eaten cooked (*junëdï-* or *alu-dejae*) and the latter fresh (*idiko-jae*). Within each generic, there are several named varieties, including 12 types of *walulë* and six types of *jedala*. The varieties of *jani walulë*, *wañi walulë* and *yajka jedala* are especially longevous and may even survive for several years after the garden has been abandoned. In the Mosquito and Upper Cuchivero regions, we came across viable and fruit-bearing stands of *Musa* in advanced successions which our Jodï companions said were at least ten years old. We also recorded numerous *Musa* harvests that the collector reported as taken from individuals considered to be wild or cultivated by unknown persons (*jkyonï mawa*).

For propagation purposes, the young sword suckers (*walulë-bule*) that grow at the foot of a mother plant are excavated whole from an old garden and transported to the new garden site. Only suckers whose corms are soft and exhibit good color are chosen for this. The best locations for planting are around the garden edges (*balo onejikaki*) or in a segregated patch (*ña jodeya majaeki*). The cultivator begins by digging holes (*laikë ju dekae*) about 35-45 cm deep with a *chicora* or machete, spaced at least three meters apart.

[18] The distinction between *walulë* and *jedala* is not always strictly maintained and there is some referential overlap in the use of the terms. Thus there are some varieties that may be considered either or both *walulë* or *jedala* (e.g. *yajka walulë* = *yajka jedala*) and one that is called *jedala walulë*. It seems to us that *walulë* is the label given to the higher inclusive taxon which encompasses all plantains/bananas and at a lower inclusive taxonomic level *walulë* contrasts with *jedala*. Furthermore it also appears that the category may be organized cognitively as a fuzzy set, in which *walulë* occupies a more focal range. However, our queries about this were met with variable or ambiguous responses and therefore we are not able to affirm these hypotheses with certainty at this time.

A single sucker is placed in each hole and then loose dirt is filled in around it. Before inserting the sucker, he or she will spit (*jolëbe dekae*) into the hole in order to ensure that the crop will be abundant and palatable, a common practice with other crops as well (see below). *Musa* is one of the few plants cultivated by the Jodï that can be planted year-round. Occasionally it is planted in cleared out sections of mature or older gardens but there is no need to replant from where it is harvested since it generates juvenile plants (*ini*) naturally from the parent plant (*ae*).

MANIOC

A seasonally important food crop, manioc (*ale*) is one of the most common plants found in Jodï gardens (see Table 6). Traditionally the Jodï only had sweet manioc[19], a single variety of it which they call *nï ale* 'true manioc', which was eaten boiled or roasted. However, through contact with other ethnic groups they have borrowed some other varieties. The variety called *jtijtiwa ale* 'bitter manioc' or *majtude ale* 'fish poison vine manioc' was acquired 'long ago' from the Eñepa (Panare) and is made into cassava bread (*ale-baba*) or must be cooked repeatedly to render the tuber safe to eat. Sweet manioc is by far the dominant variety cultivated by the Jodï but most local groups are at least familiar with the bitter variety. Besides these two, another three varieties were present at Kayamá and additional ones were also observed at Iguana and Majagua.

Manioc is reproduced exclusively by stem cuttings (*ale-wajtä*). The collection of stems for planting is carried out simultaneously with the tuber harvest by cutting off sections of the above-ground stem branches (*ale-wa̲wa̲*). The thick base and leafy tip of the stem are cut off and the remaining mid-section is then cut into smaller pieces about 30-40 cm long. The tuber size, either long or thick, is the main criteria for choosing which individuals to get the cuttings from. The central sector of the garden is favored for planting this cultigen. Mounds of loose dirt about one meter wide are dug with a distance of 2-3 meters between them. Between three and five stems are shoved deep into each mound either in a circular or parallel arrangement. Similar to the planting practice observed for *Musa*, the manioc cultivator will spit on the lower end of the stem or on his hands just before it is implanted. The Jodï say that this procedure is done to make the tuber less bitter and prevent headache when eating it. When the plant matures and is harvested, it is often replanted once or twice in the same spot using stem cuttings from the same individual.

MAIZE

Maize (*jtamu*) becomes a near staple crop for several months during its harvest season, August-October, and is a permitted food for people subject to ritual prohibitions or life-cycle transitions. The Jodï possess several named varieties which contrast phenotypically – by color (kernels), size (kernel, ear and stalk) and hardness (kernel) – and by culinary preparation – roasted (*alu de-ja*), in flour form (*jyowa*) or as a thick soup (*jtajta*). However, it is hard to pinpoint exactly how many varieties there are because names and descriptions vary among individuals and communities. At Kayamá, four basic varieties were inventoried but the people there recognized another four varieties that were cultivated elsewhere but not at Kayamá due to unfavorable growing conditions. At Mosquito, we found six different varieties and at Iguana at least five.

Maize is one of the dominant crops found in first-year gardens (see Table 6) and is also planted in nonswidden spaces such as tree-fall clearings or riverbanks (Zent and Zent, 2004a). Besides the desire to maintain cultivar diversity, the main criteria for seed selection include the number and size of kernels, full rows of kernels on the

[19] It should be noted, however, that according to Jodï myth the humanoid creature *uli yewi au̲* 'jaguar wife' did possess bitter manioc in the mythical past but lost it (see section on Agriculture and cultural imagination). Besides providing a symbolic explanation for the historical absence of this important crop in their cultivation system, we are tempted to speculate that this tale amounts to a cultural memory of its former material possession by their ancestral forebears.

cob, and the healthy appearance of the corncob and tassel. The selected ears are first cured by hanging them in the upper house rafters for several months, where they dry out thoroughly, and then they are remoistened a few days before planting by hanging them from a tree branch above a small creek or by placing them directly in the creek itself (in a basket). The humidification procedure causes many of the grains to sprout tiny roots and accelerates the germination process during the vulnerable first days after planting. The planting technique entails making shallow holes 5-10 cm with a quick stab and back-and-forth pull of a digging stick or knife. Anywhere from two to six seeds (modal range of 3-4) are placed in the mouth and then dropped into the hole, which is usually left open. Some maize planters were observed murmuring words of blessing aimed at encouraging the crop to grow well or appeasing the spiritual owner of maize (*jtamu ae*) who could get angry that someone else is cultivating it. One farmer reported that he sings to *waiyo ae* 'rat owner' asking to keep all rodent pests away and not molest his growing crop. Holes are sometimes dug in a linear row or random arrangement with a nearest neighbor range between holes of 75-100 cm. The planting of maize usually takes place in the latter part of the planting season, after the root crops and before the plantains/bananas are planted. Although this crop is normally planted in new gardens, it is occasionally planted in older gardens or sections of these that have been weeded and subsequently burned.

YAMS

Yams (*Dioscorea* spp.) are widely cultivated in all the communities studied here and after plantains and bananas constitute the most important cultivated food type by weight. The Jodï possess both the Neotropical yam (*D. trifida*), whose common name is Indian yam, and the Paleotropical yam (*D. alata*), also referred to as the greater yam or winged yam, which are grouped under the same folk generic taxon labeled *jwa̲ne*. Although the greater yam was obviously introduced at a later date than the Indian yam, both are considered ancestral cultigens and the former is more prevalent in Jodï gardens by a ratio of about two to one (see Table 6 and Figure 3). Living specimens of *D. trifida* are usually classified as *ja̲ni jwa̲ne* 'small yam' and those of *D. alata* are distinguished as *uli jwa̲ne* 'large yam', and there is a further subdivision of each of these by color (white, blackish and purple)[20]. At least three other varieties are recognized, the most widely cultivated one being *adedowa jwa̲ne*, which is a rather small-leafed variant of *D. trifida* that is highly regarded for its exceptional flavor.

Seed material for planting all varieties is obtained by harvesting the tuberous root (*jwa̲ne-jae*) and cutting off the bulbous tips (*jwa̲ne-jtu*) which are conspicuous for the small stringy roots (*jwa̲ne-mëña* or *jtu-mëña*) growing out of them. The main criteria for such selection are that the roots are large and healthy (good color and texture) and free from nematodes. If the roots are harvested ahead of time (several days or weeks before planting), they are stored in the house or put onto a pile and covered with banana leaves until they are needed for planting. After hauling the seed roots to the cultivation site, the cultivator digs shallow circular holes 10-15 cm deep and 30-50 cm wide with a machete or *chicora*. If there are any weeds or stones in the immediate area, these will be extricated and thrown off to one side. If planting *uli jwa̲ne*, three or

[20] We qualify this statement with the word 'usually' because we detected some inconsistencies with respect to the use of these subgeneric labels and their application to *D. trifida* and *D. alata*. It seems that the meaning indicated by the modifier terms *jani* 'small' and *uli* 'large' changes according to the referential context which frames the statement, especially the taxonomic level being referred to. Thus, when the frame is the taxon in a generic sense or when comparing any two specimens, one being *D. trifida* and the other being *D. alata*, the distinction is very consistent: *jani jwane* refers to the former and *uli jwane* refers to the latter. However, when the frame is at a finer taxonomic level, for example when comparing or distinguishing different varieties belonging to the same species, the referential targets are obviously different, in which case a certain variety of *D. trifida* may actually be called *uli* 'big'. It is likely that usage of this contrast set is flexible and relational to whatever objects are being talked about.

four root pieces are carefully placed around the edges of the hole, and if it is *jani jwane*, 5-6 pieces are arranged in a similar fashion. Following the same technique applied to other crops whose roots or stems are cut into pieces and then planted, the cultivator will spit into the hole or onto the roots to propitiate a prosperous and tasteful crop. He or she will then scoop up handfuls of dirt and crumble it into fine particles over the hole until it is completely covered, leaving a slightly raised mound 10-15 cm above the ground level. *Jwane* is one of the first cultigens planted in the new garden, along with sweet potato and squash, and may be planted in small monocultural patches with a distance of 1-3.5 meters between the mounds (larger for *uli jwane* and smaller for *jani jwane*). Upon harvest, it is frequently replanted in the same spot one or more times, and we observed it growing in gardens at the 4-5 year interval and even somewhat later.

SWEET POTATO

Sweet potato (*iyë*) is another important food crop although its production levels across communities vary more than any other major crop (Table 7). The Jodï cultivate five varieties of *iyë* which are distinguished on the basis of color and size. A portion of the roots (*iyë-ïëya*) that are collected during the harvest season will be put away and stored in baskets in the house in anticipation of planting at the beginning of the wet period. Only healthy looking roots with no sign of nematodes are chosen for the seed. Another positive indication is if the parent plants exhibit abundant leaves that are relatively free of snail or leaf-cutter ant predation. This is one of the few crops where a sexual division of labor is observed, at least in theory if not always in practice. Women carry the seed roots to the garden in round baskets (*nala*) but men dig and plant the mounds. The central sector of the garden is one of the preferred locations for planting *iyë* and it is sometimes bicropped with *Musa*. The planting operation begins by digging holes about 10-15 cm deep, 25-30 cm wide and 1-1.5 m apart, and then one or two whole roots are placed into each hole. The cultivator sings (*jobe-dekae*) to the incipient plantations and the Jodï say that this will make the forthcoming *iyë* plants happy (*jojawa*) so that they grow well and their roots will turn out to be sweet to the taste bud. The holes are covered over with dirt which is kneaded by hand into small pieces. The assiduous gardener will keep the sweet potato patch free from weeds during the first few months of growth and will redirect the routes of the spreading vines so that they steer clear of logs and therefore set down secondary roots (*jlëya*) that will eventually develop edible underground storage roots. Sweet potato is one of the first crops planted in a new garden, but it is also not uncommon for it to be planted at the beginning of the second year in patches formerly sown in maize. Upon harvesting, it is frequently replanted in the same mound.

SUGARCANE

Sugarcane (*jkalala*) is a common snack food and thirst-quencher that is mostly consumed *in situ* when one is working out in the garden or walking through it. As it is harvested, 40-50 cm long slips from the top portion of the stem (*jkalala-jena*) are taken and planted that same day. Shallow mounds about 10 cm deep are dug and 3-5 slips are thrust into it in a circular pattern with the ends pointed outward. The cultivator spits on the lower end of each slip to augur the exuberant growth of the future canes[21]. Sugarcane is usually planted in second or third year old gardens, or it may be replanted repeatedly in the same place where it is harvested. When replanting, a small hole is dug and a single slip is inserted. This habit of successive replanting may explain why it is sometimes found in very old gardens up to ten years old.

[21] If several plantings are done at the same time, the act of spitting or anointing the seed stems with one's saliva is only performed on the first one. This fact points to the symbolic rather than technical motive of this type of treatment.

PAPAYA

Papaya (*waya*) is another cherished snack food that may be eaten on the spot when harvested or taken back home. There are two named varieties at Kayamá but in other communities there is only one. The Jodï say that they do not usually plant papaya purposely but simply discard the seeds where it is eaten and they germinate spontaneously (*wai dewa*). One of our consultants recounted that the facile ability of the papaya to reproduce on its own accord and in any place is explained by the fact that the spirit guardian of the plant (*waya ae*) is in fact one and the same as the forest guardian, *jkyo ae*. Thus it is a common feature of swidden, dooryard and trailside landscapes, and often grows in bunches or scattered stands. Although it has a relatively short life cycle of 2-3 years, it can be found growing in older gardens ostensibly due to the interaction of the cultural habit of *in situ* consumption and the biological habit of spontaneous generation.

TOBACCO

Tobacco (*jkawai*) is consumed daily by most adults and is the focus of one of the key life cycle rites of passage[22]. There is only one consensual cultivated variety although there is also a wild form that may be a different species. The fruit capsules (*jkawai-adë*) are collected from the tops of mature plants, preferably from individuals not infested by worms, after the flowers have dried up, usually in September or October. These are stored carefully in a container made from gourd of *waleba-bo ibuju*, a primary forest liana which is considered to be a gift from the universal deity *jkyo ae*. The seeds are normally planted in new gardens right after the firing date and before the first rains of the wet season. It can be planted anywhere there is an abundant ash layer. If the plants are to be used for ceremonial purposes, the exact location of the crop will be kept a secret. The seeds are broadcast by rubbing a bunch of capsules together between both hands (*najlu dekae*). This causes the tiny seed pellets to drop out and scatter across the ash-laden ground. No further action is taken until harvesting. Although tobacco is typically a new garden crop, occasionally it is planted in patches of older gardens where weeds were piled up and burned.

GENERAL ASPECTS OF PLANTING PRACTICES

Some general aspects of the Jodï approach to garden management can be highlighted based on this brief ethnographic narrative of planting practices. The first is that the Jodï extend the productive life of swiddens by successive planting and replanting of certain crops in a way that seems more characteristic of more intensive swidden agriculturalists. Although this characteristic is more developed among the more sedentary mission communities, nevertheless it is also evident among the more nomadic, independent groups as well. Second, many crops, including all of the major cultigens, are planted in somewhat segregated patches[23] and this feature is probably enhanced by the habit of successive planting and replanting. In practice and timing, planting, weeding, harvesting and replanting typically form a continuous activity and cannot be easily separated as distinct phases of swidden development. Due to the patchy management style, whereby delimited patches are harvested and subsequently replanted in different crops at different times, the garden eventually evolves into a spatially – and temporally – heterogeneous mosaic of younger and older sections. A third aspect is the application of magical/medicinal methods (*yu dekae*),

[22] The Jodï invariably consume tobacco as an orally administered paste, commonly referred to as *chimo* in Venezuela. The leaf is dried, ground into a powder, mixed with ashes and moistened with water, and then placed between the lower lip and gum. It causes the user to spit frequently, which is why it is known as spitting tobacco.

[23] All of the primary food cultigens – yams, manioc, maize, sweet potato, plantain and cocoyam – were observed growing in patches. This is not to imply, however, that they are never intercropped. We use the term patch here to indicate restricted areas where one or two species are dominant but not necessarily the only crops present. Patches grade into one another and thus overlap at the boundaries. Moreover, some garden areas are thoroughly polycultivated with no real dominant species.

by way of spitting or verbal blessings, to nurture proper crop growth and production. It is important to note that the Jodï do not attempt to fertilize crops (beyond burning organic matter) or control pests by material means and this lack of such treatment is probably related to their reliance and faith in magical means. At a deeper ideological level, we might interpret the specific magical methods used here as establishing intimate contact between the human cultivator (through his/her saliva or words) and the seed bodies of the crop plants, to the mutualistic benefit of both. Elsewhere we have referred to this phenomenon as the 'interpenetration of essences' and have argued that it constitutes a basic philosophical principle which is manifest in other facets of Jodï economic and social life, including hunting behavior (Zent and Zent, 2007).

GARDEN COMPOSITION AND EVOLUTION

It has been shown that the conventional image of tropical shifting cultivation as consisting of highly polycultural (i.e. intercropped or mixed cropped) gardens that mimic the generalized structure and composition of the surrounding tropical forest (Harris, 1971) does not apply very well to many indigenous Amazonian horticultural systems (Beckerman, 1983). Beckerman's (1987) comparative survey of the swidden farming practices among > 30 lowland South American Indian groups reveals instead that native Amazonian swiddens typically display a more mono-cropped composition, with one major crop dominating in terms of quantitative frequency. The dominant crops found in this survey were either manioc (sweet or bitter), *Musa* (plantain and banana) or, less commonly, maize (one case), and these constitute the staple food of the group in question. Besides the dominant crop, an important secondary crop is often found, such as maize, and the rest are all minor due to their low frequency. The first author's research among the Upper Cuao River Piaroa, who are western neighbors of the Jodï, seems to confirm this general pattern. Manioc accounts for 82% of all plantings in new Piaroa gardens, maize occupies another 13%, and all other crops make up only 5% of the total (Zent, 1992, p. 198). Given the huge size and biocultural diversity of the greater Amazonian region and the large number of groups whose horticultural habits have not been well described thus far, it remains to be seen just how generalized this pattern may be.

Jodï gardens appear to diverge from the pattern described by Beckerman in the sense that they are not dominated by single crops or bi-crop associations. We studied garden crop composition by means of crop inventories and censuses of plant stems in measured plots of 100 m^2 (3 m wide by 33.33 m long) in 126 gardens of varying age and size (see Table 5). The results of this work are represented in Table 6[24]. Here we can see a fairly even frequency distribution among several different crops, although with noticeable differences. The highest average frequencies for the universe of all sample plots (right-hand column) are registered for manioc (2,422/HA) and maize (2,263/HA). A second level on the frequency scale is occupied by plantain/banana (1,648/HA) and greater yam (*D. alata*) (1,044/HA). At a lower rank, we find sugarcane (725/HA), Indian yam (*D. trifida*) (535/HA), cocoyam (469/HA) and papaya (398/HA). From this perspective, it seems reasonable to claim that all of these constitute co-primary crops. Rice, though adopted only a couple of decades ago,

[24] The data on stem counts is intended to provide a relative sense of the crop composition of garden spaces, to the extent that stem frequency can be taken as a proxy for crop biomass or importance value, and should not be interpreted as an absolute measure of actual production values. Crops differ considerably in terms of their size and especially in terms of how much edible product is produced by a single plant. There are also conceptual limitations that should be recognized when attempting to compare crops with different growth habits. Small herbaceous plants and shrubs, for example, may produce numerous stems that are part of the same root complex and therefore are not directly comparable to tree or tree-like plants. Some vines may spread out laterally from an initial planting and form secondary stems, such as sweet potato (discussed below in another footnote). In that sense, the figures displayed here should be taken only as a rough approximation of their true importance value.

also has a notable presence overall (137/HA) but it was only found in new gardens up to one year old. The stem density of sweet potato was recorded as being slightly lower than rice (123/HA) but if ground cover or dietary contribution is used as the measuring stick, then this crop could also be considered as a major crop in this system[25]. All other food crops exhibit a significantly inferior representation (< 50/HA). Of nonfood crops, the most prevalent ones are: tobacco (303/HA), cotton (172/HA), fragrant flatsedge (73/HA), curagua (51/HA) and ginger (50/HA). Although Jodï gardens may not be dominated by any single main crop species, they are dominated by crops with a singular use value: food production. A comparison of stem counts by the main use classes shows that food plants comprise 93% of all stems counted, magical and medicinal plants make up 4.5% and technological plants are only 2%.

The variations of crop frequency across the different age classes gives us some idea of the management cycle associated with individual cultigens over time as well as the evolution of the garden vegetation from early to mature to late stages before it is eventually abandoned (or neglected) and turns into an unmanaged fallow stage. Maize stands out as a fairly dominant crop in the 0-1 year interval (10,033/HA), accounting for slightly more than half of all stems, and thereafter its frequency drops dramatically. Considering that it is a nutrient-demanding crop and bears edible grains within a few months after planting, the most surprising thing is that it continues to be found at all after the first year. Although it is unusual for the crop to be replanted in exactly the same spot where it is harvested, it is occasionally planted in cleared-out and reburned sections of one and two-year old gardens. Manioc is maintained at a high frequency rate (> 2,000/HA) during the first four years of a garden's life cycle, a result that hints at the continuous and prolonged style of Jodï cultivation. The harvesting of manioc is frequently accompanied by the additional step of replanting stem cuttings in the same spot, and this operation may be repeated once again if tuber size and number are judged to be vigorous. However, the fact that its stem density peaks in the second and third years may also be due to the need to plant more individuals in order to maintain the same level of tuber production. The density of plantain/banana is lower during the first year but then it increases and maintains an elevated level throughout the later years (3-5 years after the initial burn) as spontaneously generated offspring grow to maturity and then generate offspring of their own. The yams are most abundant during the first two years and thereafter their numbers level off. The greater yam seems to be more popular than the Indian yam even though the former is a nonnative variety. The fact that the greater yam is much more frequent in the first year of cultivation, while the native variety is more dominant in the second year, may reflect different maturation rates or replanting habits. Cocoyam remains fairly steady, albeit at lower frequencies, throughout the entire five year active phase. Sweet potato is more abundant during the first three years and thereafter declines steadily. Sugarcane is another crop that appears to be more abundant in the second and third years, perhaps indicating that more of it is replanted than was initially planted or that it is commonly planted in spaces that have been cleared following the harvest of another crop.

Another perspective on the regular development of the productive phase of Jodï swiddens is provided by looking

[25] Sweet potato sprouts secondary stems from the main stem which can reach many meters in length and these secondary stems set down numerous, seemingly countless, support roots into the soil. While some of these secondary roots will develop into true storage roots many will not. Moreover, as the plant grows and spreads over large areas it forms a continuous ground cover displaying a carpet-like aspect. When several individuals of the same species are planted close together their stems and leaves become densely intertwined. Thus it is extremely difficult to make an accurate count of the number of actual plantings beyond the early stages of a new garden. Because of the practical difficulties of distinguishing and therefore counting sweet potato main stems, we also measured the relative ground cover of this plant using a point-line method, as an alternative way of assessing its relative importance. The average ground cover of this crop by garden stage was as follows: 0-1 year interval: 10.6%; 1-2 year interval: 37.7%; 2-3 year interval: 36.5%; 3-4 year interval: 19.2%; 4+ year interval: 3.8%. Average cover for all gardens: 21.6%. By this measure, sweet potato certainly constitutes one of the major crops in Jodï gardens.

Table 5. Sampling plots in Jodï gardens by locality and age.

Locality	0-1 yr.	1-2 yrs.	2-3 yrs.	3-4 yrs.	≥ 4 yrs.	Total
Caño Iguana	15	12	15	10	10	62
Caño Majagua	4	5	9	6	6	30
Caño Mosquito	7	5	6	4	6	28
Upper Cuchivero	1	3	1	1	0	6
Total	27	25	31	21	22	126

Table 6. Crop stem frequency per hectare of garden area. (Continued)

Age interval	0-1	1-2	2-3	3-4	≥4	Total
Crop						
Manioc	2,174	3,332	2,777	3,029	614	2,422
Maize	10,033	320	190	14	0	2,263
Plantain/banana	726	1,828	1,852	2,071	1,882	1,648
Greater yam	2,611	848	868	310	291	1,044
Sugarcane	193	2,228	842	200	9	725
Indian yam	896	1,028	245	176	282	535
Cocoyam	415	476	377	471	655	469
Papaya	548	292	161	629	445	398
Tobacco	1,056	320	35	29	0	303
Cotton	130	404	142	152	23	172
Rice	641	0	0	0	0	137
Sweet potato	233	136	100	76	50	123
Fragrant flatsedge	48	240	61	0	0	73
Curagua	15	52	84	5	91	51
Ginger	0	192	13	52	0	50
Guamo	0	20	39	10	132	38
Arrowroot	44	16	35	14	32	29
Pineapple	4	56	13	5	50	25
White star sedge	30	76	0	0	0	21
Chili pepper	0	8	35	0	5	11
Sweet corn root	0	0	0	33	23	10
Unidentified legume	0	0	6	0	45	10
Peach palm	0	8	0	5	36	9
Peanut	0	4	0	0	45	9
Watermelon	0	0	35	0	0	9
Unidentified grass	22	0	0	14	0	7
Surinam poison	0	0	0	33	0	6
Squash	7	8	0	0	0	3

Table 6. (Conclusion)

Age interval	0-1	1-2	2-3	3-4	≥4	Total
Common bean	15	0	0	0	0	3
Anatto	0	4	6	0	5	3
Musk mallow	7	4	0	0	0	2
Lime	4	4	0	0	0	2
Avocado	0	0	6	0	0	2
Mango	0	0	6	0	0	2
Guava	0	4	0	0	5	2
Seed beads	0	8	0	0	0	2
Red calico	0	4	0	0	5	2
Unidentified pepper	0	0	0	10	0	2
Unidentified aroid	0	0	3	0	0	1
Caladium	4	0	0	0	0	1
Sessile joyweed	4	0	0	0	0	1
Total	19,859	11,920	7,935	7,338	4,723	10,621

at the temporal succession of crop densities according to different life form classes. The cultivated 'grasses', including the grains of maize and rice, and sugarcane, are preferred startup crops which provide edible harvests during the first two years (Figure 2). A second phase of the swidden, the middle period (1-3 year interval) is marked by greater abundance of the major root crops, such as manioc, yams, cocoyam and sweet potato (Figure 3). The slower maturing tree or tree-like crops, dominated by *Musa* but also featuring papaya, guamo and peach palm, become somewhat more conspicuous during the latter phases (3-5 year interval) (Figure 4). Beyond confirming the eminently polycultural and successional composition of Jodï gardens, one of the general conclusions that can be drawn from charting the trajectory of crop densities over time is that Jodï cultivation practice is a somewhat drawn-out affair in which the productive life of the garden is extended over several years by planting crops with different maturation schedules and through a management regime that entails a repeated cycle of successive harvesting-weeding-clearing-replanting.

From a Jodï perspective, the garden is also conceptualized as passing through different phases of change from clearing and initial planting to fallowing. The different phases, or states of perceptual appearance, can be expressed linguistically by a rather large number of terms, leaving the impression of an incredibly complex system for classifying gardens. However, we should emphasize that the use of such terminology is very flexible, varying by speaker, speech context and perceptual cues present. This flexibility along with the observed pattern of lexical formation suggests that semantically these terms operate more as descriptive labels rather than conventional names. There are three main semantic dimensions which are employed to describe the temporality of gardens: abstract notions of relative time space, gross vegetation features and specific biological indicators.

With regard to relative time, we find the sequence of terms: *ñabae* (*jae*) *balo* 'current garden', *bae balo* 'new garden', *baede balo* 'old garden', and *jtajwä balo* 'very old garden'. We can draw only a tentative correlation of these abstract terms to concrete phases or physical features, but they correspond more or less as follows: *ñabae balo* – the period from first planting to the beginning of the maize harvest; *bae balo* – the period of greatest production, dominated by the major root crops like sweet potato,

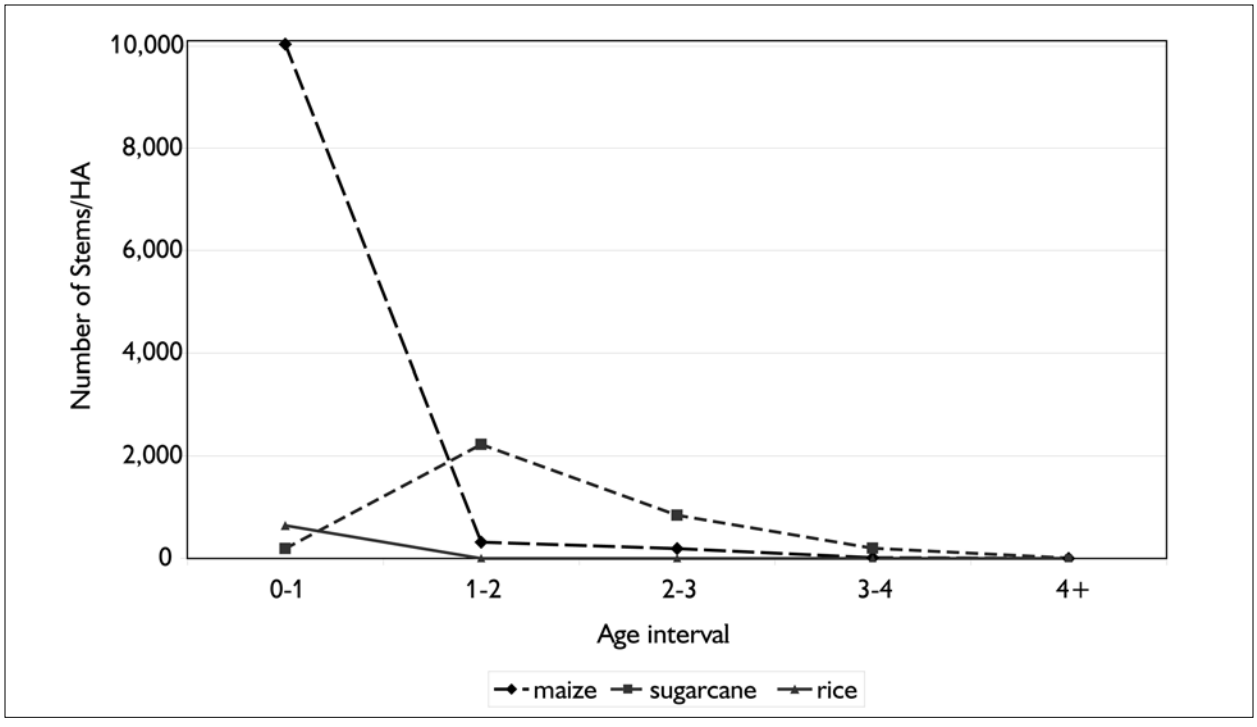

Figure 2. Stem densities by age: cultivated grasses.

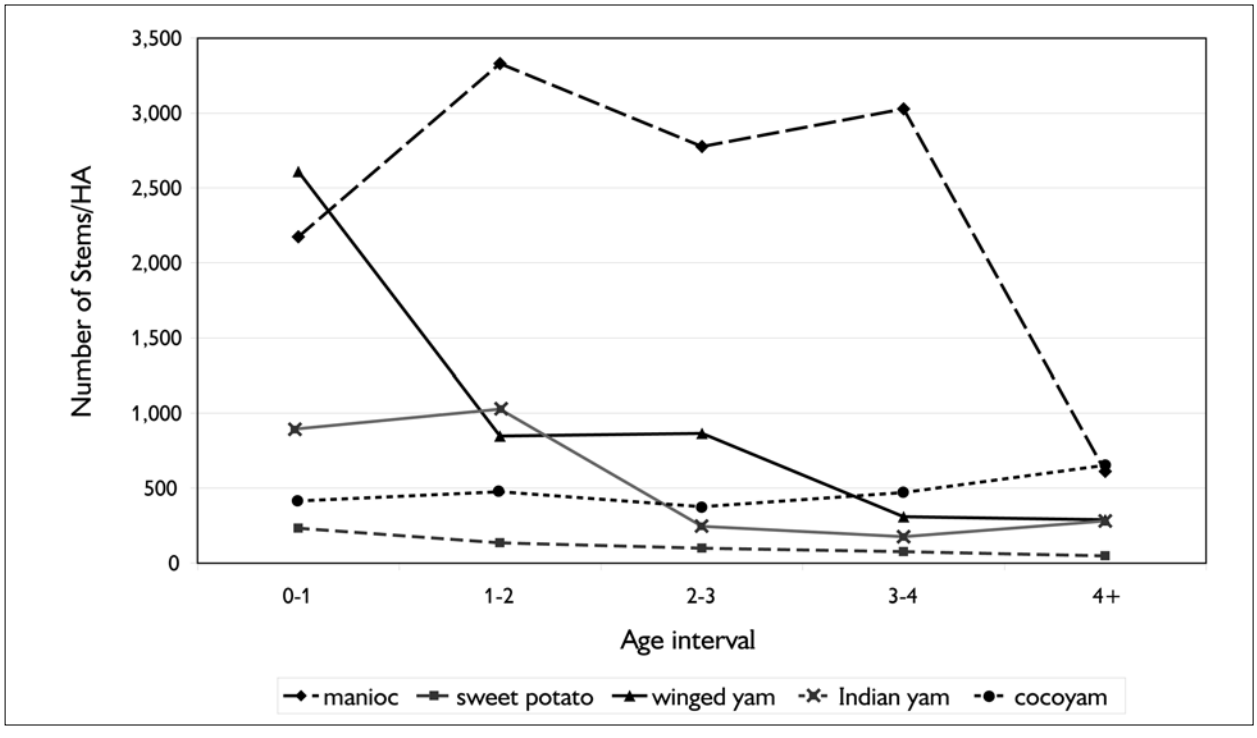

Figure 3. Stem densities by age: root crops.

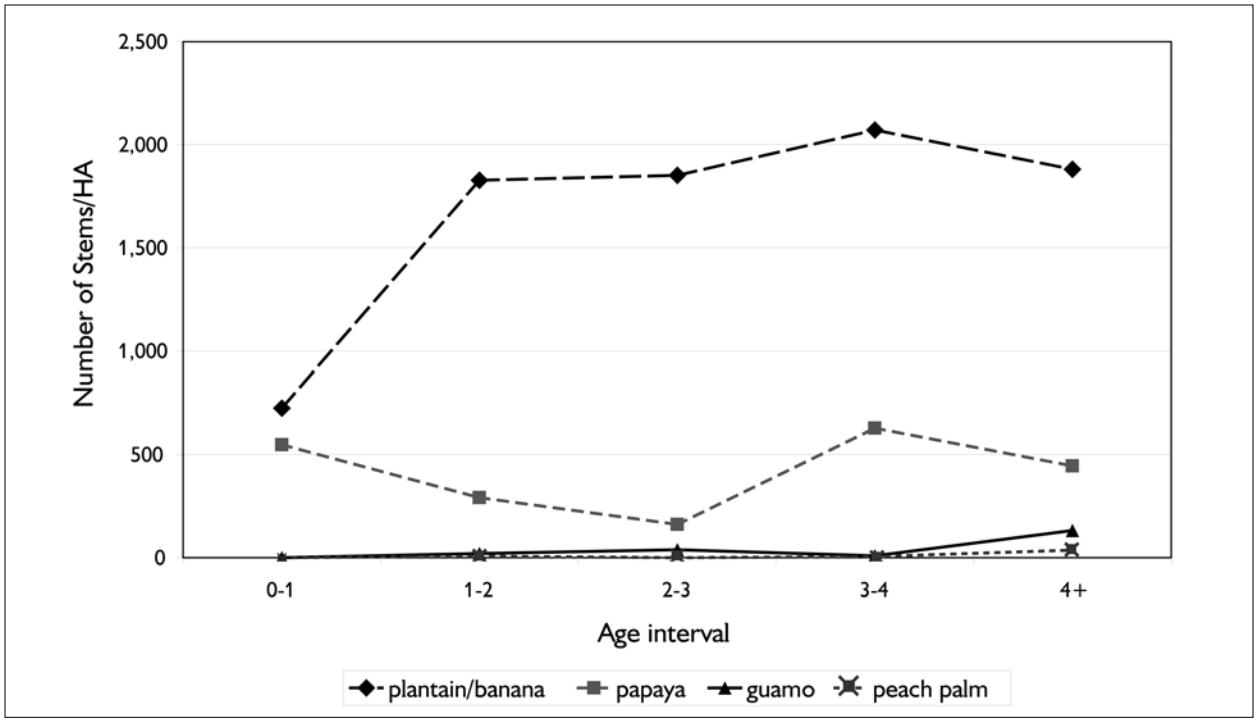

Figure 4. Stem densities by age: tree crops.

yams, manioc, and cocoyam; *baede balo* – the later years of the active cultivation phase, when crop production has declined somewhat and weeds are starting to take over; and *jtajwä balo* – the fallow phase consisting of mostly secondary forest with perhaps a few vestiges of former plantations, like old *Musa* stands or a single sugarcane or curagua plant here and there.

A more precise, though still generic, depiction of the state of swidden development is communicated by expressions describing the general appearance of the vegetation. These include expressions such as the following: *lidïdewa balo* 'garden with cultivated plants', *jkyëno yëlido baenï dejae balo* 'garden being taken over by grassy weed growth', *yëlido dejae balo* 'weed-infested garden', *yëlido alejto baenï dejae* 'place where weedy and woody growth are dominant', *jtajwä balo jtau/jkyo baenï dejae* 'old garden turning into forest', and *jkyo balo* 'forest garden'.

The third semantic dimension, involving the use of specific biological species as the modifier term, is the most precise and concrete form of garden classification. Examples of this include the following: *jtamu balo* 'maize garden', *iyë balo* 'sweet potato garden', *ale balo* 'manioc garden', *walulë balo* 'plantain garden', *jkyëno balo* 'grass garden', *jtujkuli balo* 'hummingbird garden'. Essentially, the species that is named here is the dominant one or the most perceptually salient one from the speaker's perspective. Expressions of this kind immediately convey information about the developmental stage and management style of the garden because the speaker and listener are well informed about the life cycle of the garden and the different plants it contains. Thus *jtamu balo* is a first year garden, *iyë balo* somewhat older and *walulë balo* older still. *jkyëno balo* is an old garden dominated by grasses and is usually the product of an especially long or intensive prior period of cultivation. *jtujkuli balo* is populated by woody species, such as *Inga* trees, whose flowers attract very small birds and thus the latter are found in abundance there.

WEEDING (*BALO WAE*)

Weeding (*balo wae*) is a continuous but not a very prominent feature of Jodï horticultural practice. As a matter of fact, we got the distinct impression that the Jodï maintain an ambivalent attitude about weeding. Thus on one hand, it is widely recognized that weeds (*ñajawa* or *yëlido*) are a bane to good crop growth and therefore their removal is seen as a necessary chore to achieve optimal yield. On the other hand, many cultivators admit to being lax about attending to this duty and our direct observations of work behavior in the garden attest to the casual and often superficial nature of this activity[26].

According to Jodï ideals of proper garden management, weeding should be diligently carried out during the first year of the garden's life cycle and especially up until the end of the maize harvest (first 6-7 months). However, our consultants also pointed out that a thorough burn will minimize the need for this task. It is generally considered that men are responsible for this type of labor while women dedicate their efforts more to the planting side. If the planting has been delayed and weeds have begun to sprout in the meantime, then some weeding is performed at the same time but only where the planting is taking place. As might be expected, there is considerable variation from one cultivator to the next with respect to the amount of weeding that gets done. The uneven nature of this activity is evidenced by the fact that some gardens appear to be extremely tidy and well weeded, at the other extreme there are those that are literally overrun by weeds, and the majority fall somewhere in between. Such variation may be affected by economic or ecological variables of the larger environmental context. At the larger settlements of Iguana and Kayamá, more intensive weeding could be observed and this also may be related to shorter fallow periods and the cutting of lower secondary forest for new gardens. Among the more nomadic and foraging-dependent Mosquito group, weeding was mostly neglected.

Beyond variations among individuals or communities, a general tendency of increasing weed cover by garden age can be discerned. This relationship was studied by measurements of ground cover occupied by weeds in sample plots set up in 17 gardens of different ages. The results show that by the second year nearly half (48%) of the surface area is covered by weeds, by the third year almost 60%, by the fourth year over 80%, and by the fifth year close to 100% coverage (see Figure 5).

In theory, gardens are not systematically weeded after the first year. In practice, however, a good deal of weeding actually takes place during the later phases in conjunction with harvesting and replanting activities. In this context, a patch of ground is cleared of aerial plant matter, of both cultivated and weedy plants, the edible parts are extracted and seed material planted in the cleared ground. The weeding technique itself may entail pulling out the plants by their roots or slicing them off at ground level. The resulting brush is then piled up and thrown off to the side. More often than not the resulting brush piles will be left as is and only occasionally are they burned. Beyond patch clearing, some slight weeding may be done whenever a person visits or passes through a garden, for example pulling out a few weeds here and there. While this practice may appear to be haphazard, the Jodï explain that weedy plants that are deemed to be useful, either in the present or future, will be spared. Numerous weedy species yield edible fruits, flowers or hearts (e.g. *Phenakospermum guyannense* (Rich.) Endl., *Sorocea muriculata* Miq., *Costus* spp., *Heliconia* sp., various unidentified) and provide tasty morsels for children during garden outings, while others are medicinal (e.g. *Senna obtusifolia* (L.)

[26] When we were accompanied by Piaroa companions on our visits to Jodï communities and their gardens, the former frequently complained about the lack of proper weeding by these people and even suggested that we instruct them on how to do it better.

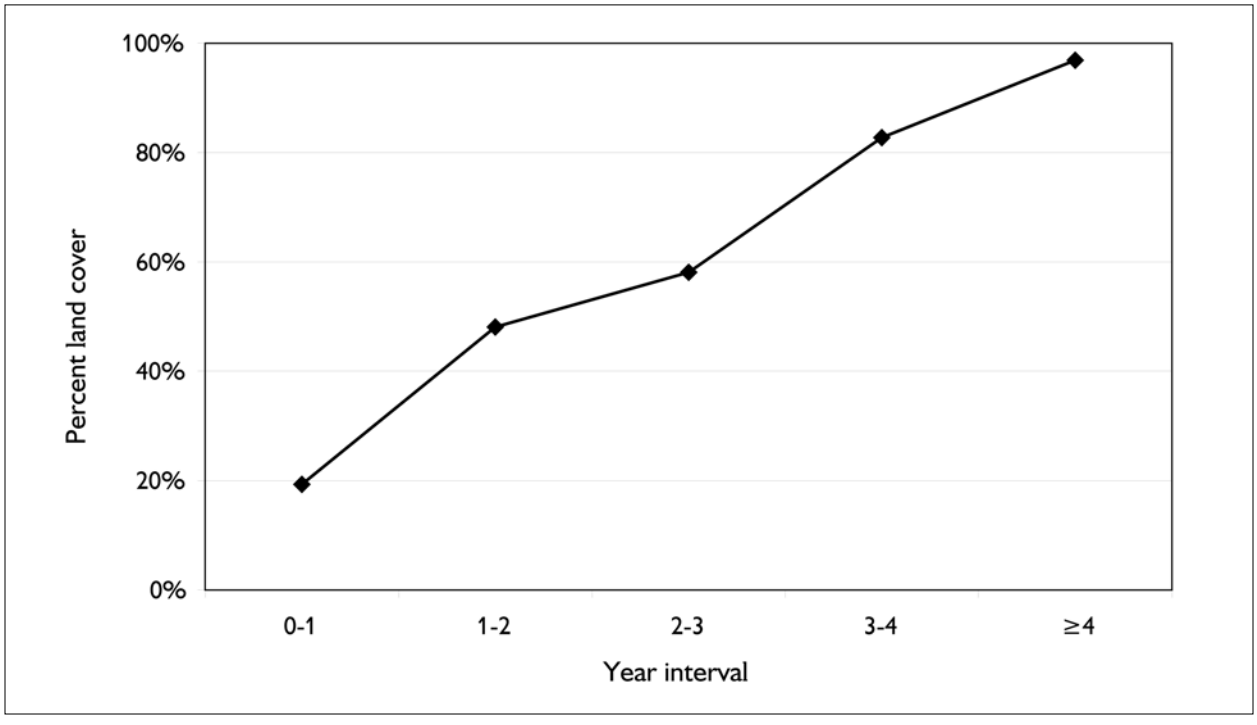

Figure 5. Weed cover by garden age.

H.S. Irwin & Barneby, *Pothomorphe umbellata* Miq., *Calathea lutea* G. Mey., *Phytolacca rivinoides* Kunth & C.D. Bouché, *Piper* spp., *Sclerolobium* sp.) and hence they are harvested (nondestructively) instead of being cut down. Some successional species are consciously allowed to grow because they will produce economic benefit many years later, such as *jnema ji̱* (*Bactris gasipaes* Kunth)[27], *ulu ji̱* (*Attalea maripa*), *luwe jyëï* (*Inga* spp.), *mojwe jyëï* (*Spondias mombin* Jacq.), *jtabali jyëï* (*Ceiba pentandra*), *ulujku jyëï* (*Rhodostemonodaphne kunthiana* (Nees) Rohwer), *waijka jyëï* (*Guazuma ulmifolia* Wall.), *uli ba ji̱* (*Astrocaryum gynacanthum* Mart.), *muyë jyëï* (*Hymenaea courbaril* L.), among others. In sum, the Jodï style of weeding is eminently selective and the selection/nonselection process is dependent upon the cultural use value of the plant species in question.

ALTERNATIVE PLANTING VENUES: DOORYARDS, TRAILS AND GAPS

Swiddens are not the only places where the Jodï cultivate plants. Alternative venues for cultivation include dooryard gardens, trail borders and tree-fall clearings. The characteristics and dynamics of cultivation in these localities differ somewhat from the swidden and deserve a brief mention here. While the diversity and complexity of dooryard or house gardens (*nuwei(ki) balo*) is to some extent a function of settlement longevity, even in the more mobile groups of the Mosquito and Upper Cuchivero watersheds one finds cultivated plants growing in the immediate area surrounding the house. In the latter regions, a preponderant number of these are magical/medicinal plants (e.g. ginger, sedges, musk mallow, and caladium) or technology crops (e.g. curagua, cotton, seed beads) and there are only a few individuals (sometimes

[27] Even though *jnema* is a cultivated plant, the Jodï say that many people do not cultivate it and instead it comes up spontaneously in their gardens. When it does so, it is normally protected. Besides providing edible fruit and hard wood for bows, it is regarded as one of the first species that provides canopy cover for the garden and in that sense contributes to the successional process.

only one) of each one. At Caño Iguana, more tree crops dominate the village landscape, such as guamo, mango, guava, citrus trees, anatto, peach palm, papaya, and bottle gourd tree. Recently adopted crops, like watermelon, new varieties of capsicum or manioc, and exotic gourds, are more likely to be found there as well, which points to the experimental function of these venues. It is also likely that some of the plants growing there were generated from discarded seeds, like papaya. More curious is the frequent presence of *Musa*; almost every permanent type house has at least one *Musa* plantation growing nearby.

Trail gardens (*mana(nï) balo* or *mana ajkunë lïdï dekae*) are very small, very inconspicuous, plantations that are established alongside of foot paths. Sometimes they consist of a single cultivated plant or two or three, rarely more than that. But what they lack in size, they make up in number: they are a common feature of the landscape across the length and breadth of the Jodï territory. We have come across trail gardens 2-3 days walk from any currently inhabited settlement. One reason that they are so prevalent is because they are exploited (and created) during trekking and camping expeditions. The trail garden is managed in the sense that useful plants are planted or transplanted there, but they are not slashed or felled by people. Instead, small natural gaps in the canopy caused by tree falls or where colonies of herbaceous vegetation are found are usually exploited for this type of cultivation (see following paragraph). However, some cultigens are better planted under shade. It is precisely the shaded borders of footpaths that are favored for mango cultivation. More than once, we witnessed someone grab a mango fruit on the way out the door and eat it as they walk to the garden and then plant the seed along the trail before they ever reach the garden itself. Bananas and papaya are probably the most common crops found in trail gardens but really just about any plant the Jodï cultivate can be found there. We have noticed, however, that the crop inventories of these venues are limited mostly to food crops, which seems to point to their role as tiny but scattered food reserves. Besides domesticates, it is likely that some of the 'wild' fruit trees found growing alongside trails were effectively 'propagated' in those locations by human carriers even if it was not their intention to do so. The Jodï seek out and bring back home an impressive variety of tree fruits from the primary forest. But they begin eating them before they get back home and throw out the seeds along the way. Some of these seeds germinate and eventually grow into canopy trees, at which time they provide resources for people (Zent and Zent, 2004a).

Prior to acquisition of steel axes, natural canopy gaps or tree fall clearings (*jtawï laijwi de(jae) balo*) were favorite areas for plant cultivation. The Jodï continue to practice this form of farming, and it overlaps somewhat with trail gardening, but it is much rarer nowadays. The best gaps for cultivation are where very large trees, like *Micropholis egensis* or *Brosimum alicastrum* Sw., have fallen down. Their crowns have diameters of 60 meters or more and therefore occupy considerable areas when lying on the ground. The tree is allowed to dry out and then the crown is burned. After that it is treated as a normal swidden though in miniature, in which cultivation is confined to the crown area (*jtawï-bo jtukï majae*). Most of the principal food crops are grown in canopy gap gardens and it is also considered a good place to cultivate peach palm. Another type of cultivated gap is located in open areas on the banks of small creeks that flood the area in the high water season (*jkyo jedä anï balo*). The natural vegetation growing in these areas consists mainly of grasses and once they dry out they are burned and then planted. The only cultigen we saw in this type of gap garden was maize (see also Zent and Zent, 2004a).

HARVESTING

Harvesting is an activity that is carried out more or less continuously throughout the year whenever people have easy access to their gardens. The major exception to this is when local groups go on extended trekking or camping

trips (*jkyo ujibikï uḏïmë*) and even then they usually manage to find cultivated plants to harvest from the trail and gap gardens as well as old gardens they find along the way[28]. When staying at the main settlement, household units go to the garden to harvest foodstuffs about two or three times a week. Women probably do more harvesting than men but this is only a tendency and not a rule, and not infrequently married couples accompanied by their children will go to the garden to collect enough food to last 2-3 days.

Maize is the first food crop to be harvested in a new garden. The very first harvest is not eaten but instead is given as an offering to fish. A couple of early corn ears are selected and dekerneled, and the grains are placed in a gourd container (*nuye*) made from the cultivated *nuyejtu* vine (*Cucurbita* sp.). The grains are then sprinkled into a creek for small fish (*molojko*) to eat while the person recites some words of blessing directed to the fish guardian (*mojto ae*). This ritual has the effect of sanitizing all of the food produced by the garden. People can then eat any food from the garden without danger of becoming sick. No further rituals are necessary and the rest of the harvest is conducted as a secular activity.

The principal maize harvest (*jtamu baedona*) occurs from late August to the end of October and most trips to the garden during this time are motivated by the desire to eat some fresh corn on the cob. Children are often sent to do this since it is quick and easy to harvest. The harvester simply yanks off the ear and throws it into a basket. The stems may be cut down and piled up (and later burned) or just left standing where they are. Sweet potato is ready to harvest by late November-early December, and the yam roots reach an edible size a month or two after that. The harvesting of these root crops takes place throughout the course of the dry season (*jtuwöni*). By this time the manioc crop has also matured but its harvest may be delayed until the wet season, when there are no more sweet potatoes or yams to eat (see below). The harvesting of these root crops is usually performed section by section whereby all the edible tubers worth harvesting in a delimited patch are excavated at one time. The harvester(s) remove(s) all of the aerial plant parts and any weeds in the patch and then dig(s) up the roots before replanting. The harvest is loaded into leaf-lined baskets and then hauled back home. Before reaching home, a stop will be made at a creek to wash off all the dirt. Most varieties of plantain/banana do not produce edible fruit until after one year of growth. After this date, they are closely monitored to estimate when they will be ready for harvesting. When this time comes, the entire bunch is cut down and if no further fruiting is expected, the main pseudostem will be felled, clearing the way for one of the daughter stems to grow up and take its place. A single bunch may weigh 20-30 kilograms or more so only one or two plants will be harvested at any one time. Snack foods like sugarcane and papaya are usually eaten on the spot but some of it may also be brought back to the house.

The Jodï seem to have a delicate open-access policy with regard to harvesting practice. Thus while most harvests of cultivated plant products take place in gardens that are owned by the family unit making the harvest, it is also fairly common to take crops from other people's gardens if someone is passing through and sees something they want. This practice is usually incidental and the amounts taken are usually small. Such passerby harvests are not considered stealing but good etiquette dictates that the beneficiary should tell the owner about it the next time they meet. If, however, the harvester attempts to conceal what he or she has done, or takes an exaggerated quantity, then it could be interpreted as trespass of the owner's property. Especially at the nucleated communities of Kayamá and Iguana, it is

[28] Extended camping trips lasting several weeks or even months may take place in both wet and dry seasons as well as the transitional period between although they tend to be longer in the wet season, when they rely on maripa palms (*Attalea maripa*) as their main source of caloric support. Nowadays the main local groups still engaging in this type of subsistence-driven mobility are those inhabiting the Mosquito, Upper Cuchivero and Upper Parucito basins.

not uncommon to hear complaints about neighbors stealing food from their gardens. However, there is no thought of personal retaliation beyond gossip and the main sanctions for this type of antisocial behavior are handled by the spirit world. Since all crop types possess guardian spirits (*aemo*) that look out for their well-being, anyone who steals a crop runs the risk of angering its *ae* owner which in turn may cause the thief to fall ill.

The importance of the different cultigens in the Jodï diet was evaluated as part of our study of food resource accounting[29]. We found that six cultigens make up more than 90% of the total weight of cultivated food products: plantain/banana (*Musa x paradisiaca*), maize (*Zea mays*), yams (*Dioscorea alata* and *D. trifida*), sweet potato (*Ipomoea batatas*) and manioc (*Manihot esculenta*) (Figure 6). Given this aggregate importance value, as well as the relative contributions of each one to the sum total, we conclude that they all should be considered as co-primary crops. The breakdown of their individual contributions show that plantain/banana is the most important crop from a dietary standpoint, contributing 33% of the total cultivated plant food weight for all study communities combined. Second place is occupied by yams (20%)[30], followed by sweet potato (17%), manioc (14%), and maize (6%).

The results on crop importance value vary significantly when viewed at the community level of analysis (Table 7). At this level, *Musa* is still the top food contributor in three of the four study groups – Mosquito (45%), Kayamá (36%), and Majagua (30%) – but drops to third place at Iguana (21%), where sweet potato is number one (33%) and yams are number two (23%). Sweet potato accounts for 23% of the total at Majagua but is considerably less important at Kayamá (10%) and Mosquito (3%). Yams make a similar contribution at Mosquito (30%) as they do at Iguana but are much less important at Kayamá (15%) and Majagua (12%). The highest levels of manioc production were recorded at Kayamá (24%) and the lowest at Iguana (9%). The relative weight contribution of maize is very similar at Majagua, Kayamá and Iguana (7-9%) but nearly absent at Mosquito (1%). However, the latter result may be due in part to sampling error since maize is primarily a first-year crop and, as reported earlier, the Mosquito group did not fell new gardens during the first year of our study. A summary interpretation of these variable results is that while *Musa* is undoubtedly the top crop overall there is no one cultivated product that really dominates by very much in any one place and there is considerable latitude from place to place regarding how much people depend on any one member of this principal food basket.

Although quantitative data on monthly or seasonal variation of harvest levels will not be presented here, nonetheless we can offer some qualitative observations.

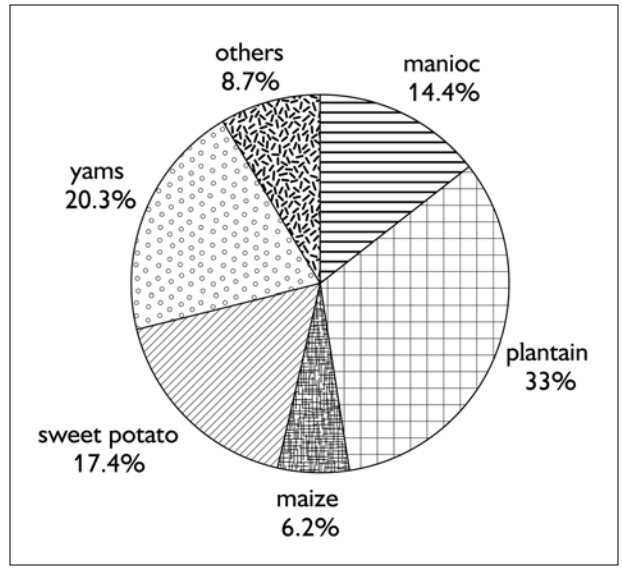

Figure 6. Relative food contribution of crops overall.

[29] A detailed description of the general concept and methods of resource accounting is provided in Zent (1996). The specific set of methods we used in the Jodï research is described in the report cited on footnote 6.

[30] Quantitative description and analysis of the harvested amounts contributed by the two yam species had to be combined since we found it impossible to keep them apart during weighing events, and therefore the results for these two cultigens are presented as a single figure. In a similar vein, we were unable to segregate plantain from banana harvests so they are combined as well.

The only crop that is steadily available on a year-round basis is *Musa*, another trait that cements its position as the most important food crop. All of the other co-principals exhibit a pattern of annual fluctuation marked by a single period or season of relative abundance. Maize production is mostly confined to the months of August-October, although some of this harvest can be stored in the house and it continues to provide meals on an infrequent basis for some months afterward. The sweet potato harvest is greatest during the early phase of the dry season (November-February). It is interesting to note that this time of year also corresponds to the period when most ceremonial feasting occurs, during which large quantities of sweet potato beer are consumed. Yams are ready for harvesting when the leaves dry and fall off during the latter part of the dry season (February-April) while manioc reaches its production peak during the first months of the wet season, April-June[31]. During their respective harvest seasons, the different crops mentioned here become virtual staple food items. The respective periods of high-volume availability are staggered throughout most of the annual cycle such that when production of one seasonal staple falls off another rises to take its place. The only gap is the period from the mid-wet season to the beginning of the maize harvest (July-August) when no seasonal staple is available. This time of year constitutes the lean period of the Jodï subsistence cycle when calories are in shortest supply. In view of the caloric importance of maize, sweet potato, yams and manioc, albeit temporary and rotational, it seems reasonable to consider all of them as co-principal crops along with the perennial plantain/banana.

Besides the harvest of cultivated plant products, certain animals that visit or inhabit the swidden ecosystem are also 'harvested' when the opportunity presents itself. Pacas and agoutis come to the garden to feed on root crops and hunters build blinds to lay watch for them. Toucans, aracaris and oropendolas are attracted by bananas, papaya and pioneer tree fruits and adolescents set traps to catch them. Young boys hone their blowgun shooting skills by targeting tiny birds like hummingbirds and manakins. While parents are busy at garden work, children spend their time looking for wasp larvae or chasing down edible lizards. Harvests of these subsidiary resources are not very significant in a quantitative sense but they do provide a highly appreciated if sporadic bonus.

THE FALLOW

There is no exact moment when the garden becomes just a fallow since the area is visited and small quantities of resources, especially plantains or bananas, may be harvested for years to come afterward. The transition of the garden to fallow ecosystem is a slow process that starts to unfold well before active management of cultivated plant resources has terminated. Essentially the first time that weeds are overlooked instead of being cut down is tantamount to the beginning of the ecological succession. Since weeding declines drastically by the end of the maize harvest, this juncture marks a qualitative leap in the intensity of the successional process. However, the Jodï habit of extending the cultivation period by successive replanting also delays the inevitable turnover of species. Moreover, the patchy management style, whereby different patches are harvested and replanted in different crops at different times, leads to a very uneven succession over time and space.

As noted previously, the Jodï have a rich vocabulary for referring to different swidden stages and their specific floristic features. Similarly, there are various ways for expressing the

[31] In view of the fact that manioc is a staple crop and available year-round among many other lowland South American groups, the Jodï pattern of seasonal dependence on it seems quite curious. While this limited usage is at odds with the pattern found elsewhere nevertheless it is consistent with the subsistence pattern being described here in which there are several principal crops that are available at different times of the year. It is interesting to note that many of the wild resources they exploit are also available only seasonally. For maize, sweet potato and yams, the fact of seasonal production seems to be biologically determined whereas in the case of manioc it may instead be culturally imposed. This seems to suggest a reason why the Jodï have several principal crops at the same time instead of just one: cultural preference and tradition.

Table 7. Relative food contribution of cultivated crops by community.

Location	Mosquito	Majagua	Iguana	Kayamá	All Sites
Major crop	%	%	%	%	%
Manioc	13	12	9	24	14
Plantain/banana	45	30	21	36	33
Maize	1	7	9	8	6
Sweet potato	3	23	33	10	17
Yams	30	12	23	15	20
Other crops	8	16	5	6	9
Total	100	100	100	100	100

concept of fallow and its different forms. A generic phrase expressing the transition from garden to forest is *balo jkyo bae jae*, literally 'garden-forest-becoming-thing'. The primary terms used to refer to an old garden that is no longer planted or weeded, or visited on a regular basis, are: *baede balo* 'old garden', *jtajwä balo* 'very old garden' or *jkyo balo* 'forest garden', usage depending on the speaker's preference or frame of reference. Additional words are added to specify in greater detail the age and appearance. For example, the expression *baede balo jtau alëjtä bae dejae* indicates an old garden that is characterized by small tree growth, whereas *jtawjwä balo jtau ajtaï bae dejae* indicates a somewhat older garden that is covered by large trees.

Just as there is no sharp distinction between garden and fallow, the line between secondary forest and primary forest is also fuzzy. In its earlier phases, the old garden is easily recognized by the configuration of tree species which are present. Prominent botanical indicators of early secondary forest include the following: *wejtolo* (*Cecropia* spp.), *jkyo luwë* (*Inga* sp.), *jtïjtïmo jyëï* (*Apeiba schomburgkii* Szyszył.), *wani jelë* (*Jacaranda copaia*), *jtabali jelë* (*Ceiba pentandra*), *uli nejkana jelë* (*Pothomorphe umbellata*), *jtewa jena* (*Heliconia* spp.) and *jtöjkona jelë* (unidentified). Another group of trees are identified as being indicative of a later phase of secondary: *ae jlude jyëï* (*Dacryodes* sp.), *iyë jyëï jtau* (*Trichilia* spp.), *maladaijku* (*Guarea guidonia* (L.) Sleumer), *olou jtau* (*Eschweilera subglandulosa* Miers.) and *dudibu* (*Erythrina* aff. *poeppigiana* O.F. Cook). Many of the constituent secondary forest tree species have utilitarian value for food or technology, which makes these biotopes a valuable part of the Jodï economy. Some game animal species are also attracted to this habitat because numerous plants of the secondary forest are food for them and the Jodï are keenly aware of these relationships and exploit them to locate game for hunting purposes. At some indeterminate stage of development, when the height of the canopy is uniformly high (~ 20 meters) and large trunks (~ 1 m dbh) are present, and emblematic trees of high forest like *Micropholis egensis* or *Brosimum alicastrum* are conspicuously present, the Jodï claim that they cannot tell whether a given patch of forest used to be a garden or not. At this point, the forest is simply called *jkyo* 'forest', *jtau jkyo* 'tree forest' or *nï jkyo* 'true forest', which is the closest the Jodï come to a concept of primary forest, that is, a forest in which alteration is undetectable[32].

The Jodï clearly prefer *jkyo* for making a new garden and in that sense could be considered to be long fallow shifting cultivators. However, given the ambiguity of being able to distinguish between high secondary and high primary forest types, or how long it takes to reach a *jkyo* state, it remains questionable whether the Jodï are really fallowing their gardens as a conscious management strategy.

[32] An alternative expression that would also work here is *jtau jkuwë* 'beneath the trees'.

In choosing to slash and burn what they perceive as primary or old-growth forest, the Jodï may resemble pioneer shifting cultivators who by definition do not fallow or rest a piece of land in anticipation of its reuse (Chagnon, 1973). Although our informants did recognize that the forest helps to replenish soil fertility, in the sense that the leaves which fall from trees (*jtau aiyë*) provide nutrients or 'food' (*jkwaï kawa*) for the soil, there is no indication that they purposely choose secondary forest for swiddens or plan on land rotation in any way. The pioneering quality of their farming practice may be related to their traditional semi-nomadic lifestyle, which of course is starting to change since contact with outsiders and the establishment of mission outposts in their territory. Support for this hypothesis is drawn from the observation that among the small settlement groups at Mosquito, Majagua and Upper Cuchivero, most of the gardens surveyed were cleared from high forest, whereas at the larger, more sedentary communities of Iguana and Kayamá, it is quite common to find gardens created out of secondary growth. Thus it seems that population pressure on land resources and greater dependence on garden food are compelling the Jodï to adopt secondary forest clearance and systematic land rotation as standard swidden practice. It remains to be seen whether the reduction of fallow periods, assuming this trend continues, will cause environmental degradation over the long-term.

CONCLUSIONS

Based on the evidence presented in this paper, we contend that the Jodï horticultural system looks more integral than incipient, if we understand the concept of integrality as meaning that the cultivation system is integrated with other systems in a given sociocultural matrix (Conklin, 1957). At a first-order level of analysis, we can point to linkages and interactions with alternative strategies or subsystems within the broader domain of subsistence (i.e. hunting, collecting, and fishing). At a second-order level, we are able to observe numerous ties to other institutional spheres of social life, from ritual dietary customs to ecocosmological beliefs to notions of property rights and social reciprocity. Some of the characteristic features or tendencies associated with integral cultivation systems include: maintenance of high levels of agrobiodiversity, relative autonomy from external markets or sociocultural influences, high productivity and nondestructive environmental impact. We submit that all of these features are clearly present in the Jodï horticultural system and therefore it deserves to be recognized as integral in its own unique way.

We reviewed the significance of the horticultural arts and products in different manifestations of the Jodï cultural imagination (or expressive culture) and found that cultigens are not only good to eat but also good to think. The ways of thinking about cultivated plants are consistent at an abstract level with the intangible perceptions accorded to nondomesticated plant and animal beings, namely that all living organisms have a material and a spiritual existence and human appropriation or use of them must be regulated by proper conduct. These perceptions in turn fit in with a broader world view of how different life forms relate to one another as real/potential predators/prey which we referred to as 'mystical predation'. The notion of predation, in turn, is linked to other basic themes of Jodï existential philosophy, like the interrelated concepts of movement and life. Predation seems to act as a trigger of movement, and any movement produces a cycle of action-reaction which is the outward embodiment of life. The inner side of life is conceptualized as an immanent, irreducible core from which every potential perspectival form, whether tangible or intangible, comes from (Zent, 2005, 2006, 2009). That is why everything that moves or grows is also capable of responding to stimulation and changing their role from prey to predator or back again, including crop plants. The human-like agencies of 'natural' species are also evident in oral narratives. The prominent representation of cultivated resources and knowledge in mythical history, together with more natural or predatory beings, like *uli yëwi*, suggests the great antiquity and cultural rootedness of this practice.

We presented quantitative data on the relative importance of horticulture in the Jodï subsistence system from the perspectives of labor input and production output. From the former perspective, horticulture appears to be a secondary activity, especially among the most nomadic group of our sample. From the latter perspective, however, cultivated foods supply a major fraction of the total food output, a trend that is more pronounced among the larger, more sedentary (ex)mission communities. This seemingly paradoxical result attests to the high productivity of this type of food pursuit; obviously horticulture is more efficient in energetic terms than the other activity types. One might wonder: if it is so efficient, why don't they rely on it more than they do now? In any case, the results confirm that horticulture is a primary, rather than a secondary, subsistence activity for the Jodï.

The different phases and operations of the swidden cycle were described as a fairly organized yet flexible process. For us, what stands out most here is the considerable technical knowledge and skill that is employed in the management of this process. For example, the abundance and variety of botanical indicators for locating promising sites for new gardens. However, it also clear that the Jodï perceive the garden-making process as something more than a mundane affair and ritual techniques are also an important part of their technological package.

Jodï horticulture can be characterized as maintaining a high level of agrobiodiversity. Such diversity is exhibited by the inventory of cultigens and cultivars, the creation of mosaics of different patches, the cultivation of ecotopes other than swiddens, and the exploitation of a large range of noncultivated plant and animal species that also inhabit cultivated landscapes. Another characteristic is relative longevity. The cropping phase of the swidden is extended through successive replanting up to five years or more. Hardy and self-regenerating cultigens like banana and papaya are capable of surviving even longer and can provide harvestable goods long after the rest of the plot is engulfed by successional vegetation. This habit of extending the cropping period in years, although more characteristic of sedentary or market-oriented agriculturalists, may actually be a legacy of pre-contact conditions when steel tools were much less accessible. Denevan (2001) has argued that stone tool-using horticulturalists probably had longer cropping periods because of the difficulty and high labor costs of clearing forest with stone axes.

Our analysis of swidden crop composition along with data of harvested food amounts indicates that Jodï swiddens display a fairly even mix of five (or six) principal crops: plantain/banana, maize, yam, sweet potato, and sweet manioc. This result confirms the distinctiveness of Jodï swiddens in comparison to their horticultural neighbors who rely much more heavily on one or two crops, especially bitter manioc. *Musa* provides the largest caloric contribution to the Jodï diet and is available year-round, and therefore rates as the most important crop, but the other four also make substantial contributions to the diet and constitute virtual seasonal staples (maize: late wet season; sweet potato: early dry season; yam: late dry season; manioc: early wet season). We believe that the relative preponderance of *Musa* is due to its great energetic efficiency, easy processing (eaten raw or roasted), extremely low maintenance costs (i.e. little weeding necessary), and considerable longevity (e.g. one fruit-bearing stand we encountered was > ten years old). Such properties make it compatible with a nomadic, foraging-dependent lifestyle.

Another distinctive feature of Jodï horticultural practice is the extensive use of natural gaps in the forest canopy as cultivation zones. There are very few reports of other native Guianese groups resorting to this technique (but see Zent, 1992, p. 168-169). The gap gardens provide people with extra food supplies that can be used during their frequent camping and trekking activities. Nearly everyone we interviewed about this subject agreed that this type of cultivated space was much more extensive and relied upon a generation ago when steel axes were hard to come by and trekking was more frequent. Obviously this form of 'nomadic agriculture' is well integrated with the

custom of mobile residence and in that sense complements rather than competes with foraging activities.

Perhaps one of the reasons why the Jodï horticultural system looked so incipient to the early ethnographers is because it is so well adapted to a nomadic, foraging lifestyle, and what appears to be foraging activity may also be horticultural and vice-versa. Obviously, this has changed somewhat after several decades of contact with foreign groups and the material goods they provide as well as changes in settlement pattern. The differences observed between horticultural practices among the mission groups and the nonmission groups demonstrate that this system is somewhat elastic and capable of greater intensification, but everywhere retains its basic multi-staple character. We might speculate that elasticity was a basic property in the past as well and the same basic system will diverge under different population and technology parameters. This may account for some of the differences noted in the early ethnographies. In any case, we are left to conclude that the Jodï are definitely integral cultivators but they are also integral foragers.

As a final reflection, we wish to point out that a synthetic reading of the data and information presented in this text leads us to postulate an inextricable connection between cultural perspective and ecological praxis in the way that Jodï agricultural behavior plays out on a day-to-day basis. What emerges as the Jodï horticultural 'system' really constitutes part of a more holistic strategy of multidimensional and multifarious contacts and interactions with the great diversity of inhabitants of the forest biosphere. The ties established between people, quasi-human and nonhuman entities are infused at once with intangible (essence interpenetration) and tangible (energetic inputs and outputs), ritual (magical planting methods) and mundane (technical planting methods), primordial (ancestral crops) and contemporary (recently introduced crops) components. We have shown elsewhere that deeply philosophical principles of life (e.g. connectivity, movement, re-creation) intersect with pragmatic material interests (sustenance, health, reproduction) to produce many aspects of Jodï subsistence and social pattern, hunting behavior for example (Zent and Zent, 2007; Zent, 2009). In a similar sense, we should emphasize that the observed figures on cultivated food production or garden composition should be understood not only as numerical functions of the application of technical know-how and labor but also as the material outcomes of mythological lessons, ritual performances and moral imperatives. Meanwhile, the concrete practice of cultivation is a common element or trope (symbolizing, among other things, human agency) that appears over and over again in cultural discourses of a more abstract nature. Such discourses include, but are not limited to, the following themes: protogony (the genesis of human life being associated with the care of certain plants and animals in order to guarantee continuity), cosmogony (the articulation of agriculture to a cosmic order of permanent life-generation in which people play an active role), anthropogony (the emergence and persistence of humankind being associated with food production), ecogony (humans and culturally prescribed behavior, such as good cultivation practices, serving as nodes of ecological interaction for diverse life forms which in turn is necessary for the perpetuation of the biosphere) and eschatology (upon death, people and other creatures passing on to another world where they are sustained by agricultural and wild food products that are constantly abundant and never rot). In sum, Jodï horticulture can be interpreted as a particular technological creation that is imbued with their unique biocultural *ethos* and materialized in ecological, moral and emotional performances (Århem, 1996a, p. 200; Zent, 2006, p. 359).

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