*Human Ecology, Vol. 20, No. 4, 1992*

# Labor Specialization and the Formation of Markets for Food in a Shipibo Subsistence Economy

**Clifford A. Behrens**[1]

*Traditionally, the Shipibo economy was subsistence-based with shifting cultivation supplying calories, principally in the form of plantains and root crops, while fishing and hunting provided animal proteins to the diet. Some men, who recently began producing rice for sale in regional markets, now allocate less time to wild food procurement. Moreover, this trend has been accompanied by the nucleation of households, a growing cash market for agricultural labor, and the intravillage sale of faunal foods. This paper shows that with cash cropping, some Shipibo now freely distribute less food to others in relation to the amount they produce. To account for this change, a theory is developed based on time allocation and patterns of economic behavior reported throughout the Amazon. This theory is then applied to explain specialization and the formation of cash markets for food labor among the Shipibo.*

**KEY WORDS:** labor specialization; Shipibo, time allocation; decision-making; mathematical model.

## INTRODUCTION

This paper examines the relationship between food production and exchange, and the manner in which this relationship is affected by a shift from a subsistence to a market-oriented economy. Analysis of Shipibo production and exchange data reveals that cash cropping has produced two groups of specialists within the formerly subsistence economy. The first group produces rice for regional markets and includes households with fewer women, but continues to exchange food within the traditional kin-

[1]Bell Communications Research, 445 South Street, MRE 2B-397, Morristown, NJ 07960-1910.



0300-7839/92/1200-0435$06.50/0 

based exchange system when it can. The second group contains men whose superior abilities as fishers and hunters are well recognized, and who now frequently sell wild food to rice producers, rather than distribute it freely. To understand better this specialization, a formal theory that replicates the formation of cash markets for food and labor in a subsistence economy is developed based on the ethnographic literature for the Amazon and on the theory of time allocation.

## SHIPIBO ECONOMY

The Shipibo are a Panoan-speaking group (Loukotka, 1968; Shell and Wise, 1971) which inhabits the Central Ucayali River of Eastern Peru and its major western tributaries. Presently, the Shipibo population includes more than 16,000 members (Chirif and Mora, 1976; Uriarte, 1976). This study uses data that were collected in Nuevo Edén, a village with about 342 resident Shipibo, located near the headwaters of the Pisqui River.[2] Fieldwork lasted from June 1980 until August 1981.

### Nuevo Edén

Until about 35 years before the study period, Shipibo Indians in the area lived in extended family homesteads dispersed along the Pisqui River. The economy of these families was subsistence oriented with occasional wage labor and the trading of hides and other forest products to obtain metal tools, shotguns, cooking utensils, and cloth from *mestizo* traders. Shifting cultivation produced *Musa* (plantains and bananas), the dietary staple, along with root crops. Fishing and hunting provided most proteins in the Shipibo diet. When gardens and wild food procurement sites were no longer productive, settlements either relocated in their entirety or in parts after fissioning into their constituent uxorilocal social units.

Through the efforts of an influential headman and a powerful *mestizo patron*, Shipibo families were persuaded to form a village so that its residents could petition the Peruvian government for a bilingual school. Once formed, Nuevo Edén became an important administrative and political center. Because it was the largest indigenous settlement on the Pisqui, Nuevo

[2]As has been previously reported (Behrens, 1986a; Roe, 1981), there exist notable economic and cultural differences between the Shipibo who inhabit the Pisqui River (sometimes referred to as "Pisquibo") and those who live along the larger Ucayali River. While such distinctions are also made by members of these two groups, this study focuses on social and economic variation within a single Shipibo village. Nevertheless, it is the author's contention that the processes fostering change in Nuevo Edén are not unlike those observed in other Shipibo communities and elsewhere in the Amazon.

Edén was selected to host a medical clinic and is occasionally visited by representatives of the Peruvian government at the *departamento* level.

Contacts with outsiders have increased the Shipibo's demand for cash and the Western goods it can buy: improvements are frequently needed to the school and health clinic, children require school supplies, and adults desire many of the modern goods that they are shown by river traders and by shopkeepers while on trips to distant towns like Contamama and Pucallpa. *Mestizo patrones* found it easier to recruit laborers concentrated in a single village and, consequently, one settled in the village and others have established large commercial ventures nearby. Until recently, wage labor for *mestizo patrones* was the major source of cash for the Shipibo in Nuevo Edén.

## Economic Changes

Detailed interviews of Shipibo informants reveal that significant changes in their economy have occurred during the last two decades. In 1974, a severe flood stressed local food supplies because in preceding years many Shipibo men had left Nuevo Edén to work for *mestizo patrones* and, therefore, had not planted subsistence gardens. Families were forced to rely on immature crops, wild foods, and support from missions. As a response to this natural catastrophe, Shipibo farmers sought an activity whereby they could generate cash without leaving their village for extended periods. Since many had learned to grow rice while working for *patrones*, and because the price of rice increased propitiously at about the same time, the people of Nuevo Edén began producing rice for sale in regional markets about three years before the study period. Using simple technology, some are now able to match yields of controlled experiments at Peruvian agricultural research stations (Behrens, 1989a).

Shipibo men say that, due to the increased time requirements of rice production, they are hunting and fishing less than before the change. Men are selling fish and game within the village, whereas before, meat was commonly exchanged among women through traditional kinship networks. The Shipibo also report recent changes in social relationships within their village. While a traditional role of men was "to serve their mother- and father-in-law" by supplying them with agricultural labor, plantains, fish and game, fewer men are assisting their father-in-law in rice production. Changes in relations between affines are reflected in deviations from the traditional residence pattern. Traditionally, household residence was uxorilocal, with all nuclear families in each extended family household sharing a single *cocina* (cooking structure). However, recently there has been a

**Table I.** Average Composition of 50 Shipibo Households in Nuevo Edén, August 1981

| Category[a] | Average number | Total (%) |
|---|---|---|
| Male adults | 1.6 | 23.2 |
| Female adults | 1.9 | 27.5 |
| Male youths | 0.8 | 11.6 |
| Female youths | 1.0 | 14.5 |
| Male toddlers | 0.7 | 10.1 |
| Female toddlers | 0.5 | 7.3 |
| Male infants | 0.2 | 2.9 |
| Female infants | 0.2 | 2.9 |
| Total | 6.9 | 100.0 |

[a]Adults = 15 years and older, youths = 5–14 years, toddlers = 1–4 years, infants = less than 1 year.

tendency for some men to establish smaller, nuclear family households with their own *cocinas.*

## HOUSEHOLD AND COCINA GROUP COMPOSITION

A Shipibo man takes up residence in his wife's mother's house when he is married. Analysis of residence in Nuevo Edén shows that 94% (47 of 50) of its households are consistent with this uxorilocal ideal. While in the past three to four married men would live in the same large house as their father-in-law, now there are more nuclear family households, though most of these smaller houses are grouped into uxorilocal compounds.[3] Usually, a man will live with his father-in-law for at least several years, or until another son-in-law moves in, before making his own house. The degree of adherence to the principle of uxorilocal residence frequently depends on how well people are getting along, though the availability of space is also cited as a factor.

During the study period, the average size of the 50 Shipibo households in Nuevo Edén was 6.9 persons (SD = 2.7). Of these, 27 (54%) were uxorilocal with extended families, not including one household whose male household head was nonresident at the time of the census, and 20 (40%) were uxorilocal with nuclear families, including two polygynous families and three married couples with no married daughters or whose married children lived in other houses.[4] There was also one virilocal household containing

[3]There is a remarkable degree of adherence to the principle of uxorilocal residence within Shipibo society, even among more acculturated villages (Abelove, 1978; Roe, 1980).

[4]The households of a resident *mestizo patron* and those of schoolteachers were also censused but are not included in this study. By the end of the study period one elderly woman was

the male household head's mother-in-law and a virilocal nuclear family household which established itself away from the uxorilocal compound because there was not enough space for another house. The average number of adults, youths, toddlers, and infants in Shipibo households is listed by sex in Table I.

The most important unit for the production and consumption of food is the *cocina* group. By the end of the research period, Nuevo Edén contained 42 *cocinas.* Village settlement pattern conforms to the traditional Shipibo plan with *cocinas* located parallel to the river and on the opposite side of the street from the house(s) they serve. Houses and their corresponding *cocinas* are numbered and mapped in Fig. 1.

Some small households have their own *cocina* while larger extended family households may maintain a *cocina* shared among two or more houses with each adult woman in the *cocina* group tending her own earthen cooking hearth. Women in polygynous marriages may manage their own *cocina*, each living with a daughter and son-in-law. Consequently, the size and composition of many Shipibo *cocina* groups differ from that of households. The average size of *cocina* groups was 8.2 persons (SD = 2.9). Table II gives the average number of individuals in Shipibo *cocina* groups by sex and age class. Even though many households have their own *cocina*, a woman and her daughters often use each other's *cocinas* freely, and families in the same uxorilocal compound frequently eat in each other's *cocina* as food is cooked. Access to another's *cocina* also depends on how well families get along and wives, who maintain hearths within a single *cocina*, may ask their husbands for separate *cocinas* when relations become strained.

## FOOD EXCHANGE

During fieldwork, 241 days were divided into half-day intervals and, several times each week, the activities of a random sample of seventeen *cocina* groups were recorded for each half-day (Behrens, 1986a, 1989b). This represents approximately a 40% sample, i.e., 17 out of 42 *cocina* groups.[5] The age/sex composition of these sample *cocina* groups is shown in Table III.

In addition, 75 random visits, one about every third day, were made to the 17 *cocina* groups used in the time allocation survey. The study period was stratified into five sampling periods and for each the order of visits to

recognized as a household head since she was widowed and her son-in-law was living outside of the village.

[5]Initially, 14 *cocina* groups were selected for sampling but, later on, three of these fissioned so that by the end of fieldwork the sample included 17 *cocina* groups.

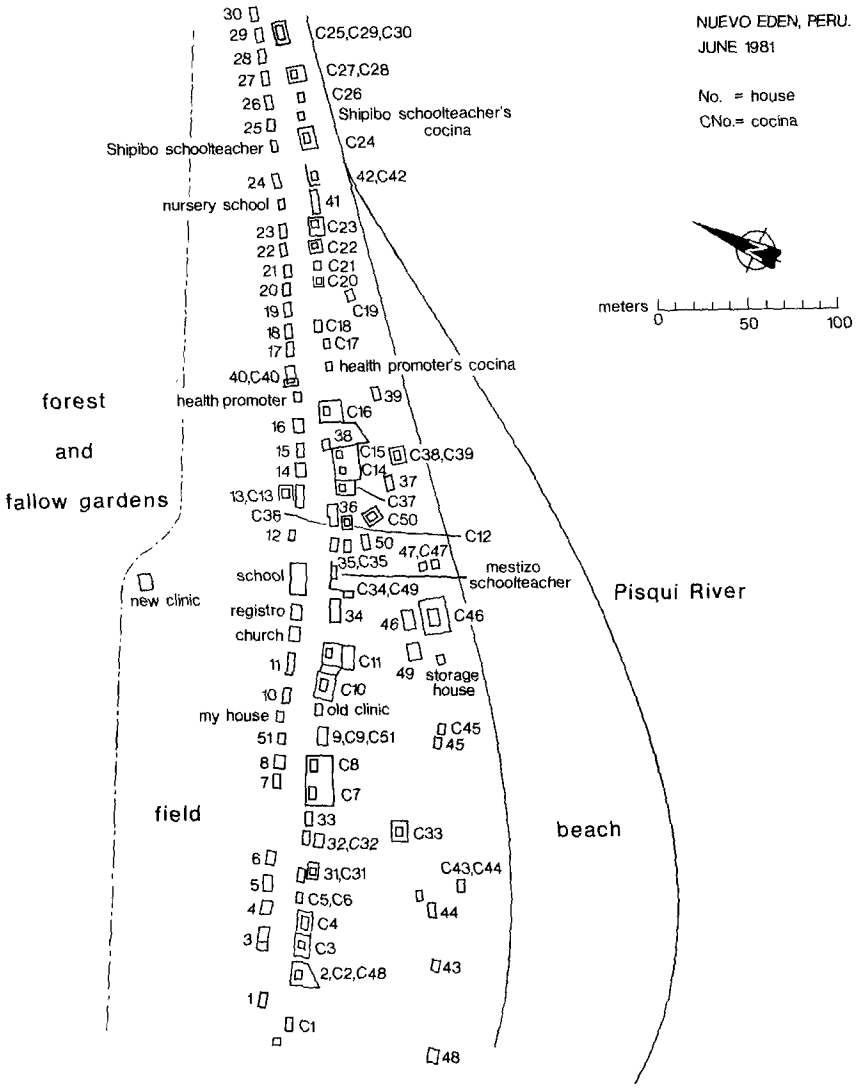


Fig. 1. Map showing distribution of houses and *cocinas* in Nuevo Edén during June 1981.

the *cocina* groups was randomized. During each visit, the activities of women in the sample *cocina* were kept within sight and all food prepared between 6 am–6 pm was weighed and recorded. In addition, the names of consumers were noted for each meal and any food either sent out or

**Table II.** Average Composition of 42 Shipibo *Cocina* Groups in Nuevo Edén, August 1981

| Category[a] | Average number | Total (%) |
|---|---|---|
| Male adults | 1.9 | 23.2 |
| Female adults | 2.2 | 26.8 |
| Male youths | .9 | 11.0 |
| Female youths | 1.2 | 14.6 |
| Male toddlers | .8 | 9.7 |
| Female toddlers | .6 | 7.3 |
| Male infants | .3 | 3.7 |
| Female infants | .3 | 3.7 |
| Total | 8.2 | 100.0 |

[a]Adults = 15 years and older, youths = 5–14 years, toddlers = 1–4 years, infants = less than 1 year.

brought into the *cocina* was recorded along with the names and *cocina* numbers of the givers and receivers, when possible.

## Sharing and Reciprocity

Not all of the food produced by a *cocina* group is consumed by its members. Much of it is eaten by members of other *cocina* groups who are either sent food or invited to eat with a host group. As with many other Amazonian people (cf. Flowers, 1983; Kaplan and Hill, 1985), meat production is the catalyst for the exchange of other foods by the Shipibo, and they consider both plantains and meat essential for a "good" diet (Behrens, 1986b). When fish or game is brought back to a *cocina*, a man usually gives it to his wife who may, in turn, present it to her mother. The mother may distribute it anyway she pleases, including sending portions to her son's *cocina* group.

The nature of subsistence agriculture results in periods when some *cocina* groups lack plantains and bananas while other *cocina* groups possess an abundance. Hence, food exchange is a means of reducing both spoilage and the risk of temporary food shortage (Hames, 1983, 1990; Kaplan and Hill, 1985; Yost and Kelly, 1983). As one Shipibo informant put it, "At times one has many ripe plantains, so he gives some to other members of his family. Later, when they have many, they reciprocate." It is not uncommon to see women during the morning or late afternoon carrying large reams of plantains which others have given them back to their own *cocinas.*

**Table III.** Age/Sex Composition of Seventeen Shipibo *Cocina* Groups in Time Allocation and Food Consumption Sample, August 1981

| *Cocina* group | Sex | Infants | Toddlers | Youths | Adults | Total |
|---|---|---|---|---|---|---|
| 2 | Female | 0 | 0 | 2 | 2 | 4 |
| | Male | 0 | 2 | 2 | 1 | 5 |
| 5 | Female | 1 | 2 | 1 | 3 | 7 |
| | Male | 0 | 0 | 2 | 2 | 4 |
| 7 | Female | 0 | 2 | 2 | 2 | 6 |
| | Male | 1 | 0 | 1 | 3 | 5 |
| 8 | Female | 0 | 0 | 1 | 2 | 3 |
| | Male | 1 | 0 | 1 | 2 | 4 |
| 9 | Female | 1 | 1 | 0 | 3 | 5 |
| | Male | 1 | 0 | 0 | 3 | 4 |
| 10 | Female | 0 | 0 | 1 | 2 | 3 |
| | Male | 0 | 0 | 0 | 2 | 2 |
| 12 | Female | 0 | 0 | 0 | 2 | 2 |
| | Male | 0 | 2 | 1 | 1 | 4 |
| 15 | Female | 1 | 2 | 2 | 2 | 7 |
| | Male | 0 | 0 | 0 | 1 | 1 |
| 19 | Female | 1 | 1 | 1 | 2 | 5 |
| | Male | 0 | 0 | 2 | 2 | 4 |
| 34 | Female | 0 | 0 | 3 | 4 | 7 |
| | Male | 1 | 3 | 2 | 3 | 9 |
| 36 | Female | 0 | 0 | 1 | 2 | 3 |
| | Male | 0 | 2 | 1 | 1 | 4 |
| 37 | Female | 0 | 0 | 2 | 2 | 4 |
| | Male | 1 | 0 | 0 | 2 | 3 |
| 40 | Female | 0 | 0 | 1 | 1 | 2 |
| | Male | 0 | 3 | 1 | 2 | 6 |
| 45 | Female | 1 | 2 | 2 | 3 | 8 |
| | Male | 0 | 2 | 3 | 3 | 8 |
| 46 | Female | 0 | 0 | 1 | 2 | 3 |
| | Male | 0 | 0 | 0 | 1 | 1 |
| 47 | Female | 0 | 1 | 0 | 2 | 3 |
| | Male | 1 | 0 | 0 | 1 | 2 |
| 50 | Female | 2 | 1 | 0 | 3 | 6 |
| | Male | 0 | 0 | 1 | 2 | 3 |

Men belonging to different *cocina* groups do not usually hunt or fish at the same time and, when a large fish or terrestrial animal is

brought back to the village, it is difficult for most *cocina* groups to consume the entire animal themselves. Many times kinsmen, other than a man's own *cocina* group, know when he has gone hunting or fishing and arrive at his *cocina* about the time he does. News of a recent catch or kill is often passed by travelers on the river and reaches the village before a man returns. Consequently, he may be met on the beach by not only his wife, but a large group of other women as well, each with a pot to carry back their own share of the distribution. When a large fish, deer (*Cervus rufus*) or peccary (*Tayassu tajacu*) is brought back it is butchered on the beach by a man's wife or mother-in-law who then distributes pieces to the other women. The butchering and distribution of smaller animals such as *majas* (*Cuniculus paca*) more often takes place in the woman's *cocina*. Every woman who waits for a portion of the kill is given something, though many women walk away from meat distributions with only a piece of hide or fat. Distributions are orderly and even women who help clean or butcher an animal will later wait along with the rest for their share of the distribution. Sometimes, a man will deliver part of his catch or kill directly to his mother and he eats with those in her *cocina*.

Other food exchanges between members of different *cocina* groups take form as invitations to share a meal. When a *cocina* group has much fish or game, women often make *batën* (stew). Once the *batën* is prepared, a man or his wife may stand in the village street and yell, "*Batën! Pihuë*!" ("[Come,] eat stew!"). Soon neighbors arrive. Some bring their own bowls and spoons, and the crowd divides into smaller groups of men and groups of women with their children.

The extending of invitations and others' response to them are not solely determined by the particular kin relationship between giver and receiver but, as one informant pointed out, also depends on how well people happen to be getting along at the time. In fact, several men noticed attitudinal changes among others in the village that were contrary to the Shipibo virtue of generosity. One claimed that, in the past when one had something big like a peccary or deer, he invited his neighbors and sent his son to fetch his brother and brother's wife. Now, there were fewer invitations and, when one did invite others, often they do not come. Another middle-aged man said that he missed the "old days" because when a family lacked plantains, they could rely on their kinsmen for assistance. Still another man observed that half of the village was changing. Families on the east side no longer extended invitations to eat and one had to pay for their food, the "way of the *mestizos*." He said that his side of the village still invited others when there was plenty of fresh food and only expected payment for salted fish or game. According to him,

the reason that his side had not changed was that the village founder and another elder, who lived on the west side, did not wish to change from the old customs.[6]

Some individuals, particularly men who have little food of their own, have to *"buscar"* (search) for their food. Several informants claimed that these usually were men who planted only rice and lacked plantain gardens, so they had to rely on their affines for food.

## Social Context of Exchange

During the *cocina* survey food distributions were recorded. These included exchanges of cultigens, fish, game, meat from domesticated animals, and gathered foods. Table IV gives the frequency of distributions for the 15 most common kin types who received food from heads of the 17 sample *cocina* groups. In other words, a record was made for any individual belonging to another *cocina* group who received food either personally in the form of a gift or as part of a group invitation to share in a meal. The number of *cocina* groups that exhibited exchanges involving each kin type is provided.

A total of 647 food distributions is represented by the data in Table IV. This means that in each *cocina* group there was an average of 8.9 food distributions to others per day.[7] As expected, most of these transactions involved consanguineal kinsmen, particularly members of the same uxorilocal compound of *cocina* groups. Included in this group are Si, SiSo, SiDa, Da, Mo, Fa, and DaDa. Those consanguines who were not members of the same uxorilocal compound, but who also were commonly recipients of food distributions, included brothers, sons, and BrDa. The next group of consanguineal kinsmen who often received food were matrilateral aunts and their offspring since they, too, live in the vicinity of a woman's *cocina* group. These include MoSiDa and MoSiDaDa. Exchanges frequently involved sisters' husbands because they are members of the same uxorilocal compound of *cocina* groups,

[6]The selling of meat goes against the Shipibo virtue of generosity expressed in Shipibo mythology. For example, read Roe's (1982) tale of *Yoashico*, the "Stingy Inca." *Mestizos*, called *monsobo* by the Shipibo, are deemed "less than human." Since stealing and withholding of meat is considered "typical" *mestizo* behavior, any Shipibo who exhibit similar behavior open themselves to the same depreciatory remarks usually reserved for *mestizos*.

Several informants mentioned that a few years before the study period, some men who lived on the east side of the village talked about fissioning to form a new village downriver. Apparently, they were tired of traveling long distances to their gardens and then having to return to their wives and children in Nuevo Edén.

[7]Only 73 of the 75 *cocina* visits had complete food exchange data. Distributions for the first two visits to *cocina* group 36 were missing.

**Table IV.** Kinsmen Who Received Food from Female Heads of 17 Sample *Cocina* Groups

| Kin type | Kin term | Total exchanges | Number of *cocinas* | Exchanges/ *cocina* |
|---|---|---|---|---|
| Consanguine/same compound | | | | |
| Si | huëtsa | 66 | 11 | 6.0 |
| SiSo | koko | 27 | 10 | 2.7 |
| SiDa | ini | 52 | 9 | 5.8 |
| Da | bakë | 40 | 7 | 5.7 |
| Mo | tita | 27 | 5 | 5.4 |
| Fa | papa | 9 | 4 | 2.3 |
| DaDa | baba | 52 | 3 | 17.3 |
| Consanguine/different compound | | | | |
| Br | pui | 33 | 10 | 3.3 |
| So | bakë | 41 | 8 | 5.1 |
| MoSiSo | pui | 10 | 6 | 1.7 |
| BrDa | chio | 15 | 4 | 3.8 |
| Consanguine/adjacent compound | | | | |
| MoSiDa | huëtsa | 19 | 4 | 4.8 |
| MoSiDaDa | ini | 10 | 4 | 2.5 |
| Affine/same compound | | | | |
| SiHu | bënaitsa | 14 | 5 | 2.8 |
| Affine/different compound | | | | |
| DaHuBr | — | 7 | 5 | 1.4 |
| Others[a] | | 225 | | |
| Total | | 647 | | |

[a]This category includes readily identifiable kin types with few exchanges and others, most likely involving some of the same kin terms in the table but not so easily identified.

even though they are affines. The only other affinal kin type which turned up, rather unexpectedly, with the others in the table was DaHuBr and distributions of this type were observed in five of the 17 *cocina* groups.

The data in Table IV are enigmatic for the lack of exchanges between affines. These data provide but a partial picture of food exchange in Nuevo Edén because they only indicate kinsmen who received food during visits to each *cocina* in the sample. Table V shows female heads of *cocina* groups who gave food to female heads of the 17 sample *cocina* groups. In other words, a record was made whenever a female head of another *cocina* group sent food, cooked or unprepared, to the female head of one of the sample *cocina* groups. Figures are listed for the ten most common kin types in-

**Table V.** Female Heads of *Cocina* Groups Who Gave Food to Female Heads of Seventeen Sample *Cocina* Groups

| Kin type | Kin term | Total exchanges | Number of *cocinas* | Exchanges/ *cocina* |
|---|---|---|---|---|
| Consanguine/same compound | | | | |
| Si | huëtsa | 38 | 8 | 4.8 |
| Mo | tita | 17 | 4 | 4.3 |
| Da | bakë | 13 | 3 | 4.3 |
| Consanguine/adjacent compound | | | | |
| MoSi | huata | 27 | 5 | 5.4 |
| Affine/different compound | | | | |
| HuMo | bankënsha | 7 | 6 | 1.2 |
| HuSi | tsabë | 6 | 4 | 1.5 |
| DaHuMo | — | 5 | 4 | 1.3 |
| BrWi | tsabë | 4 | 4 | 1.0 |
| SoWi | baban ëhua | 4 | 4 | 1.0 |
| SoWiMo | — | 4 | 2 | 2.0 |
| Others | | 48 | | |
| Total | | 173 | | |

volved in food giving from other *cocina* groups. These data differ qualitatively from those in Table IV because the name of the giver was often acquired through a second source, i.e., the giver was not actually observed in the distribution when food was delivered by a child or brought back by a woman's husband, and so the giver was always assumed to be the head of a *cocina* group.

The results in Table V are similar to those in the previous table with several important exceptions. Four of the ten most common food givers were affines: HuMo, second only to sisters in the number of *cocinas* exhibiting this type of exchange, HuSi, DaHuMo, and SoWiMo. (BrWi and SoWi, for all purposes, can be interpreted as distributions from Br and So, i.e., from consanguines.) A woman's Si, Mo, Da, and MoSi also are frequent food givers. Other kin types that were common recipients of food distributions such as SiSo and SiDa are not listed because these individuals are dependents of female heads of *cocina* groups, not exchange partners.

A comparison of Tables IV and V reveals two interesting results. First, the average number of distributions is greater among *cocina* groups

belonging to the same uxorilocal compound than among those belonging to different compounds. Second, while a woman's affines are often food givers, they usually do not receive food in return. The reason for this is that women rarely eat with other *cocina* groups outside of their own uxorilocal compound, though a woman's husband has access to both his affines' and mother's *cocina* groups. Since affines do not frequently visit a woman's *cocina* group but, instead, usually send food in with a child or the woman's husband they were rarely ever observed receiving food in distributions.[8]

## Selling and Buying

The Shipibo in Nuevo Edén reported that they had been selling food for about 3 years, approximately the same amount of time that they had been producing rice. One man, who lived on the east side of the village said, "*Ahora, toda es plata. Sin plata, no se puede comer.*" ("Now, everything is money. Without money, one cannot eat.")

Cultigens other than rice were never sold, at least not to other Shipibo in the village, only fish, game, pork and chicken.[9] In marked contrast to food distributions, meat is usually sold by men and the process is more disorderly: buyers frantically rush to the scene with their money in hand the moment that they hear there is meat for sale. Also, unlike food distributions, meat for sale is weighed with a spring scale and sold by the kilogram (cf. Nietschmann, 1973). However, as in food distributions, grades of meat are not distinguished, so a kilogram of meat sells for the same price as an equal amount of hide, fat, or other parts. Meat prices varied among sellers and over the year of fieldwork.[10] Fish sold for anywhere from 100–200 *soles*/kg and the price of game varied from 50–300 *soles*/kg by the end of the study period. Pork sold for 10–15 *soles*/kg in June, 1980 but rose to 150 *soles*/kg within a year. The price of a medium-sized chicken was about 1000 *soles*.

The Shipibo value fish and game more than pork and chicken because the latter pair are thought to have "disgusting" eating habits (Behrens, 1986a, b); hence, they are willing to pay more for faunal foods. Fish and game fetched a higher price than pork or chicken due to the cost of fishing line, hooks, shotgun shells, and flashlight batteries for hunting at night. By the end of fieldwork, the cost of a shotgun shell and a battery each had risen to about 400

[8]Asymmetry in exchange may also be related to the social friction that exists between affines. This relationship has a basis in Shipibo mythology as in the *Bi Yoshin* or "mosquito spirit" cycle (Roe, personal communication).

[9]Plantains were sometimes sold to *patrones* to feed them and their agricultural workers.

[10]At the start of fieldwork, one U.S. dollar was equivalent to 270 *soles*. By August 1981, the exchange rate had changed to 410 *soles* per U.S. dollar.

**Table VI.** Production, Consumption, and Food Distribution Data Collected for 17 Sample *Cocina* Groups

| *Cocina* group number | Average meat produced/visit (Kg) | Average food distributions/ visit | Average women/visit[a] | Rice yield (Kg) | Cluster |
|---|---|---|---|---|---|
| 2 | .64 | 4.6 | 2.0 | 1507 | Giver |
| 5 | 3.72 | 15.2 | 3.0 | none | Keeper |
| 7 | 2.43 | 14.3 | 2.0 | 2317 | Giver |
| 8 | 1.38 | 18.4 | 2.0 | 1931 | Giver |
| 9 | 1.52 | 18.8 | 3.0 | 1986 | Giver |
| 10 | .80 | 11.2 | 2.0 | none | Giver |
| 12 | .70 | 10.5 | 2.0 | 915 | Giver |
| 15 | 1.46 | 7.0 | 2.0 | 703 | Giver |
| 19 | .52 | 2.6 | 2.0 | 460 | Giver |
| 34 | 5.70 | 3.5 | 4.0 | 2644 | Outlier |
| 36 | 1.60 | 1.3 | 2.0 | none | Keeper |
| 37 | .60 | 1.6 | 2.0 | 997 | Giver |
| 40 | .86 | 4.8 | 1.0 | none | Giver |
| 45 | 3.46 | 9.4 | 3.0 | 720 | Keeper |
| 46 | 1.98 | 5.8 | 3.4 | 1490 | Keeper |
| 47 | 3.07 | 11.0 | 2.0 | none | Keeper |
| 50 | 2.50 | 7.8 | 3.6 | none | Keeper |

[a]The number of women for these *cocina* groups differs slightly from those listed in Table II. This is because the counts in Table III were taken at a single point in time near the end of fieldwork while the figures above represent a weighted average over the entire sampling period. Two women in *cocina* group 50 left to form group 12. Similarly, the women in *cocina* group 34 were once members of group 46.

*soles.* The price of meat may also have been driven upward by *mestizo patrones*, who purchased meat and then resold it to their workers for a profit.

It seems that some men, who already may have been adept at hunting or fishing, now use their specialty to gain money by selling fish and game. One man, who was the only person that owned a throw net, often sold the fish that he caught. At least some men in the village found the selling of fish and game repugnant and one in particular said that, unlike those who sold food, he worked to raise his children and feed his friends.

## ANALYSIS

In a subsistence economy, what determines the amount of its food production a household gives away in exchange? This question is examined with respect to recent changes in Shipibo food exchange/production ratios and the organization of Shipibo *cocina* groups. First a theory, based on

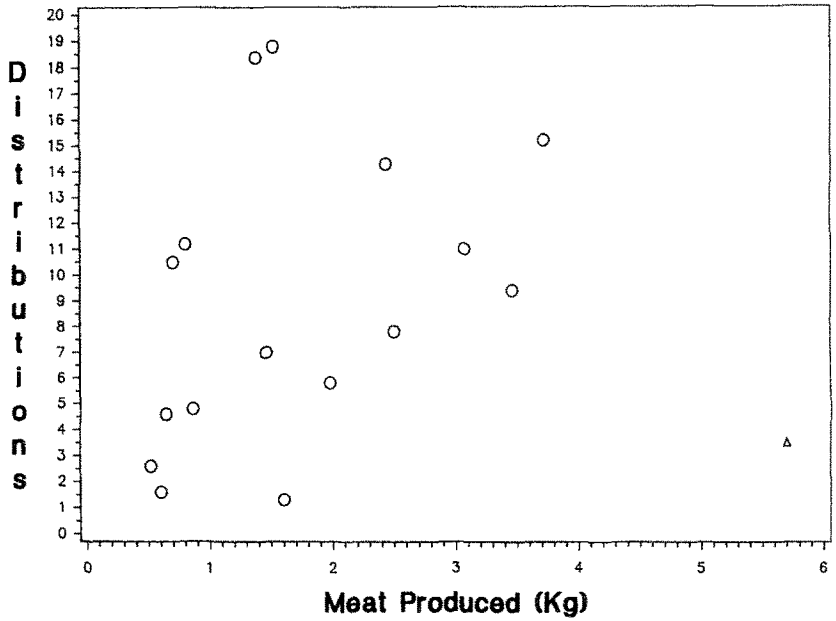


**Fig. 2.** Scatterplot of daily food distributions by daily meat production for 17 sample *cocina* groups. The *cocina* group with the *presidente* of the village (34) is represented by a triangle. This data point was treated as an outlier.

time allocation and the ethnographic literature for the Amazon, is developed to replicate economic specialization and the formation of cash markets for food and labor. Next, the conclusions of this theory are applied to explain changes in Shipibo attitudes and behavior since they began producing rice for sale in regional markets.

## Relationship Between Food Production and Exchange

Table VI lists, along with other variables to be discussed later, production and food distribution data collected for the 17 sample *cocina* groups. Figure 2 shows a scatterplot of two of these variables: the average number of food distributions that sample *cocina* groups made daily to members of other groups against the average amount of meat (kilograms of fish and game) they produced each day. At first glance, there seems to exist

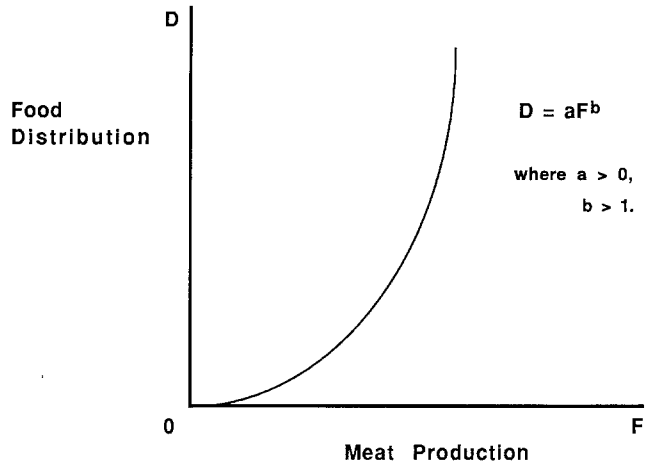


**Fig. 3.** Curve showing the hypothesized relationship between food distribution ($D$) and meat production ($F$).

no clear relationship between food exchange activity and meat production. The scatter of points is widely dispersed and seems to increase as meat production increases.[11] Thus, if one were to fit a statistical model to these data, any number of structural forms would seem equally likely candidates.

To resolve this dilemma, ethnographic information about Shipibo food production and exchange is examined, and then a mathematical model is selected that best characterizes the relationship between the two. Based on ethnographic information concerning food exchange among the Shipibo, it seems that they give food to others when a *cocina* group has more fish and game than it can consume itself. While one would not expect a Shipibo *cocina* group to share fish and game with other *cocina* groups if doing so resulted in each producer receiving less than desired, there exists an upward limit on the amount of fish and game that a single *cocina* group can consume. Beyond that limit, most fish and game will be distributed to members of other *cocina* groups. Again, among the Shipibo this behavior is reinforced by a long-established principle of generosity and the absence of any affordable means for preserving or storing faunal foods.

This intuitive argument, together with knowledge about food exchange among Shipibo *cocina* groups, suggests that food distributions should always increase with meat production (and at an ever increasing

[11]Patterns such as these in a scatterplot often indicate that the assumption of homoscedasticity is violated (Afifi and Clark, 1984).

rate) but should equal zero when a *cocina* group has no meat to consume. A curve that expresses these relationships between meat production and food distribution is depicted in Fig. 3. One mathematical form that possesses the properties represented in Fig. 3 is a power function, $D = aF^b$ where $a > 0$ and $b > 1$. This model simply captures the idea that food distributions ($D$) to other *cocina* groups increase positively with meat production ($F$) but, in the absence of any fish or game, no food is distributed.

Closer examination of the plot in Fig. 2 seems to reveal two clusters of points consistent with the shape of curve hypothesized in Fig. 3. One cluster includes six points on the right of the scatterplot that lie along a single curve, while the second cluster contains the remaining 10 points farther to the left of the plot. A point to the far right of the plot, representing the *cocina* group with the *presidente* of Nuevo Edén, was treated as an outlier. His *cocina* group (34) often hosted visitors to Nuevo Edén; however, food exchanges made to nonresidents were not counted in these data.

To control for grouping effects within the data, the statistical model illustrated in Fig. 3 was linearized (by taking natural logarithms of both sides), then separate curves were fit to these two clusters of points (Chatterjee and Price, 1977). By fitting a log-linear regression model to the group of 10 points (represented as circles), one curve is estimated (Pearson $r = 0.730$; $p = 0.012$). Another curve (with Pearson $r = 0.906$; $p = 0.013$) is estimated by fitting a log-linear model to the other group of 6 points (represented as squares).[12] These two curves are shown in Fig. 4. The results indicate that a log-linear model fits the data well, corroborating earlier intuitions about the mathematical form of the relationship between food distribution and meat production among Shipibo *cocina* groups. Furthermore, it seems regression analysis provides additional motivation for exploring the possibility that there exists two kinds of *cocina* groups with different food exchange/production strategies. For any level of meat production, those *cocina* groups represented by the second curve give less food in distributions than *cocina* groups represented by the first curve. Hence, within the Shipibo economy there exist food "givers" and "keepers." A closer examination of these two types of *cocina* groups follows.

## Validation of Shipibo Exchange Groups

In the absence of other corroborating evidence, it is difficult to defend the assertion that there exist two types of *cocina* groups. Without this evidence, the partition imposed on the data plotted in Fig. 2 appears arbitrary.

[12]A program in the *BMDP Statistical Software* library (BMDP6D) was used for regression analysis (Dixon, 1981).

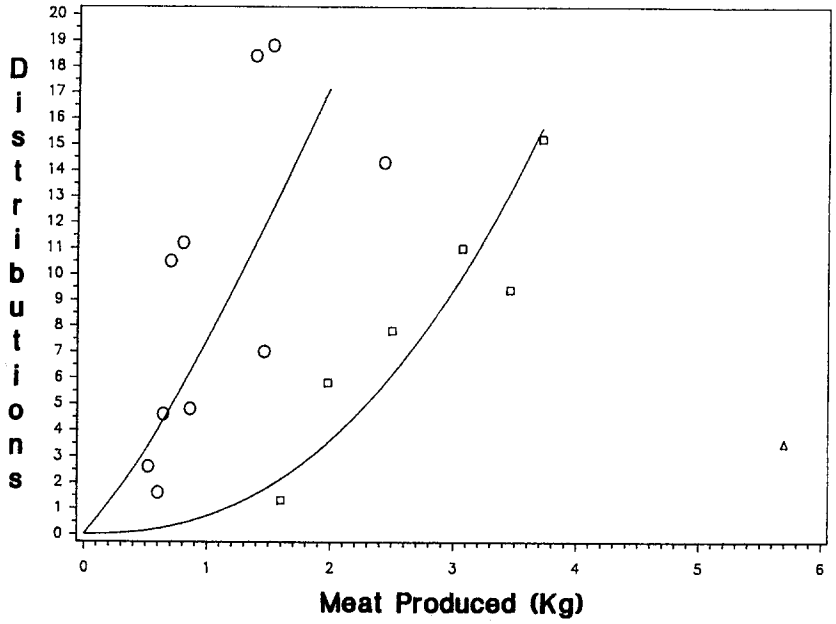


**Fig. 4.** Regressions of food distributions ($D$) on meat production ($F$) for "food giving" and "food keeping" *cocina* groups in Nuevo Edén. The regression model for "food givers" (shovw as ten circles) is estimated as $D = 7.493F^{1.209}$; $r = 0.730$; $p = 0.012$. For "food keepers" (shown as squares) a different model was estimated so that, with group size = 6, $D = 0.694F^{2.371}$; $r = 0.906$; $p = 0.013$.

However, ethnographic information about Shipibo production and exchange suggests that two variables might be important for determining the exchange behavior of a *cocina* group, the amount of rice produced by the group and the number of adult women contained in the group. Correlation analysis of Shipibo time allocation data has already confirmed that those who produce rice tend to spend less time in wild food procurement (Behrens, 1986a, 1989b). Therefore, rice producers have less meat and, since meat is the catalyst for exchange among the Shipibo, rice producing *cocina* groups should distribute less food. Moreover, a *cocina* group's level of participation in the traditional exchange network is related to its number of women, since food distributions involving matrikin are by far the dominant

form. Rice yields for each *cocina* group in the sample were recorded at the time of sale (Behrens, 1989a). These figures, along with the number of women in each *cocina* group, are also listed in Table VI.

To test these ideas, stepwise discriminant analysis was applied to the Shipibo data (Afifi and Clark, 1984; Tabachnick and Fidell, 1983). First the number of women then rice yield entered the discriminant function which was statistically significant ($F = 10.441$; $df = 2, 13$; $p < 0.005$) and correctly classified 94% (all but one) of the Shipibo *cocina* groups into their respective exchange/production strategies.[13] The signs of coefficients in the discriminant function indicate that "food giving" *cocina* groups tend to produce more rice, but also contain fewer women, than "food keeping" *cocina* groups. These findings seem related to the recent formation of cash markets for food and agricultural labor within the Shipibo economy.

## SPECIALIZATION AND MARKET FORMATION

It was just observed that Shipibo *cocina* groups can be categorized by their food exchange/production ratios, and that their level of participation in the traditional exchange system is related to the amount of rice they produce and their number of women. This section offers a formal theory to account for these relationships in the Shipibo data.

### Theory

Recent investigations into Amazonian economies have implicated the importance of group size and food exchange for indigenous systems of production and consumption (Hames and Vickers, 1983; Johnson, 1978; Kaplan and Hill, 1985). One important by-product of this work is that anthropologists have found the concept of time allocation to be indispensable for providing quantitative cross-cultural descriptions of economic behavior. Still others, outside of anthropology, have built formal theories of both Western and non-Western households using time as an essential conceptual building block (Barnum and Squire, 1979; Becker, 1965; Becker and Michael, 1973; Grossbard-Shechtman, 1984; Hymer and Resnick, 1969;

[13]Discriminant analysis was performed using program BMDP7M in the *BMDP Statistical Software* library (Dixon, 1981). One "food giving" *cocina* group (10) was incorrectly classified as a "food keeping" *cocina* group. The male head of this *cocina* group was the oldest in the sample and his son-in-law left Nuevo Edén to seek medical attention at the time others were preparing their rice gardens. Consequently, unlike most other "food giving" *cocina* groups, this one produced no rice and was misclassified. The standardized coefficients for the discriminant function are: Exchange Group = 3.436 + 0.913 (rice yield)–1.909 (women), where "givers" have a mean on the canonical variable of 0.918 while that for "keepers" is −1.531. The canonical correlation for this analysis is 0.785.

Stryker, 1976). The approach taken here is to apply the formal methods, described in previous research, to the analysis of subsistence economies that are just beginning to produce cash crops for regional markets, typical of the Amazon.

The first component of the proposed theory is a function that describes the goals of group decision-makers. A general concept that has been proposed for comparing peoples' quality of life cross-culturally is "well-being" (Baksh, 1987; Baksh and Johnson, 1990; Colby, 1987). For this theory, it is assumed that native decision-makers attempt to maximize their group's well-being by consuming amounts of both faunal foods and purchased Western goods. This seems a reasonable assumption because much research among native Amazonians has shown that these two classes of goods are most highly desired, and faunal foods often motivate exchanges of others kinds of food (cf. Hames and Vickers, 1983; Murphy and Steward, 1956). Mathematically, this function is expressed as follows:

$$W = W(C, M) \tag{1}$$

where $W$ = group well-being, $C$ = amount of faunal food(s) consumed, and $M$ = amount of Western good(s) consumed.

Well-being is maximized subject to several constraints. The first is a budget constraint that requires a group's monetary expenditures to equal its total income, given below:

$$p(F - \mathrm{C}) + sR = qM \tag{2}$$

where $p$ = price of faunal food(s), $s$ = price of cash crop(s), $q$ = price of Western good(s), $F$ = quantity of faunal food(s) procured, and $R$ = quantity of cash crop(s) produced. Unlike the price of faunal foods, prices of cash crops and Western goods are assumed to be determined in regional marketplaces outside of the village. It is further assumed that cash crops are produced only for sale, not for local consumption (Behrens, 1989a).

In addition, there is a time constraint on group production decisions, and it expresses the fact that cash crop production competes with faunal food procurement for decision-makers' time. This theory considers only the time that decision makers reserve for faunal food procurement and cash crop production.[14] The time constraint is expressed as:

[14]Some activities have much higher opportunity costs than others. For example, correlation studies of the Shipibo time allocation data indicate that, while cash cropping and wild food procurement are negatively correlated, there is no correlation between subsistence agriculture and cash cropping. Moreover, subsistence agriculture is positively correlated with wild food procurement (Behrens, 1986a). Hence, this theory focuses on decisions to allocate time to faunal food procurement and cash cropping, since the assumption about their high opportunity costs is well-founded (also see Werner et al., 1979).

$$H + J = T \tag{3}$$

where $H$ = time allocated to faunal food procurement, $J$ = time allocated to cash crop production, and $T$ = total time reserved for the production of either faunal foods or cash crop(s).

This theory also has two production functions, one for faunal foods and the other for cash crops. The quantity of faunal food(s) procured is expressed solely as a function of the time allocated to this activity; similarly, cash crop production is specified only as a function of time allocated to it:

$$F = F(H) \tag{4}$$
$$R = R(J) \tag{5}$$

The group is assumed to choose $C$, $M$, and $H$ so as to maximize $W$, represented by the Lagrangean function (Chiang, 1974):

$$Z = W(C, M) - \lambda[pF(H) + sR(T - H) - pC - qM]$$

where the time constant (3) has been used to replace $R(J)$ with the difference $R(T–H)$. The first-order conditions for a maximum are:

$$Z_C = W_C + \lambda p = 0 \tag{6}$$
$$Z_M = W_M + \lambda q = 0 \tag{7}$$
$$Z_H = \lambda(sR' - pF') = 0 \tag{8}$$
$$Z_\lambda = pF(H) + sR(T - H) = pC + qM \tag{9}$$

By solving (7) for $\lambda$ we can substitute the result in (6) to obtain:

$$W_C/p = W_M/q \tag{10}$$

This merely states that well-being is maximized when the ratio formed by the rate at which well-being changes with consumption and price is the same for both faunal food(s) and Western market good(s).

Condition (8) defines the relationship between time and the production of faunal foods and cash crops:

$$R'/p = F'/s \tag{11}$$

This equation reveals the opportunity costs of the two production activities $H$ and $J$, i.e., the opportunity cost of allocating time to one activity is proportional to the price paid for the good produced by the other.

Condition (9) reiterates the budget constraint. If $k$ is defined as total group income and time allocations are assumed to be fixed at equilibrium, then it is possible to solve for $C$ in terms of $M$:

$$qM + pC = k = pF(H) + sR(J)$$

and so

$$C = 1/p\ (k - qM) \tag{12}$$

The relationships captured by the formal theory can be visualized better in a graph. Figure 5 illustrates the ideas represented mathematically in expressions (1–12). The axes of the graph indicate the quantities of Western goods ($M$) and faunal foods ($C$) consumed. A curve $CM$ represents the production capacity of a group, given its production functions (4 and 5 above) and time constraint (3). This curve is concave to the origin, reflecting the fact that as a group begins to specialize in one production activity, it becomes increasingly difficult to allocate time to another. For example, if a group commits to the production of cash crops which is labor intensive, little time is available for travel to distant wild food procurement sites. Curve $I_o$ depicts a group's indifference curve to faunal foods and Western goods. This curve is a graphical representation of the well-being function (1) such that any combination of either good on this curve produces the same well-being.[15] Notice that when a group does not participate in market activities (by selling its faunal foods to purchase Western goods), then its consumption of $C$ and $M$ is given by O, the point at which its indifference curve $I_o$ is tangent to its production capacity curve $CM$. Under these circumstances, the theory indicates that $C_o$ and $M_o$ are the quantities of faunal foods and Western goods that a group will consume.

If a group chooses to participate in a market for faunal foods by selling them to those whose primary source of cash comes from producing cash crops, then it can actually increase its well-being by specializing. Line B represents the budget constraint, and its slope shows the market trade-off between $C$ and $M$, given their respective prices. From Eq. (12), it was determined that at equilibrium this line is downward sloping. Trading in the local market allows a group to move along B until it attains the highest feasible indifference curve at point $E$, representing result (10) above. So if a group is willing to trade along $I_e$, then it can produce faunal foods at $A$, the point of tangency between the budget line and the production capacity curve, expressed by result (11). Thus, by specializing in faunal food procurement, a group can still consume at point $E$. Through selling the amount $C_A$—$C_e$ of faunal food to other groups, it can purchase the quantity $M_e$—$M_A$ of Western goods and be as well off (if not better off) than it would be if it did not sell faunal foods. Next, this theory will be applied to explain the tendency for some

[15]Indifference curves have already been applied to economic problems by other anthropologists (e.g., Hill, 1988). However, as this paper demonstrates, indifference curves, Winterhalder, 1990 are *not* a different approach from, or an alternative to, linear programming. Indifference curves are merely graphical representations of linear programs expressed in algebraic form and, like the latter, are studied as part of the mathematical domain of convex sets (Chiang, 1974; Dorfman et al., 1958).

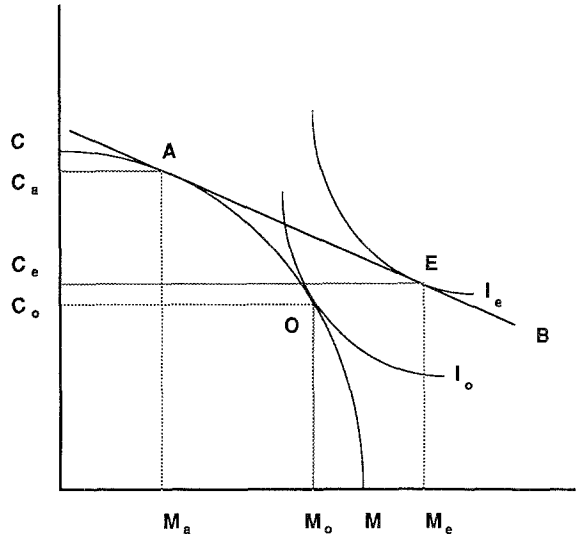


**Fig. 5.** Theory for economic specialization and the formation of food markets in a subsistence economy.

Shipibo *cocina* groups to keep food rather than distribute it freely to others.

## Market for Faunal Food

As stated before, since Shipibo men started producing rice, they have tended to expend less time in faunal food procurement. This has resulted in a decrease in the amount of fish and game available for consumption and exchange within the village. The increased demand in the village for fish and game, along with the increased opportunity costs of fishing and hunting, creates a seller's market for faunal foods among those *cocina* groups who also desire Western goods, but continue to fish and hunt. First, these *cocina* groups can no longer expect rice-producing groups to reciprocate as often with fish and game distributions. Second, the time a *cocina* group allocates to fishing and hunting is time that it could alternatively expend in rice production for cash. Thus, there is specialization among those whose faunal food procurement skills put them in a position to gain money by selling the surplus fish and game that they produce.

In Nuevo Edén, one way that a *cocina* group can continue to hunt and fish, and still acquire cash, is to sell any of its surplus fish and game to rice producing *cocina* groups. As a result, in addition to the food consumed by a *cocina* group choosing to specialize in faunal food procurement, food is held from exchange for sale. Under these conditions, one would expect a gradual change in the relationship between food production and exchange such that, for any amount of faunal food produced by a *cocina* group, less food will be given to other *cocina* groups (hence a shift right from the first curve to the second in Fig. 4). Perhaps contrary to intuition, the theory above opens the possibility that, when it comes to food exchange, it may be those who are slowest to adopt cash cropping, rather than the cash croppers themselves, who are among the first to eschew cultural principles of generosity and reciprocity.

In fact, this is exactly what has happened in Nuevo Edén since the adoption of rice as a cash crop. The Shipibo have been selling fish and game in Nuevo Edén about the same amount of time that they have produced rice. The theory suggests that this is no coincidence. One way fish and game producers in a subsistence economy can acquire cash from rice producing *cocina* groups is to form local markets for the sale of fish and game. Regression analyses in Fig. 4 confirm this conclusion by revealing that those non-rice producing *cocina* groups who produce the most meat also tend to give less food to others for any quantity of meat production.

Anecdotal data also support the conclusion above. Three *cocina* groups in the "food keeping" cluster (5, 45, and 47), who produced the most meat, were headed by three brothers. While each lived in a different residence unit, the three men were recognized throughout Nuevo Edén as skilled fishers and hunters. Nonetheless, several people (in "meat giving" *cocina* groups) complained that these men often sold meat rather than giving it to those in need.[16] One of these men had grown quite defensive about his behavior. On an occasion when I first observed him selling meat, he was quick to point out that, while he was frequently criticized by others in the village, he only sold meat to recover the costs of shotgun shells and other hunting supplies.

Cash can be used to purchase Western goods and, unlike meat and many cultigens, is not perishable but can be stored (even hoarded). Hence, with the formation of a cash market for food, one might expect a gradual deterioration in the traditional support system, based on kinship and a prin-

[16]One Shipibo informant claimed there is a saying in Nuevo Edén that, "Nobody will be miserable or left without." While there is much variability among *cocina* groups in the amount of food they produce, this seems to express the ideal that no one should be denied access to food, certainly not for lack of money to purchase it!

ciple of reciprocity. This already has begun in Nuevo Edén where men are now purchasing more food, but refusing cash loans to their fathers-in-law. Reprehensible behavior such as this only increases tension between a man and his father-in-law and undermines the traditional authority of the latter, a major force promoting social cohesion.

### Market for Agricultural Labor

As noted above, the two exchange groups also differ in their composition, with rice producing *cocina* groups having fewer women. This finding is also anticipated by the theory and seems related to an increasing emphasis on monetary transactions, and less on those which are kin-based.

It can be argued that one effect of a transition from an exchange to a cash economy is the eventual erosion of traditional social ties and the disintegration of large, extended family *cocina* groups into smaller, nuclear family *cocina* groups (cf. Netting, 1968). The formation of local markets for food make it possible to purchase food from anybody who is willing to sell it. Cash transactions decrease one's participation in the traditional kin-based exchange network and lessen the importance of women for extending and maintaining this network.

Cash can also be used to pay wages, and so less reliance need be put on kinship, particularly one's wife's kin, as a means for recruiting labor. Further, competition by *mestizo patrones* has driven up the price of wage labor, making participation in the traditional kin-based system even less attractive. In fact, young married men increasingly are establishing their own *cocina* groups, albeit in the vicinity of their fathers-in-law, and some now talk about residing near their own families after marriage.

One irony in the current structure of the Shipibo economy is that, while rice production is a means whereby Shipibo producers are able to acquire cash, at least some of this money must now be spent on the purchase of fish and game. The situation is further exacerbated by *mestizo patrones* who also compete for workers, and for the purchase of fish and game, but who can afford to pay a higher price for them. *Patrones* can recoup their expenditures by reselling faunal foods to their workers who must use meager wages (paid by the *patrones*) to buy food.

## CONCLUSION

This study has assumed that food exchange has its own costs in terms of time allocations to fishing and hunting, so as to fully participate in the traditional exchange network, along with the opportunity costs of these activities. Consideration of time as a cost in decision-making provided the

motivation for determining the relationship between faunal food production and exchange among Shipibo *cocina* groups. Analysis of data collected from the Shipibo revealed the existence of *cocina* groups practicing two exchange strategies, food "givers" and "keepers." It was argued that, if Shipibo decision-makers were to satisfy their desire for both faunal foods and Western goods given the high opportunity costs of wild food procurement and cash cropping, then some skilled hunters and fishers should specialize and cash markets for food and labor should form. Recent ethnographic accounts of Shipibo behavior seem to support this conclusion. Hence, this paper demonstrated that time allocation is useful, not only as a means of quantifying, describing, and comparing human behavior across different societies, but also as an important concept for building theories to explain economic and cultural changes within indigenous societies.

## ACKNOWLEDGMENTS

Field research in Peru was funded by a National Science Foundation grant for improving doctoral dissertation research (BNS79-10367). I owe a debt of gratitude to Peter Roe, Dwight Read, Allen Johnson, Johannes Wilbert, Martin Cody, Jack Hirshleifer, Gregory Truex, and anonymous reviewers for commenting on earlier drafts of this paper.

## REFERENCES

Abelove, J. (1978). Pre-Verbal Learning of Kinship Behavior Among Shipibo Infants of Eastern Peru. Unpublished Doctoral dissertation, Department of Anthropology, City University of New York.

Afifi, A. A., and Clark, V. (1984). *Computer-Aided Multivariate Analysis.* Belmont, CA: Lifetime Learning Publications.

Baksh, M. (1987). Ecology of Cultural Change: The Machiguenga Case. Paper presented at the 86th Annual Meeting of the American Anthropological Association, November, Chicago.

Baksh, M. and Johnson, A. (1990). Insurance policies among the Machiguenga: An ethnographic analysis of risk management in a non-Western economy. In Cashdan, E. (ed.), *Risk and Uncertainty in Tribal and Peasant Economies.* Westview Press, Boulder, CO., pp. 193-227.

Barnum, H. N., and Squire, L. (1979). *A Model of an Agricultural Household: Theory and Evidence.* World Bank Staff Occasional Papers, Number 27, The Johns Hopkins University Press, Baltimore.

Becker, G. S. (1965). A theory of the allocation of time. *Economic Journal* 75: 493-517.

Becker, G. S., and Michael, R. T. (1973). On the new theory of consumer behavior. *Swedish Journal of Economics* 75: 378-395.

Behrens, C. A. (1986a). The cultural ecology of dietary change accompanying changing activity patterns among the Shipibo. *Human Ecology* 14(4): 367-396.

Behrens, C A. (1986b). Shipibo food categorization and preference: Relationships between indigenous and Western dietary concepts. *American Anthropologist* 88(3): 647-678.

Behrens, C. A. (1989a). The scientific basis for Shipibo soil classification and land use: Changes in soil-plant associations with cash cropping. *American Anthropologist* 91(1): 83-100.

Behrens, C. A. (1989b). *Shipibo Time Allocation. Cross-Cultural Studies in Time Allocation* (Vol. 4). Human Relations Area Files, New Haven.

Chatterjee, S., and Price, B. (1977). *Regression Analysis by Example.* John Wiley & Sons, New York.

Chiang, A. C. (1974). *Fundamental Methods of Mathematical Economics.* McGraw-Hill Book Company, New York.

Chirif, A., and Mora, C. (1976). *Atlas de Comunidades Nativas.* Sistema Nacional de Apoyo a la Movilización Social, Dirección General de Organizaciones Rurales, Lima.

Colby, B. N. (1987). Well-being: A theoretical program. *American Anthropologist* 89(4): 879-895.

Dixon, W. J. (ed.) (1981). *BMDP Statistical Software* (1981 Ed.). University of California Press, Los Angeles.

Dorfman, R., Samuelson, P., and Solow, R. (1958). *Linear Programming and Economic Analysis.* McGraw-Hill, New York.

Flowers, N. M. (1983). Seasonal factors in subsistence, nutrition, and child growth in a central Brazilian Indian community. In Hames, R., and Vickers, W. (eds.), *Adaptive Responses of Native Amazonians.* Academic Press, New York, pp. 357-390.

Grossbard-Shechtman, A. (1984). A theory of allocation of time in markets for labour and marriage. *Economic Journal* 94: 863-882.

Hames, R. (1983). The settlement pattern of a Yanomamo population bloc: A behavioral ecological interpretatation. In Hames, R., and Vickers, W. (eds.), *Adaptive Responses of Native Amazonians.* Academic Press, New York, pp. 393-427.

Hames, R. (1990). Sharing among the Yanomamo: Part 1, The effects of risk. In Cashdan, E. (ed.), *Risk and Uncertainty in Tribal and Peasant Economies.* Westview Press, Boulder, CO., pp. 89-105.

Hames, R., and Vickers, W. T. (eds.) (1983). *Adaptive Responses of Native Amazonians.* Academic Press, New York.

Hill, K. (1988). Macronutrient modifications of optimal foraging theory: An approach using indifference curves applied to some modern foragers. *Human Ecology* 16(2): 157-197.

Hymer, S., and Resnick, S. (1969). A model of an agrarian economy with nonagricultural activities. *American Economic Review* 59(4): 493-506.

Johnson, A. (1978). *Quantification in Cultural Anthropology: An Introduction to Research Design.* Stanford University Press, Stanford.

Kaplan, H., and Hill, K. (1985). Food sharing among Ache foragers: Tests of explanatory hypotheses. *Current Anthropology* 26: 223-239.

Loukotka, C. (1968). In Wilbert, J. (ed.). *Classification of South American Indian Languages.* Latin American Center, University of California, Los Angeles.

Murphy, R. F., and Steward, J. H. (1956). Tappers and trappers: parallel process in acculturation. *Economic Development and Cultural Change* 4: 335-355.

Netting, R. (1968). *Hill Farmers of Nigeria: Cultural Ecology of the Kofyar of the Jos Plateau.* University of Washington Press, Seattle.

Nietschmann, B. (1973). *Between Land and Water: The Subsistence Ecology of the Miskito Indians, Eastern Nicaragua.* Seminar Press, New York.

Roe, P. (1980). Art and residence among the Shipibo Indians: A study in microacculturation. *American Anthropologist* 82: 42-71.

Roe, P. (1981). Aboriginal tourists and artistic exchange between the Pisquibo and the Shipibo: "Trade ware in an ethnographic setting." In Francis, P., Kense, F., and Duke, P. (eds.), *Networks in the Past: Regional Interaction in Archaeology.* The Archaeological Association of the University of Calgary, Calgary, Canada, pp. 61-84.

Roe, P. (1982). *The Cosmic Zygote: Cosmology in the Amazon Basin.* Rutgers University Press, New Brunswick, NJ.

Shell, R. O. A., and Wise, M. R. (1971). *Grupos Idiomáticos del Perú, Segunda Edición.* Universidad Nacional Mayor de San Marcos/Instituto Linguistico de Verano, Lima.

Stryker, J. D. (1976). Population density, agricultural technique, and land utilization in a village economy. *American Economic Review* 66(3): 347-358.

Tabachnick, B. G., and Fidell, L. S. (1983). *Using Multivariate Statistics.* Harper & Row, New York.

Uriarte, L. M. (1976). Poblaciones nativas de la amazonía peruana. *Amazonia Peruana* 1: 9-58.

Werner, D., Flowers, N., Ritter, M., and Gross, D. (1979). Subsistence productivity and hunting effort in native South America. *Human Ecology* 7: 303-315.

Winterhalder, B. P. (1990). Open field, common pot: harvest variability and risk avoidance in agricultural and foraging Societies. In Cashdan, E. (ed.), *Risk and Uncertainty in Tribal and Peasant Economics.* Westview Press, Badder, CO., pp. 67-87.

Yost, J. A., and Kelly, P. M. (1983). Shotguns, blowguns, and spears: The analysis of technological efficiency. In Hames, R. and Vickers, W. (eds.), *Adaptive Responses of Native Amazonians.* Academic Press, New York, pp. 189-224.