

## THE RELATIONS OF THE SOCIAL ORDER, AGRICULTURAL PRACTICE, AND ENVIRONMENT IN TANA 'AI, FLORES

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The thesis of this paper is a simple one and is by no means my original creation: the human population is an integral element in the complex ecosystem of the Tana 'Ai valley of eastern Flores. Furthermore, in ecosystemic terms, the people of Tana 'Ai constitute the ecologically dominant<sup>1</sup> species of the ecosystem not because of their numbers, nor because of their biomass, but because they comprise a society. The decisions the Ata Tana 'Ai take with regard to their horticultural activities both determine and regulate the ecological succession (the gross evolution of species structure and community processes in time) of the valley. While these regulating decisions are taken by individuals and small groups, they are informed by larger patterns of relations between social groups and between those groups and the land on which they subsist. More than any other element in the Tana 'Ai ecosystem, its human population is the regulator of the ecosystem as a system. Because that human population constitutes a society, an understanding of the organization of society with respect to subsistence is required for an analysis of agriculture and ecology in Tana 'Ai.

The major significance of the human population in the Tana 'Ai ecosystem is that its activities are partly governed by what Odum (1983) calls the "controlling program" of anthropocentric ecosystems, that is, the culture of the human inhabitants of the valley. In ecological terms, the succession of the Tana 'Ai ecosystem can be viewed as largely autogenic (self-generated) rather than allogenic (externally generated). Odum describes undisturbed succession as directional and, therefore, predictable. However, even though the autogenic succession of ecosystems which do not include *Homo sapiens* may be directional and predictable, anthropocentric ecosystems are not: if culture is a program, it is not one which governs deterministically and mechanically, but is evolutionary and essentially stochastic, both in itself and in its ecosystemic effects.

A thorough study of the ecosystem and cultural ecology of the Tana 'Ai valley has not yet been undertaken. The major points of this paper are founded on casual observations of the edaphic and biotic features of the Tana 'Ai environment and the ways in which the

Ata Tana 'Ai exploit them. I can offer no demonstrable conclusions and my remarks here must, therefore, be taken as hypotheses which await testing in the future.

#### THE ATA TANA 'AI OF EAST CENTRAL FLORES

##### Social System and Ecosystem

The Tana 'Ai valley is something of a topographic anomaly on the island of Flores. Whereas the major chain of mountains and volcanoes which make up the island runs east-west, the Tana 'Ai valley is bounded by chains of hills and mountains that run north-south. These mountain chains enclose a complex catchment system of approximately 500 square kilometers. The higher watershed, the chain of mountains which includes Ili Wukoh, an inactive volcano, forms the eastern boundary of Tana 'Ai and the administrative border between the Regency of Sikka and the Regency of East Flores. Ili Wukoh itself is 1450 meters in height. To the west, the valley is bounded by a more complex series of ravines and high ridges which ultimately rise to Ili Mapi (Gunung Egon). Ili Mapi attains a height of 1703 meters and is the only active volcano in the Regency of Sikka. The domain of Tana Wai Brama and the closely related domain of Tana Wérang, which have been the subject of ethnographic research since 1978, are located on the western slope of the Ili Wukoh range on the eastern side of the valley.

Tana 'Ai, the name of the valley in Sara Sikka, the Sikkinese language of which Sara Tana 'Ai is a dialect, means "Forest Land". But relatively undisturbed climax forest is found in Tana 'Ai only above the 900 meter contours of the valley's encircling mountains (an altitude above which the Ata Tana 'Ai do not normally clear land for shifting cultivation), along water courses, and in steep ravines whose landforms prevent successful cultivation. In a given year, at least half of the land in the valley is either cultivated or is in the bush fallow phase of the system of shifting cultivation.

Both Tana Wai Brama and Tana Wérang are watered by many perennial springs feeding watercourses running generally east to west down the slopes of Ili Wukoh. Climax vegetation on land undisturbed by the horticultural activities of the Ata Tana 'Ai consists of deciduous forests which include a number of species of eucalypts in addition to ebony, ironwood, and other large timber. Tana 'Ai is well within the macro-ecological zone commonly called the dry (or arid) tropics, a term which characterizes to differing degrees all the islands of the Inner and Outer Arcs of the Lesser Sunda Islands. In eastern Flores, short, intense seasons of rainfall (in Tana 'Ai, roughly from the end of December through March, with lesser, intermittent rains from March to May) separate longer dry seasons during which no rain falls (May or June through November or December in Tana 'Ai).

The inhabitants of the Tana 'Ai valley, the Ata Tana 'Ai ("People of the Forest Land") divide the region into seven traditional ceremonial domains, or *tana*, each with its own independent social system of clans, clan-branches, houses (*lepo*), and households. The number of inhabitants of the seven domains of Tana 'Ai is not known with accuracy, but on the evidence of previous research can be estimated to be between 9,000 and 15,000 people. The domain of Tana Wai Brama is the largest and ritually most important of the

seven ceremonial domains of Tana 'Ai. To date, Tana Wai Brama, the least densely populated of the domains of Tana 'Ai, has been the focus of study.

In the communities of the Tana 'Ai valley, society, the natural environment, and the cosmos are ordered by a culturally constituted logic by which components of the universe are conceived in terms of dualistic and complementary categories. Elemental dyads of complementary terms (such as male//female, hot//cold, center//periphery, base (trunk)//tip (branches), up//down, wild//domestic, and elder//younger) interarticulate in the thought of the Ata Tana 'Ai to form an exhaustive system of classification whereby all elements of the universe and human society are ordered and made manipulable by human beings. Thus, for example, the complementary roles of male and female in procreation are mapped on to the relations of men and women as reproducers of society. Patterns of social reproduction, in turn, are recapitulated in patterns of economic production in which the principal resources are seen by the Ata Tana 'Ai as land and, more specifically, forest.

Land is categorized as forest land or garden land, a classification which reflects material divisions of the landscape. The Ata Tana 'Ai conceive forest to be a male domain which is associated with men whereas gardens constitute a female domain and are associated with women. In terms of trophic activities, men hunt deer, wild pigs, and other wild animals in the forest and clear timber and bush for planting while women cultivate gardens for the production of maize, dry rice, sorghum and a variety of other cultigens of economic value to the community. The apparent classification of different kinds of land as symbolically related to categorical differences between men and women masks an underlying ambiguity: while forests are a male domain and gardens are a female domain, gardens are cut from forest, and most forest in the cultivable areas of Tana 'Ai (excepting scattered stands of primary forest which are the abodes of spirits) grows from fallowed gardens. This ambiguity of classification is resolved in the thought of the Ata Tana 'Ai, by which the growth of a garden and its eventual return to forest is represented as a temporal and cyclical process whose analogue is the birth, maturation, and death of individuals and the maternal descent groups (*lepo*) which hold corporately rights of access to land. The metaphorical equation of gardens and social groups is represented and addressed in the mythic histories and rituals of the ceremonial domains of Tana 'Ai (see Lewis 1988a).

In Tana 'Ai, men maintain the ceremonial system of the domain and are charged with conducting the ritual life of the community. Major components of the ceremonial system are annual rites of the planting and harvesting of gardens. However, the major political relations of clans of the domain are articulated in more seldom performed clan rituals and in the rare performances of *gren mahé*, the culminating rituals of the ceremonial system. Within the organization of clans, men are the media of interclan relations. Clans themselves are composed of houses which are organized maternally. Every Ata Tana 'Ai is a member of the house of his or her mother. As a matter of ideology, the lands of the domain are divided among the five clans of the domain. However, actual control of land resources is vested in the headwomen of houses. Thus, every house claims a number of

garden plots, many of which lie fallow in a given year and a few of which are opened for cultivation. The horticultural system of the Ata Tana 'Ai is based on the slash and burn cultivation of maize and dry (non-irrigated) rice. Decisions regarding which gardens comprising the reserve land of a house are taken annually and as required by the headwoman of the house. Her sisters, daughters, sisters' daughters, daughters' daughters, and sisters' daughters' daughters (and, through them, all members of the community) are thereby insured access to land resources adequate to their needs.

Because the major ecological relations of the valley of Tana 'Ai are founded on the clearing of forest for gardens, the decisions of house headwomen in regard to which land will be opened for cultivation are a major factor in the regulation of the socio-ecological system of the valley. While the ritual service of these gardens is in the hands of men (the brothers and sisters' sons of house headwomen and the ritual leaders of the clans), actual control of the land and the gardening pattern of the valley as a whole is in the hands of women.

Compared to the coastal and western hill areas of the Regency of Sikka, the Tana 'Ai valley is rich in soil, forest, forest fauna, and water. Until recently, Tana 'Ai has not been an area into which the larger and denser Sikkinese populations to the west have expanded, principally because of their perception of the Ata Tana 'Ai as "pagan", "aggressive" and "hostile" and because of the lack of roads into the region. Those circumstances are now changing as the local government has come to view the Tana 'Ai valley as a desirable region for the development of more intensive agriculture, cash cropping of cultigens such as coffee, coconut and cacao, and for the resettlement of people from over-populated areas of central Sikka. The construction of a motor road which will connect the north and south coasts through the Tana 'Ai valley began in the late 1970s and trucks now regularly serve settlements as far as Edat, half-way up the Tana 'Ai valley.

The sudden availability of transport has brought about two immediate changes in those communities near the new road. First, people whose gardens were before distributed more or less evenly within their territory have begun to congregate and open gardens along the road. There is now a continuous swath of clear-cut land up to 600 meters wide along the road. This dense clustering of swidden fields has already resulted in greatly increased erosion of land either side of the road. Major springs along the road, which as recently as 1980 flowed throughout the year, are now dry during the dry season. Second, vehicular access to the valley has resulted in uncontrolled felling of forest along the road and in the river beds to which the road lends access. The felling of timber is the work of timber merchants and small-scale entrepreneurs from Maumere, the Regency capital. The timber cutters do not distinguish commercially valuable trees from less useful ones and chain saws enable them to clear cut patches of forest, although not all the trees felled are removed to saw mills. The felling of timber has proceeded at an accelerating rate since 1980 and portends degradation of both the edaphic and biotic resources of those parts of the valley accessible to the timber cutters.

## HOUSES, WOMEN, AND THE SOCIAL REGULATION OF A LOCAL MONTANE ENVIRONMENT IN THE DRY TROPICS OF EASTERN INDONESIA

Three significant facts about the ecosystem of Tana 'Ai have emerged from research in the valley since 1978. First, compared to other areas of eastern Indonesia where populations practise shifting cultivation, the Tana 'Ai environment has accommodated what some have argued is an inefficient and destructive agricultural technique. While the Ata Tana 'Ai have radically reshaped large areas of the valley's landscape, the agricultural ecosystem of Tana 'Ai appears to be relatively stable and can be described provisionally as an ecosystem in equilibrium (cf. Fox 1977 for discussions of unstable systems on Roti, Savu, and Timor). Second, small groups of senior women allocate land for the community's horticultural activities by exercising culturally constituted authority to determine which plots of secondary forest will be cleared for horticulture in a given year. Third, men, who serve as articulators of the alliance relations between exogamous houses, provide the organized labor necessary for the heaviest work of horticulture, the clearing of forest and construction of fences, houses, and granaries.

The results of ethnographic research in Tana 'Ai suggest that small groups of consanguineally related women, who form the core of a Tana 'Ai *lepo* ("house/s"), control both access to the principal environmental resources of land, forest, and water from which the community draws subsistence and the labour of their brothers. Relations of mutual assistance between sisters and brothers reflect an ideology and cosmology in which things classified in terms of complementary categories are thought to be potent when brought together in social action. In their capacity as determiners of land use and governors of labour, these groups of women serve as regulators of the ecosystem of the Tana 'Ai valley, where an "ecosystem" is taken to consist of "mutually interacting and adapting populations of organisms" (Ellen 1982:254) in which, in ecosystems which include them, human populations are integral. Research to date supports the thesis that the choices and decisions made by a few heads of houses (*lepo*) are of central significance for the regulation and management of the Tana 'Ai agricultural ecosystem. Beyond this general claim, considerable additional research will be required to explore the ways in which the culturally constituted and socially organized action of individuals, with respect to the appropriation of material resources in the environment, is governed by ideology and, in turn, regulates the relations of all elements of the ecosystem.

A number of particular elements of the Tana 'Ai socio-ecological system require investigation. First, the role of discrete social groups ("houses") as regulatory elements in the agricultural ecosystem needs to be studied. Second, the relation of the agricultural ecosystem to the exploitation, by hunting and gathering, of resources in the larger environment requires determination. Third, detailed research on the annual horticultural cycle in Tana 'Ai and a survey of the edaphic and biotic resources of the Tana 'Ai valley needs to be carried out.

Additional work is also needed on the patterns of organization of domestic groups and the organization of authority by which decisions regarding the exploitation of available environmental resources are made. The relations between the cultural constitution of

gender as it is manifested in the organization of labour and decision making and the shaping of the environment of Tana 'Ai need to be examined. Contemporary studies of gender relations in socio-cultural anthropology have been principally concerned with charting the division and allocation of power and authority in the political, economic, ritual, and domestic realms of social life. An ecosystemic study of Tana 'Ai will test the conjecture that the cultural classifications of gender, the social organization of gender relations, and the order of clan relations in Tana 'Ai are all major regulatory factors in the constitution of the larger socio-ecology of the Tana 'Ai valley.

The particular form of Tana 'Ai social organization has been described and analysed (cf. Lewis 1988a). From what is known of Tana 'Ai social organization and subsistence activities, it is possible to hypothesize that, in Tana 'Ai, the "house" is not only the fundamental group of the social system but is also the major regulatory element in the larger socio-ecological system of the valley. If the relations of Tana 'Ai houses (as social groups) to the environment can be established empirically, the differences between the form of the Tana 'Ai social order and the societies of Sikka (to the west) and Larantuka (to the east) can be traced, at least in part, to a unique pattern of adaptation on the part of the people of Tana 'Ai to an environment which differs in salient and determinable features from neighboring regions of the island. A demonstration of the mutually formative relations of environment and society in Tana 'Ai would open the way to rigorous comparative studies of the relations of societies and environments in Flores and generally in eastern Indonesia.

#### HYPOTHESES REGARDING THE SOCIAL REGULATION OF THE TANA 'AI ENVIRONMENT

To date, fieldwork in Tana 'Ai<sup>2</sup> has been directed toward charting the social organization, ceremonial system and mythology of the human population of the valley (see Lewis 1988a; 1988b; 1989; Lewis and Asch, in production). This work has established that the Ata Tana 'Ai are a "house-based" society (Errington 1987; Fox 1980; Lévi- Strauss 1982, 1987; Lewis 1988a) in which small groups of consanguineally related women (who form the core of a house), rather than clans, domestic households or social units of other levels of organization, take decisions regarding the organization of human resources (such as labour and capital) devoted to subsistence and the exploitation of environmental resources.

The house in eastern Indonesia has been established as a "descent group of varying segmentary order" (Fox 1980:11) which is located within the larger organization of society (or *tana*, "domain", in Tana 'Ai) as society is located within the larger cosmos. In eastern Indonesian societies, the "House'...is a fundamental cultural category used...to designate a particular kind of social unit" (ibid.).

The results of research in Tana 'Ai during the past ten years suggest the hypothesis that, in Tana 'Ai (and perhaps elsewhere in eastern Indonesia) the "house" is not only a unit of considerable importance in the order of social relations, but is also the social unit active in exploiting environmental resources and opportunities. If this is so, the house may

best be understood as the principal regulating unit of the larger ecosystem which includes the organic and inorganic environment and the human population of the Tana 'Ai valley.

The social and cultural constitution of the "house" must therefore be examined in order to decode what Odum (1983:509) has called the "controlling program of ecosystems" which operates at the "apex of ecosystems within which they are a part" (Odum 1983: 508; see also Odum 1971). This "program", to use Odum's term, consists of the "culture" of the members of the ecologically elemental and regulatory human group. In particular, the "cultural program" consists in shared perceptions of what in the environment is exploitable and what is not, what parts of the territory of a domain can be used and what parts are reserved for the ancestors and spirits who cohabit the environment with living humans, corpora of culturally constituted and socially distributed knowledge of species and natural processes in the local environment, and knowledge of and the use of technology. The "program" also consists of knowledge about the order and organization of society and the relations of living human beings of the community to the ancestors and the cosmos. These features of Tana 'Ai ideology influence the patterning of individual behavior and social action and manifest themselves materially and concretely in the landscape the Ata Tana 'Ai have, through generations, created to facilitate subsistence activities. The cumulative results of human activities largely in accord with and sanctioned by ideology have been, in Tana 'Ai, the creation of a well-balanced ecosystem in which parts of each of the seven domains (*tana*) of Tana 'Ai are designated as usable by humans. Other portions of the environment, which are designated as belonging to spirits, make up scattered patches of primary forest in which the climax biota of the valley survives, disturbed only by occasional incursions of hunters and gatherers.

Action which has material effect in the environment is patterned, and thus alters established patterns in the environment to produce new patterns, in so far as it reflects patterns of culture and social organization.<sup>3</sup> For example, in the thought of the Ata Tana 'Ai, established patterns of social relations and relations between human beings, spirits, the deity, and the land (the social system) and *hadat* (culture) justify the diffuse settlement pattern which characterizes the human population of the valley. These social and cultural arrangements also have the effect of dispersing human action in the environment. Thus, resources are taken from the environment more or less evenly over the terrain of the valley rather than being concentrated in one or a few particular localities.

One effect of this organization of society (which itself is founded in the systems of kinship classification and ideas about the nature of social groups and their relations and must serve the material requirements of the community) is, at once, to prevent any one part of the environment from suffering uncontrolled degradation and to ensure that a maximum area within the territory accessible to human beings is shaped to serve human needs. From a strictly ecological perspective, in other words, the social and cultural program of the human population of the valley yields a maximally "humanized" environment in terms of the area affected by human action while preventing the over-

exploitation and consequent collapse of the system of environmental relations upon which humans in any one locality depend for subsistence.

At present, these are hypotheses in the strict sense of the term: the extent to which Tana 'Ai culture and principles of social organization incorporate a programmatic sensitivity to environmental relations remains to be established through research. On the basis of research already carried out, it appears likely that rules governing the exploitation of the environment by humans are encoded in culture, language, and social organization at a "deep" rather than a "surface" level. That is, in communicating with one another, Ata Tana 'Ai rarely, if ever, take decisions or order action with overt reference to "the environment". However, the decisions they take regarding the exploitation of environmental resources clearly have the effect of directly controlling exploitation and, indirectly, regulating the ecosystem as a whole. How this effect is achieved requires close examination of culture and society within the framework of systems ecology and ecosystem analysis.

The first requirement for an analysis of the Tana 'Ai ecosystem is a close examination of the annual horticultural cycle, a cycle which begins in June and July with the clearing of secondary forest for gardens and ends with the harvest of maize and rice crops in April-June. Special attention must be devoted to decisions taken by members of particular houses during the "ritual season" (the dry season) from June through September as it is during this period of the year that decisions about the next year's horticultural activities are reached by senior members of the houses and to the social relations of houses in the domain during the period when decisions relating to the next horticultural season are taken. Of particular importance in regard to decision making is the interplay between women (who exercise ultimate authority over the utilization of land belonging to a house) and their brothers and husbands (who organize the co-operative labour required for horticulture). These decisions have direct effects on the movements of population in the following year and, consequently, on the evolution of the settlement pattern of the society as a whole. A common pattern is that whereby people from two or more houses clear contiguous fields around which is constructed a single fence. Decisions about who will "share a fence" with whom, and how large the area within a fence will be, materially affect the intensity of land and resource use in a particular locality and the patterns of social life for those within the fence during the subsequent two to four years in which its gardens are productive. The role of these decisions in the shaping of local ecosystem relations deserves close scrutiny.

During the season between a harvest and the planting of new crops, the community conducts most of the rituals of its ceremonial calendar, events which are organized and carried out by men. Aside from other functions of ritual in the social life of the community, these rituals, which are attended by large numbers of people, provide men with opportunities to make arrangements for the next year's work. In a pioneering study, Roy Rappaport (1979, 1984) has demonstrated convincingly the roles of ritual and religion in the regulation of major variable components of the Tsembaga Maring ecosystem. Rappaport found that cyclical variations in population density, settlement



patterns, garden patterns, the size of pig herds, intracommunity conflict, and intercommunity warfare (between the Tsembaga and neighboring communities) correlate with the ritual cycle of the Tsembaga religious and ceremonial system. Religious beliefs and ritual practices, Rappaport argued, must be treated as significant components of and variables in the larger socio-ecological system of the Maring region.

A subsidiary hypothesis, the validity of which also must await establishment through further research, is that ritual, the province of men in Tana 'Ai, has regulatory effects in the Tana 'Ai ecosystem analogous to those Rappaport has identified in New Guinea.

In the thought of the Ata Tana 'Ai, women are associated with domesticated garden land while men are associated with the "source" of that land - the wild forests of the domain. These ideas are worked out in an exhaustive culturally constituted system of classifications whereby men are associated with forest, which is wild, "hot", and associated with those elements of the deity represented by the firmament (Sun and Moon), which is "up". Women are associated with houses and gardens which are human spaces, "cool", and associated with those manifestations of the deity represented by the Earth and Land, which are "down". At the level of explicit ideology, men are viewed as the ritual activators of the fertility of gardens which are, nonetheless, principally female and feminine in their attributes and identifications. Viewed etically, however, certain latent functions can be perceived in the social arrangements of the community which lead to another conclusion. While men are conceived as possessing authority in ordering ritual and the major political relations of the community, this cultural construction of gender masks the role and significance of women in ordering the basic ecological relations of the domain. The ecological power of women is exercised through decisions about the opening of garden land for cultivation. These decisions directly affect

- a) the settlement pattern of the human population,
- b) the garden pattern as measured against the pattern of stands of secondary and primary forest in the domain,
- c) the productivity of gardens, as the ability to read land form characteristics and soil fertility is required for optimal choices to be made and maximum harvests to be ensured.

These factors, and the values they acquire as quantifiable variables in the larger socio-ecological system of the valley, indirectly affect

- d) the fertility of the human population as a gross measure of the birth rate and rate of mortality of the population,
- e) the balance of herds of domestic animals, principally pigs and goats,
- f) the rate of emigration from the valley.

The last factor is an important variable in the socio-ecological system of the valley's domains. Research to date indicates that the agricultural ecosystem of the Ata Tana 'Ai is reasonably stable. However, present research data also indicate that the population's birth rate is high and the rate of mortality is relatively low in comparison to other populations of eastern Flores. Census and genealogical data recorded since 1978 indicate that the population of the valley has not increased greatly since the Second World War. The stability of the human population and the stability of the larger ecosystem may be, in part, the result of the emigration of a portion of each generation.

Tana 'Ai has traditionally exported excess population to the coastal areas of Sikka and to the central hill region of the Regency. Emigrants from Tana 'Ai almost always become Catholics and marry into families of central Sikka, thereby gaining access to the economy of that region. Emigrants retain certain crucial relations with their home land and natal clans and houses, however. One principal means of determining emigration is the decision taken regarding which of the children of a house shall be sent to the coast for education. Young people who leave Tana 'Ai for this purpose are almost always adopted by previous emigrants already settled on the coast. Once their education is complete, they seek employment on the coast and in Maumere rather than returning to their native valley. This population is, in essence, lost to the domains. The pattern of emigration serves a positive ecological end, however, in that it reduces demands on the land in the valley itself while providing the residents of the domains with important economic and social alliances outside the valley. It is the elder women of the houses of the domains who decide who are to leave the valley and, indirectly, the rate of emigration, and who thus control this variable in the larger socio-ecological system of the valley.

These observations notwithstanding, the mechanisms governing emigration from the valley are, at present, obscure and require investigation as migration may be the single most important factor in the maintenance of ecosystem equilibrium in Tana 'Ai. If this is the case, then the ability of the Ata Tana 'Ai to maintain their environment in an optimum state depends not upon the internal order of the social and ecological system, but upon their relations with neighboring peoples and communities who must absorb immigrants from Tana 'Ai. At least to this extent, the Tana 'Ai ecosystem must be viewed as an "open system" and research will need necessarily to account for relations between the Ata Tana 'Ai and other societies of eastern Flores. Additional demographic research is required before the validity of these conjectures can be established. Census and genealogical data acquired during the past decade need to be checked and surveys need to be conducted to determine more precisely the incidence and patterns of emigration from the valley. Present indications are that, as with other matters concerning resource utilization and access, it is the women of Tana 'Ai houses who decide which children of the house will be "exported" from the valley to attend schools or to seek work elsewhere and which children will remain in the community. If this is the case, then the centrality of women in the regulation of ecosystem relations will be demonstrated.

## METHODS IN THE ANTHROPOLOGICAL CONTEXT OF "CULTURAL ECOLOGY": THE ECOSYSTEM APPROACH IN SOCIAL ANTHROPOLOGY

It is now almost thirty years since Geertz (1963:3) proposed that the anthropological understanding of the relations of human activities, organic transactions, and physical processes requires an ecological approach in which the inclusive ecosystem is taken as the unit of analysis. Since then, ecosystem analyses have both made notable contributions to the ethnographic literature<sup>4</sup> and have been criticized as overly functionalist, as capable of identifying only homeostasis in cultural systems while being incapable of dealing with change, and as overly concerned with energy transactions in the system (Moran 1984). One cogent criticism of the ecosystem approach in anthropology focuses on the inability of ecosystem analysis either to take into account or account for the individuals who make up society and who, in taking decisions and making preferential choices, are the locus of selection among stochastically generated alternative possibilities in the evolution of social ecological systems.

Studies of the ecology of human societies can avoid this last danger by focusing on the details of decision making among individual and socially identifiable members of a particular society. Indeed, the dynamics of the Tana 'Ai ecosystem, wherein individual choices are seen as animating the system, must be of primary concern in ethnographic research.<sup>5</sup> In Freeman's view, the exercise of preferential choice, the capacity for which is a product of the unique evolution of *Homo sapiens*, is in the realm of social life and culture an analogue of natural selection in organic evolution. In human life, social change and the evolution of culture are locatable in the stochastic exercise of choice by individuals. For this reason, any analysis of ecosystem relations incorporating accounts of human activity must attend to individual actors within the system and the decisions and choices they make with reference to purposive action.

## NOTES

1 On ecological dominance, see Odum (1983: 408):

...of the total number of species in a trophic component, or in a community as a whole, a relatively small percent are often abundant or dominant (represented by large numbers of individuals, a large biomass, productivity, or other indication of importance)...

2 The field research on which this paper is based was conducted in the years 1977-1979, 1980, 1982, 1983, 1984, and 1986-1987. Since 1977, my research in Tana 'Ai has received the support of many institutions and organizations including the Department of Anthropology, Research School of Pacific Studies, The Australian National University; the Wenner-Gren Foundation for Anthropological Research, Inc.; the United States National Science Foundation; and the Australian Research Grants Council. The sponsorship of Pusat Pembinaan dan Pengembangan Bahasa and Lembaga Ilmu Pengetahuan Indonesia in Jakarta has been crucial to the conduct of the research reported here. I wish to acknowledge, with gratitude, the financial assistance granted

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3 See Ellen (1982:252-273 *et passim*) for discussions of "the close functional relationship between social formations and ecological systems" and the ways in which "human environmental representations", as elements in culturally constituted systems of ideology, mold and regulate ecological relations.

4 See Moran 1984 for critical discussions of the ecosystem concept in anthropology.

5 See Freeman's call (1978 and 1981) for an anthropology of choice and Léwis (1984 and 1989).

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