Natural Hazard Research

"OUR USUAL LANDSLIDE": UBIQUITOUS HAZARD AND SOCIOECONOMIC CAUSES OF NATURAL DISASTER IN INDONESIA

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"Our Usual Landslide": Ubiquitous Hazard and Socioeconomic Causes of Natural Disaster in Indonesia

The central argument of the paper is that social and economic processes may increase the vulnerability of populations to natural disaster and, insofar as they do this, such processes are to be considered as causes of disaster in the same way as the more obvious physical or environmental phenomena. The concept of natural hazard as a normal part of a population's relationship to its environment is discussed. It is suggested that populations are able to adapt to a certain range of hazard, but that external factors (such as resettlement in a different area of impoverishment) may change the population-environment relationship; the population's capacity to deal with hazard is reduced or restricted, thereby increasing its vulnerability to natural disaster.

After a review of previous work on these themes, the analysis of vulnerability to natural disaster proceeds through a description of aspects of land use, settlement, migration and indigenous techniques and practices, which are set in the historical context of colonial and independent governmental policies and the development of the national Indonesian economy in relation to peasant subsistence production. Much of the case-study material is drawn from fieldwork on the islands of Lembata and Flores in Nusa Tenggara Timur in Indonesia.

The paper concludes with a discussion of the theoretical and methodological implications of the analysis of vulnerability presented.

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PREFACE

This paper is one in a series on research in progress in the field of human adjustments to natural hazards. It is intended that these papers be used as working documents by those directly involved in hazard research, as well as inform a larger circle of interested persons. The series was started with funds from the National Science Foundation to the University of Colorado and Clark University, but it is now on a self-supporting basis. Authorship of the papers is not necessarily confined to those working at these institutions.

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Requests for copies of these papers and correspondence relating directly thereto should be addressed to Boulder. In order to defray production costs, there is a charge of $3.00 per publication on a subscription basis, or $4.50 per copy when ordered singly.

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INTRODUCTION

This paper is the result of a preliminary visit to Indonesia made in October, 1979, with a view to setting up a longer-term investigation of vulnerability to natural disaster. The visit was intended to isolate important aspects of such vulnerability which might be given detailed attention in future research. Most of the material here presented and discussed is from Nusa Tenggara Timur, in particular from the island of Lembata and from other parts of the regency of Flores Timur (see Figures 1 and 2).

The visit to Indonesia was decided upon after receiving news of a disaster which took place on the island of Lembata at about 0100 on July 18, 1979. The event was reported as follows in the International Herald Tribune of July 23rd, 1979:

> Tidal waves have buried the 700 inhabitants of four remote villages under tons of sand and mud scooped off the sea floor, rescue officials said yesterday.
>
> The villagers, all of whom were believed dead, had been warned earlier to move to a safer location, said a rescue official. Only a handful of survivors, none of them from the worst hit areas, had been found by today in the region, 1,000 miles east of Jakarta.
>
> The 30-foot waves hit the tiny villages on the volcanic island of Lomblen (Lembata) just after midnight Thursday.
>
> The waves were believed to have been caused by the collapse of the island's 3,000 ft Gunung Werung volcano into the Flores Sea, followed by several undersea eruptions.

On the 24th of July, the International Herald Tribune carried this story:

> The death toll in last week's tidal wave on Lomblen Island (Lembata) was revised today to 539 as the district governor declared 364 missing persons dead.
>
> Gov. Ben Mboi said a search had been made for all the missing, but all apparently were washed out to sea by the

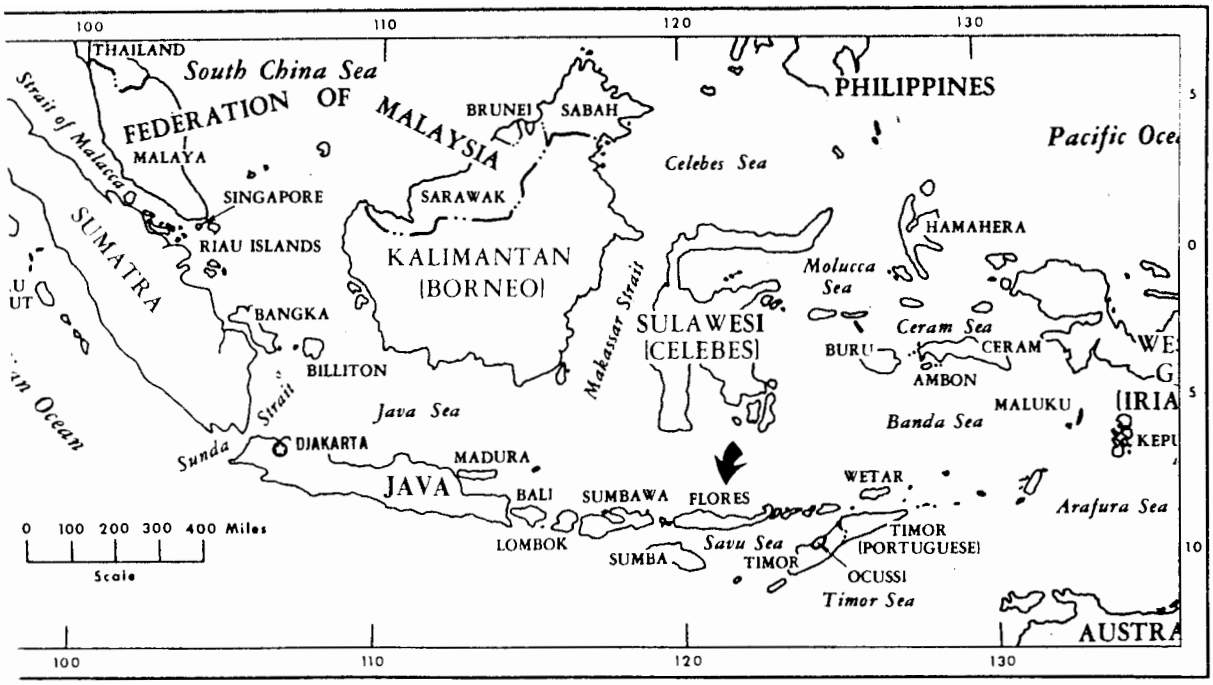

FIGURE 1

INDONESIA

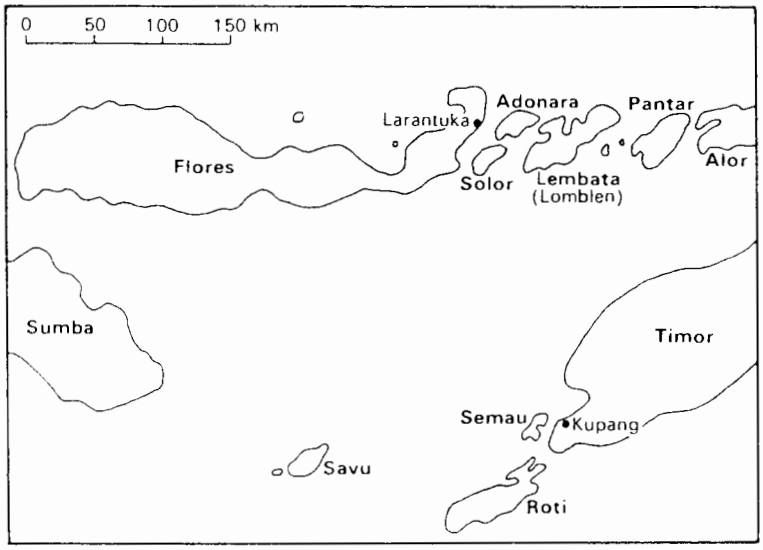

FIGURE 2

LEMBATA IN RELATION TO ITS NEIGHBORING ISLANDS

> wave that penetrated as much as 500 yards inland Thurland last Thursday and destroyed four villages.
>
> Mr. Mboi said 175 bodies were recovered and buried in a mass grave on Saturday. He said there were 171 survivors who were moved to Loang, a village on another coast of the island.

The reasons for choosing Lembata for fieldwork were various. The disaster took place in a small, clearly defined area on the south coast of Lembata (see Figure 3), and this situation seemed to lend itself to fieldwork and analysis of vulnerability at the local level. When considered in the national context of Indonesia, the Lembata disaster was a small one and even the highest casualty figure of 700 does not seem significant in relation to the total population of Indonesia. However, the disaster obviously had a tremendous impact and relief needs could not be met by the island's resources alone. Help was forthcoming from both national and regional governments, though not from international sources. In other words, Lembata could not absorb and cope with the results of the disaster, but Indonesia as a whole could do so.

The project had access to copies of the English language Indonesian newspaper, the Indonesia Times, which proved an interesting source of further information. There was also in print an anthropological monograph on the Kédang area in the northeast of Lembata (Barnes, 1974), offering important details about this otherwise undocumented island. Additionally, Bahasa Indonesia, the official language of Indonesia, is relatively easy to learn at a simple level.

Lastly, the story of the disaster on Lembata varied according to reports from different sources and this variation raised a number of interesting questions. It was stated that the inhabitants of the four villages affected had been warned prior to the disaster to move to a

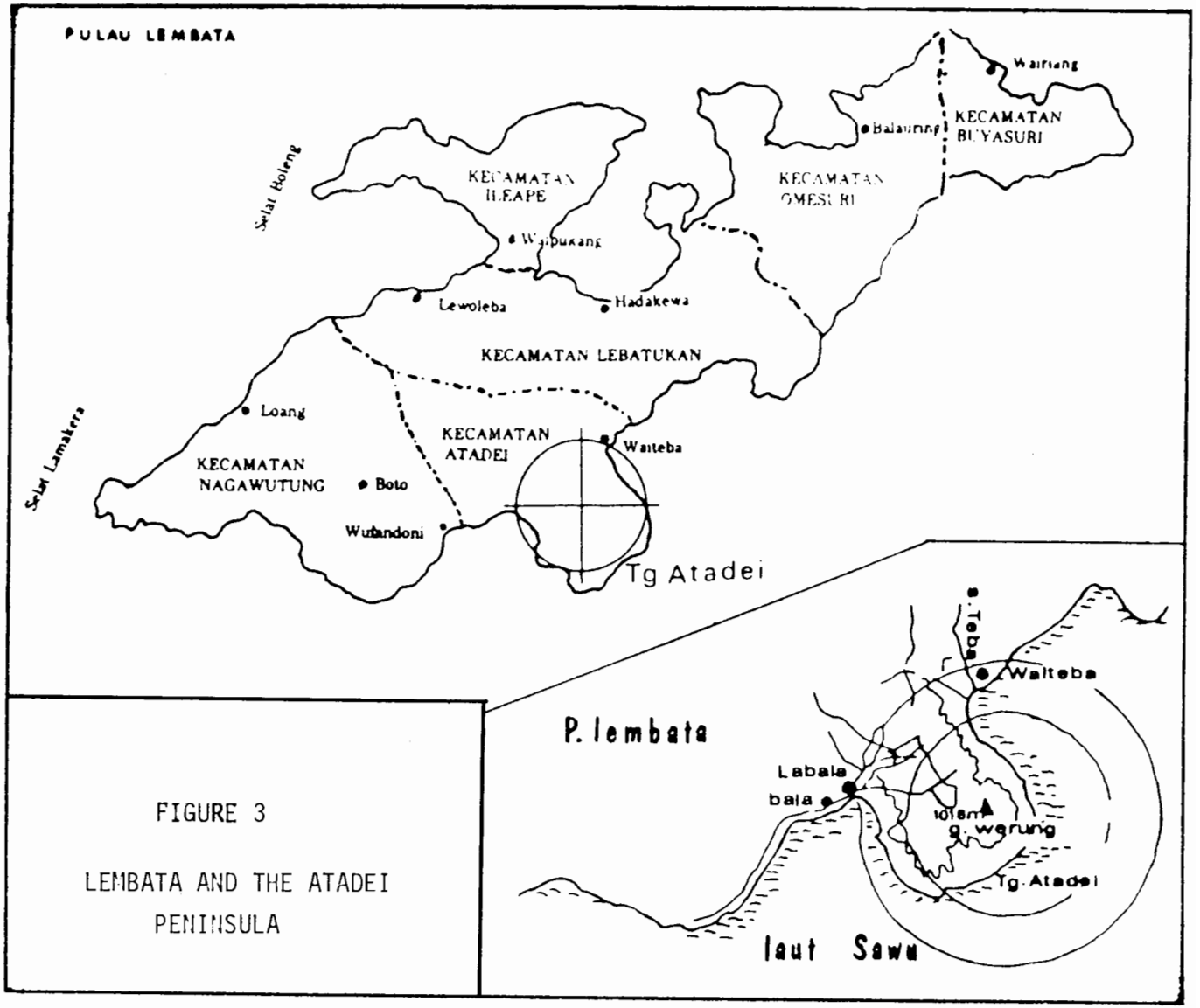

FIGURE 3

LEMBATA AND THE ATADEI PENINSULA

safer location, but that they had paid no attention to this. The Indonesia Times of July 24, 1979, reported that the villagers, although warned in December 1978, had not moved because, "they had to wait for the harvest of their rice and corn." However, according to Barnes' monograph on Kédang, Lembata (p. 132), both maize and rice crops have been harvested on Lembata by the end of May. Hence, were this the only reason for not moving, the people would surely have left by July when the tsunami struck.

It was also reported in the Indonesia Times, July 24, 1979, that prior to the disaster a fund had been allocated with presidential approval for the construction of 400 homes for the villagers' resettlement in Loang on the western coast of the island. In a later issue (August 3, 1979) of the same newspaper it was stated that the people refused to leave Waiteba because some of them had coconut palms and that these people had persuaded the others not to leave.

In light of this, it was felt that a case-study of a people's refusal to move from a hazardous area would afford insight into how vulnerability is created at the local level by non-physical factors. The programme of investigation was designed to elicit the conditions under which the people of Waiteba and other nearby villages had refused to move from the dangerous area. It was assumed that their decision was a rational one and that it was important to understand what affected their decision in order to show this. At the same time, the general vulnerability of southern Lembata to natural disaster was to be considered.

A cursory reading of the literature on Nusa Tenggara Timur also suggested to me that reasons for, and effects of changing patterns of

settlement should be elucidated. It is known, for instance, that the Dutch and the subsequent independent governments have forced or persuaded hill peoples to settle in the coastal areas; what might be the repercussions of this policy for vulnerability to natural disaster? I also thought it important to look particularly at the resettlement site of Loang which was offered to the villagers of Waiteba prior to the disaster. Clues were available from Barnes (1974) and from reading of the Indonesia Times and other published sources to suggest that the kind of "modern" agricultural development planned at Loang might be radically different from traditional methods.

In what follows, an attempt will be made to analyse data from Lembata, Indonesia, with a view to outlining economic and social processes which may increase a population's vulnerability to natural disaster. The discussion will centre on systems of economic relations and government policies, and the nature of the indigenous people's integration into a wider system.

BACKGROUND TO THE PRESENT STUDY

General Theoretical Issues

The Disaster Research Unit at the University of Bradford worked from 1973 to 1977 on vulnerability to natural disaster, and developed a theoretical perspective. The present project on vulnerability to natural disaster based at the University of Bath has as its main aim to test and develop a method for the analysis of vulnerability through local-level fieldwork.

Westgate and O'Keefe propose the following working definition of the disaster event: "The manifestation of an interaction between extreme

physical or natural phenomena and a vulnerable human group. The manifestation results in general disruption and destruction, loss of life and livelihood and injury" (1976, p. 64). The importance of this definition lies in its emphasis on disaster as the interaction between the physical phenomena and a vulnerable human group, and the suggestion that the state of human society can be considered as a "cause" of disaster in the same way as the physical phenomenon can be so considered.

In the same paper the authors state that vulnerability is "the degree to which a community is at risk from the occurrence of extreme physical or natural phenomena where risk refers to the perjorative probability of occurrence, and the degree to which socio-economic and socio-political factors affect the community's capacity to absorb and recover from extreme phenomena" (p. 65).

The authors also note that it is not helpful to distinguish between vulnerability from the hazard environment and vulnerability from socio-economic status because the two elements are inextricably one: "Consequently, it is proposed that vulnerability should be a term which embraces not merely the risk from extreme phenomena but the endemic conditions inherent in a particular society which may exacerbate the risk" (p. 63).

The last concept introduced in the same work is that of "marginalisation" as "the most extreme manifestation of vulnerability occurring on the margins of society and properly applied to the urban and rural poor of the underdeveloped countries with little or no absorptive capacity in the face of extreme phenomena" (p. 65).

Baird *et al.* (1975, p. 29) refer explicitly to the dependency theory of Frank and stress its importance for understanding "marginalisation":

> The overall effect of this dependency relationship is that while development continues in the rich countries, a concomitant, negative process of under-development occurs in the Third World. For continued development in the Western World, it requires the rich countries to control the resources, the raw materials, from the Third World and force it into the dynamic, negative condition, the development of under-development. The result of such a process is that the under-developed population is isolated from the traditional indigenous resource base. As the under-developed population attempts to discover alternative strategies of production on the edges of the imposed system that has controlled the indigenous resource base, it is forced to accept strategies that contain fewer insurance or adoptive mechanisms for survival. The new strategies leave the under-developed population more vulnerable, more disaster prone to the vagaries of the environment.

The establishment of links between vulnerability and the process of underdevelopment is of prime importance both theoretically and with regard to practical action to mitigate and prevent disaster. The authors cited contend that with more underdevelopment, vulnerability to natural disaster will increase. Populations will become more concentrated in hazardous areas. The result of this concentration will be that the people will become more disaster-prone, and that the actual number of disasters will increase.

Finally, the authors point to a relationship between relief aid and underdevelopment and argue that relief merely reinforces the status quo, produces further marginalisation and greater disaster susceptibility: "Relief is actually hindering peasant adjustment to future natural hazards and encouraging an increased vulnerability when it is seen within the context of aid and development" (Baird *et al.*, 1975, p. 34).

The present project recognises the need to develop these ideas and to test them in local level fieldwork and analysis. From this it is hoped to formulate clearly a framework for the field analysis to vulnerability to natural disaster. It is essential, for example, to give more precision to such terms as "socio-economic status" and "socio-economic and socio-political factors" by defining those terms within a theoretical framework. It is not sufficient to list certain "factors" which may affect vulnerability, but rather the relationships between and among them must be clearly established. With reference to this study, it is not sufficient to list such factors as history of settlement, government policies and agricultural practices as affecting vulnerability. It is necessary to go beyond a consideration of discrete causes and to focus on the systems of relations. Two examples, one from Kenya and one from the Honduras, can illustrate this point.

Wisner, O'Keefe and Westgate (1977) outline the changes in farmers' conditions during the colonial and neo-colonial periods in Kenya and show how such changes have affected the viability of traditional strategies of land use and herd management and, in turn, increased the vulnerability of such farmers to drought. They focus in particular on the rise of the capitalist mode of production and the implications of this for the Kenyan rural population. They argue that "direct capital penetration into the more arid parts of many African countries meant direct expropriation of the land resource and an absolute decrease in the land base of the livelihood systems of poor peasants in these areas" (p. 49). After the introduction of coffee to the Mt. Kenya highlands in the 1950's, a "coffee bourgeoisie" developed, which invested in cotton farms on the drier lower slopes of the mountains in the 1960's,

and also obtained control of a further 800 km^2 of even drier land, which was enclosed and named Meru Game Park. The land thus appropriated by highland capital for cotton and the game park had previously been "common land", which had formed about a third of the poor lowland farmers' subsistence base. These latter had combined dry farming with transhumance herding, but found their livelihood base significantly reduced, with the inevitable consequences of over-farming and erosion.

The authors suggest that even where direct capital penetration has not taken place, the general orientation of the national economy towards the needs of the capitalist mode of production means that the poor farmers of dry areas have little access to such inputs as credit, extension and marketing facilities, which tend to be made available by governments to the "high potential" areas where cash crops are produced intensively for export on high quality land. This pattern begun by the colonial governments is continued by independent governments. Finally, government programmes, when they are directed towards the poorer farmers, focus on a small number of (usually technical) discrete superimpositions, such as boreholes or a new seed variety, rather than on the broader problem of regional underdevelopment. The superimposition of a borehole, for instance, can disrupt local livelihood systems and lead to overgrazing of the area and to the creation of desert conditions (cf. also Ball, 1978, p. 287).

Baird *et al.* (1975, pp. 29-31) show how the deaths (8,000) and injuries (130,000 people) in the northern part of the Honduras as a result of Hurricane Fifi in 1974 can be traced directly to the nature of economic development in the area affected. They note that the establishment of banana plantations (of which two owners were U.S.

companies) oriented towards the export market meant that large numbers of peasant farmers were displaced from land in the fertile valleys. These peasants were obliged to seek a livelihood by cultivating the hillsides. The previously thick hillside vegetation cover was removed for this purpose, which increased the likelihood of soil erosion. When the torrential rains of Hurricane Fifi struck, the vulnerable peasant settlements were swept off the hillside and a catastrophe resulted.

In both the above examples, the unequal distribution of landholding and resources for livelihood are shown to have been a major cause of disaster. The authors have outlined the forces which have created the concentration of land in the hands of a few--the encroachment of a capitalist mode of production on a primarily subsistence agriculture. This approach seems to offer a theoretical framework for considering the creation of vulnerability to disaster in other contexts. That traditional modes of land use and herd management can become detrimental to the environment within a restricted land base is particularly relevant for considering the case of shifting agriculture in Indonesia.

Indonesia

In a detailed account of the deterioration of the environment in semi-arid Timor, Ormeling (1956) shows how the actions of the colonial Dutch administration created the problem. The introduction of cattle by the Dutch and the unrestrained early expansion of animal numbers, as well as an increase in population, "led to an increasing demand for land and, as methods remained unaltered (i.e., methods of shifting cultivation), a greater frequency of burnings. The *ladang* rotation period was shortened and, with the more frequent return to the same plot, the soil

was not given time to revegetate and regain fertility" (p. 207). The climate exacerbates this situation since the burning of plots occurs in the dry season when the east monsoon may carry the fire into surrounding growth. In 1951 alone 11,000 hectares of the forest reserves went up in flames. There is also considerable wind erosion and dust storms are frequent. This is followed once the rains begin by rain erosion of soil from cleared hill slopes. During the Japanese occupation of 1942-45, the Timorese withdrew deep into the mountain areas to avoid forced labour and carried out their traditional shifting cultivation in such marginal areas. Ormeling suggests this caused further damage to the environment.

Erosion of soil and a decrease in soil fertility have created the annual hunger period, or lapar biasa, on Timor at the end of the rainy season before the new harvest is gathered in. Such a period may last two or even three months in certain areas and in very dry years becomes a general famine. Ormeling considers the lapar biasa to be a relatively recent phenomenon since it is not mentioned in early writings and government reports of the nineteenth century.

There is also a relationship between the construction of roads and the increase in soil erosion. Roads have been built without attention to drainage and stabilisation of slopes by vegetation, with the result that roads are often lined by steep dirt banks and ditches are left raw and unprotected, all of which give run-off water increased potential for erosion. Agricultural lands bordering the roads are damaged by spreading erosion. In Ormeling's view, it was the population increase which led to a greater need of roads on Timor. However, one may perhaps look elsewhere for the reason for such roads--surely they were essential to

the Dutch colonial government's attempts to pacify and "civilise" the island, and also facilitated the trading activities of coast-based entrepreneurs who penetrated into the highland areas. Prior to the Dutch pacification, the main routes for travel on Timor were narrow paths traversed on foot, following contours of the landscape and subject to certain changes and diversions due to flash floods or the planting of gardens. They were adaptable to conditions of the environment.

While Ormeling clearly lays responsibility for the beginning of degradation of Timor's environment at the door of the Dutch colonial authorities, his work does not address directly all the implications of this. The impact of alien influences on indigenous Timorese livelihood systems are documented, but these influences are treated as separate elements (e.g., animal husbandry, the lantana weed) which, in combination with indigenous factors (shifting cultivation), have increased vulnerability to drought and soil erosion on the island. One of the main solutions suggested by the author to the problem of drought and famine is that of a more capital-intensive, irrigated agriculture in appropriate areas combined with a policy of reforestation and conservation of the environment. The biggest obstacle to the realisation of this, he considers, is tradition and the reluctance of indigenous peoples to adopt new social and agricultural practices. The blame for failure to solve the "Timor problem" is thus laid squarely on the indigenous "intransigence" to change.

Why are the indigenous peoples opposed to change? What factors influence their decisions and how do they assess the alternatives open to them? The evidence shows that their decisions are eminently rational under the conditions. Wisner *et al.* (1977) note that decision-making

may become "pathological" when external factors (such as restrictions on traditional access to land) affect the population's livelihood base. Over-farming or over-grazing of land are clear examples of this.

Meillassoux, on the Sahel, notes the phenomenon of over-farming:

> The promotion of commercial cultivation and the disinterest of the authorities in subsistence agriculture has caused peasants to over-exploit the land in an attempt to maintain both types of production. . .allocating an ever-increasing proportion of the land to [the cash] sector and thus a proportionately decreasing amount remains available for subsistence farming (1974, p. 31).

As a result of this shift from subsistence farming to cash-crop farming, the peasant becomes more dependent on the market for his supply of food and therefore becomes extremely vulnerable to price fluctuations and availability of goods in the market.

Family subsistence production has also been threatened, according to Meillassoux, by government actions such as the "head tax", which is levied immediately after the harvest and which forces the peasant to sell a portion of his produce in order to pay it. This means a subsequent shortage of foodstuffs when the farmer will be obliged to buy back provisions at higher prices and on credit, with all the dependency and debt relations that that may imply.

It may be noted from Meillassoux and from others that the system of family subsistence production should not be analysed as some kind of left-over from a previous era which is out of step with modern agriculture and which is in the process of disappearing. Rather, it can be shown that family subsistence production is intimately related to, and important for, capitalist production in that it supplies the latter with cheap labour. An over-exploitation of labour will last as long as the self-sustaining agricultural community persists as a productive and

reproductive unit of labour power. However, demand from within the capitalist sector necessitates an increase in labour productivity either in terms of cheaper labour or cheaper food products, which "usually results in the exhaustion of the factors of production" (Meillassoux, 1974, p. 29). The more surplus is appropriated from the domestic subsistence economy, the more strained become its resources, and eventual over-farming and depletion of soil resources result in an attempt to make ends meet in the conditions prevailing.

When the resources of the domestic mode of production become so depleted as to threaten its viability as reproducer of the labour force, it will become essential to adopt conservation and restoration measures involving capital outlay which lead to a modification of production within the subsistence sector. Capital investment to combat drought, for instance, presumes a radical change in the social conditions of production towards intensive, mechanised production with high capital inputs in large-scale enterprises employing wage-labourers and often producing for export.

Before discussing a particular example in terms of the theoretical approach outlined, I shall introduce the concept of natural hazard and consider it with reference to Nusa Tenggara Timur. Hazard is a normal part of a population's relationship with its environment.

NATURAL HAZARD

The concept of natural hazard as defined by Hewitt and Burton is a useful one: "A natural hazard of any sort is a function both of the physical event and the state of human society, including specifically the adjustments adopted to cope with the hazard and with the state of

preparedness.... Hazards are largely implicit in the ordinary conditions and it is extremely important to define the latter as well as the extremes" (1971, p. 5). The implication of this is that disaster is but the extreme within a series of normal events and that it must be analysed in that context. As Baird *et al.* write, disaster is "the extreme situation which is implicit in the everyday condition of the population" (1975, p. 2).

It is expected that in any given local context, there will be both cultural explanations of hazard and also cultural practices which represent modes of adaptation, adjustment to, and mitigation of natural hazard. The expression banjir biasa, "the usual landslide", was frequently used by inhabitants of southern Lembata, Larantuka, and also by villagers on the western slopes of Mt. Merapi in Java. The populations in each of these areas are adjusted to a certain range of variation of climate and material conditions. Thus, in Nusa Tenggara Timur the inhabitants experience a yearly cycle of wet and dry seasons, of which banjir biasa and lapar biasa (regular hunger) form a normal part.

In the same way, the inhabitants of kota baru ("new city"), one of the new extensions of settlement of Larantuka, Flores, state that during the wet season they live with the constant threat of landslides and flash flood. When it rains heavily during the night, they say they cannot sleep for fear that the rain will loosen the soil from Ilemandiri. Every year there are mild landslides and floods, but only occasionally are they serious enough to be classified as a disaster, as in February of 1979.

Myths and stories of origin may also portray a people's relationship with a hazardous environment. At the tip of the Atadei peninsula

on S. Lembata, wind and wave action has formed from stone a shape very like a man standing with his shoulders slightly hunched up. This figure gives the peninsula its name; Atadei in the local language means "standing man." The story is that once upon a time the people of Lamalera lived on a small island, called Lepan Batan, to the east of the Atadei peninsula. The island of Lepan Batan was, however, volcanic and the people knew this and decided to flee. One man was sorry to leave and, on reaching the Atadei peninsula, he turned around for a last look at Lepan Batan and was turned to stone. This island no longer exists and there is a suggestion that it was rather like Ili Hobal, the volcano that is alternately above and below sea-level off the Atadei peninsula.

A similar story is recorded by Keers for Larantuka and the Solor archipelago. He wrote that some inhabitants claimed to have come from Krokan Pukan, a submerged country northeast of Adonara. "Many stories are told there (in this area) about a country that was swallowed up by the sea; moreover the geological condition is of such a kind that the truth of these stories need not be doubted" (1948, p. 81). The "truth" or otherwise of such stories should, however, be regarded as of secondary importance. What interests us here is how they reveal a people's way of relating to the environment.

In Kédang, N.E. Lembata, the hari bura is a huge wave, which draws back to leave a large dry space and then rushes in to fill it; it is identified, according to Barnes, with the ara bora, a sea monster feared by boats at sea. The hari bura is prevented from inundating the land by the ular naga (a snake-like creature, deemed to live in a hole in the top of Mt. Kédang), which descends to meet and clash with the hari bura

at the beach. Barnes comments, "It is clear that a categorical distinction between the monsters of the mountain and those of the sea is considered essential to well-being and that certain disasters are readily explained by a descent of the ular naga or the rising of the hari bura, through which this distinction is confused" (1974, p. 40). A very large and destructive flash flood is said to be caused by the emergence of ular naga from its hole in the mountain.

Barnes also relates a myth from Kédang about a marriage long ago between Bota Ili (a woman of the mountain) and Wata Rian (a man of the beach), which was referred to in an informant's discussion of a particularly serious storm at Leuwajang. During this storm in 1932, huge boulders were said to have been brought down from the mountain and to have fallen into the sea. The boulders and trees thus dislodged were said to be the bridewealth brought by Bota Ili and the huge waves thrown towards the shore by the sea were the bridewealth brought by Wata Rian. In Leuwajang, if a flood is likely, alarm gongs are beaten and people in the low-lying houses (in the mouth of a ravine) flee to the higher houses on either side of the canyon walls. The neighbouring village of Leudanun, when it was situated on the beach, was once washed out to sea (Barnes, 1974, pp. 40-42).

The foregoing examples have attempted to show how people live with and express the hazards of flood, landslide and storm in particular local contexts. The hazard from volcanic activity is also present in Nusa Tenggara Timur, as indeed in most of Indonesia. There are several volcanoes in the Solor archipelago, all of which have settlements and cultivated land in the immediate vicinity.

Ili Boleng is situated on the northeastern tip of the island of Adonara and last erupted about 1975. No one was killed, but ash clouds hung in the air for days afterwards. Once people used to live higher up the slopes of Ili Boleng, but they have moved to the base which they consider to be safer. There are no settlements on the inland side of Ili Boleng, but there are a number of villages around its base on the seaward side. The lower slopes of the volcano are covered with coconut palms, and copra is an important product of the area.

At the northwestern tip of Lembata lies the active volcano, Ili Api. There are many small settlements on the narrow stretch of flat land all around its base. The local population farm the fertile slopes of the volcano and in the November nights burning gardens seem to be fire coming from the volcano itself. Ili Api has a long history of activity and in 1676 was referred to as the "wonder high burning mountain" by a passing seafarer (Barnes, 1974, p. 14). It was also reported as active in 1849-1852.

Volcanic activity associated with the Atadei peninsula is particularly interesting and it was this activity which caused the disaster that occasioned the present investigation. In 1948, the volcano Gunung Adowajo erupted and this created a new volcano, Ili Werung (the name itself means "new mountain"). The small peninsula on which Ili Werung stands (and which has no green vegetation of any kind at present) is called Tanjung Pnutu and was also created at this time.

In 1973 (possibly 1970), Ili Hobal appeared above sea level about a kilometre off Tanjung Pnutu. It looked like a small island. One informant said that Ili Hobal erupted in 1976, but caused only very high tide and no deaths because it happened in the day time. Some say Ili

Hobal disappeared after this and then began to grow again. Local opinion states that there is an underwater connection between Ili Hobal, Ili Werung and Adowajo and that these are also connected with Ili Blopor, which latter is situated behind the village of Waiteba. Ili Blopor is said to vibrate, and in 1978 it caused landslides in the area of Waiteba, but they were not serious and no one was hurt.

In 1977, various experts came to Lembata to look at Ili Hobal and they said that the people of Waiteba and the neighbouring villages in Waiteba Bay should move. The headquarters of the camat (local government official) was moved from Waiteba to the inland village of Karangora. The people of Waiteba, however, were reluctant to move because they enjoyed excellent fishing in the bay and also had extensive plantations of coconut and lontar palms, representing many years' investment.

The disaster, which struck at 1 a.m. on July 19, 1979, is generally agreed to have been caused by the eruption of Ili Hobal. Waiteba was struck by three successive tsunamis, which were followed by extensive landslides in the area. A tsunami also struck a section of the beach settlement of Labala in the bay to the west of Atadei and caused a high sea surge at Lamalera. There are settlements on the narrow strip of coast around the Atadei peninsula and also in its hilly interior. One of the larger villages of the interior is Lerek, which nestles behind the volcanoes of Adowajo and Ili Werung, though it is not actually situated on the slopes of either, but rather on a hillside facing them. About 15 years ago, people from Lerek were apparently encouraged by government to found the settlement of Waiteba in Waiteba Bay. Given the situation of volcanic hazard, the move obviously increased their vulnerability to tsunami.

Exposure to hazard is thus a part of a population's relationship to its environment. However, the population-environment relationship is not static and changes in it (whether relatively sudden, as in the case of migration, or more long-term) may increase the hazard beyond a population's capacity to deal with it. Such a process makes that population more vulnerable to an extreme environmental event, and can result in a natural disaster. The following discussion will therefore analyse the causes of changes in the Indonesian population-environment relationship by setting the latter in its historical context, and by documenting the social and economic processes which have been important in the transformation of that relationship.

INDONESIA IN THE COLONIAL ERA

There is very little published on Lembata and the neighbouring islands during the colonial era. Barnes (1974) states that the people of Lembata have "very nearly escaped all attention in the published literature" and that his book on Kédang is really the first work on the island of Lembata, certainly the first ethnography. In the absence of evidence, one cannot be sure that works and theories referring to the Outer Islands in the colonial period can also be held to refer to Lembata.

Geertz (1963, p. 50) contrasts the economies of Java and the Outer Islands. He considers that from 1619-1942 the Dutch interest in Indonesia was mainly mercantilist and that Indonesian products were sold elsewhere at a profit; however, the structure of the Indonesian economy was not changed fundamentally nor was Indonesia treated as a market for goods produced in metropolitan Holland. The Dutch East India Company, he

suggests, had only a marginal and unsystematic impact on the Indonesian ecological pattern in spite of the famous depredations of Moluccas and Java, the introduction of some new crops (such as coffee), and "the skimming of cash crops off the surface of an immobilised subsistence economy." The Dutch East India Company went bankrupt at the end of the eighteenth century.

After this, the Culture System came to dominate the colonial economy. According to this system, a peasant's land taxes were remitted in favour of his undertaking to cultivate government-owned export crops on one-fifth of his fields or, alternatively, to work 66 days of his year on government-owned estates or other projects. The main impact of this system was felt on Java, where the chief imposed crop was sugar grown on the sawahs in rotation with rice. Coffee, a perennial crop, was the main crop imposed on the swidden systems of the Outer Islands and, indeed, became adopted by many smallholder cultivators because small gardens of coffee could be cultivated without any real pressure on subsistence cultivation, while providing some cover for the soil. Geertz notes that in the last three decades of the colonial era, 60% of Indonesia's coffee production came from Outer Island smallholders.

According to Geertz, the development of Outer Indonesia is significantly different from the Javanese pattern in the following respects:

- The development in the Outer Islands is geographically extraordinarily localised so that, for instance, one-third of 1930 Outer Island export value came from an area of E. Sumatra, which forms only 0.1% of the total Outer Island area.

- Secondly, development in the Outer Islands has focused not on condiments, confections and stimulants, but on the production of industrial raw materials such as rubber, tin, petroleum.

- In the Outer Islands, the peasantry played a much greater role in the export economy. The smallholder share of the Outer Islands figure is about 35% (all of it from agricultural rather than mineral production) as against a comparable Javanese figure of about 15%. In Java the plantation production for export was of greater relative importance.

A tendency can therefore be noted in the Outer Islands towards increased cultivation for commercial export and decreased emphasis on subsistence production, which meant that some areas of the Outer Islands needed to import rice. Rubber and coconut trees have been grown increasingly with a view to export. Geertz suggests that the reduction in the relative role of rice production as against tree crops (such as the above) has encouraged a move away from true swidden to permanent or semi-permanent gardening. According to Geertz, by 1930, the cultivation of coffee, coconuts and rubber had pushed rice into the background in the Outer Islands. As more land was devoted to crops for export and less for subsistence, food shortages were inevitable.

At present, both coffee and coconuts are grown on Lembata, though only the latter is of any export importance. The island also imports rice, but exactly why will require further investigation. The following questions require an answer before we can successfully consider the position of Lembata in the colonial economy of Indonesia: Is too much land given over to coconuts or to peanuts (a cash crop important in the interior of the Atadei peninsula)? Has there been a degradation of the environment over time? Are both factors important? What kind of surpluses for export, if any, were produced by the people of Lembata in the colonial area and by whom were they appropriated?

Barnes offers some information on the history of Lembata, in particular Kédang, about early mercantile relations, power structures,

settlement and migration. The early Dutch control of Lembata, Adonara, Solor and eastern Flores was achieved through treaties with some of the small radjadoms and in 1859 the Protuguese holdings in the islands were sold to the Dutch, allowing the latter to consolidate their influence. The story of how Kédang fell under the control of the Radja of Adonara throws light on the nature of the Dutch colonial presence in the area.

Kédang was regarded as one of the richer parts of Lembata, where there was a surplus of maize and rice for external trade and an abundance of coconuts, candlenut, assam and citrus fruit. Slaves were also taken from Kédang by raiding groups from the kingdom of Lamahala on Adonara and by traders from Makasar and Buton in exchange for firearms. Barnes considers that the Dutch, in enforcing Kédangese subjection to the Radja of Adonara, helped the ruling family of Kalikur (see map) to consolidate their control of Kédang. This probably took place around the time of pacification in 1910 when the Dutch first made serious attempts to administer the island of Lembata.

The Dutch accepted the traditional boundaries of the districts in existence and also, perhaps for administrative convenience, acknowledged the territorial claims of the two powerful local radjas. Therefore, the districts of Lewo Tolo, Kédang and Kawela were placed under the Radja of Adonara and the districts of Lewoleba, Lamalerap and Labala were placed under the Radja of Larantuka. Kédang's submission to the Radja of Adonara was only achieved through Dutch military force, and Dutch soldiers were stationed at Kalikur to support the head of Kalikur (appointed Kapitan of Kédang and the local representative of the Radja) in his pacification of the interior. The head of Kalikur tried to subject the villages of the interior, twice with soldiers from Timor.

Another aspect of the pacification of Lembata by the Dutch was a change in patterns of settlement. The Dutch persuaded or forced peoples from the hills (where almost all the population had lived hitherto) to move down towards the coast near the Dutch-built roads. The reasons were to make administrative control easier and also to "civilise" the indigenous peoples. At the same time, the people could be more effectively absorbed into a national economy as both producers and consumers. This policy of the Dutch colonial authorities about settlement is also documented for Alor (du Bois, 1944), for Seram (Ellen, 1979), for Timor (Ormeling, 1956; Cunningham, 1967), for Sumbawa (Goethals, 1967). The independent Indonesian government has followed a similar line and on Lembata there are programmes to settle and farm lowlands, where previously people were afraid even to travel.

Villages, such as Lewotala on the south coast of Lembata, were formed as a result of the Dutch pressure on hill peoples. The villagers of Lewotala continue to practice a slash-and-burn agriculture, but it is likely that this practice is not well suited to their new coastal habitat which is at once drier and poorer than the interior hilly backbone of the island. Further comments on settlement and ecology will follow in a subsequent section. Here it is sufficient to note that the Dutch policy on settlement has implications for the whole ecology of the island and for the viability of communities.

Pelzer (1963), commenting on the nature of Dutch control in Indonesia, states that the colonial power was always far more concerned with domination of the coastal areas and the seas than with a deep administrative penetration of the hinterland. The example of Kédang, given earlier, seems to support this. Any sallies into the interior were made

by local potentates to consolidate their own economic and political power, rather than on the behest of the Dutch. The Dutch preferred to move populations down to the coasts, where they were accessible by boat since most travel was along the coasts and between the islands rather than overland.

There seems to have been, in Kédang at least, an extraction of surplus from the indigenous peoples of the interior by the coastal peoples. This was achieved either through the coastal villagers' role as intermediaries in trade, or through outright robbery of the inland producers on their way to market. Dutch military power supported the coastal powers against the interior. The unequal exchanges between the coastal and interior peoples (unfavourable to the latter) presumably placed some strain on the resources for production in the interior, although there is no detailed evidence to corroborate this.

There is also the question of the increase in production for trade and export of such products as copra, which increase, according to Geertz, was at the expense of subsistence production in parts of the Outer Islands. This left populations dependent on rice imports and therefore vulnerable to supplies and price fluctuations of the market.

Lastly, the effect of changes of settlement has not been assessed. On Lembata, hill villages transferred to the south coast carry on agriculture according to traditional slash-and-burn techniques, although the climate and conditions are less favourable. Additionally, there seems to be deterioration of the environment, creating a vulnerability particularly to landslides and flash floods.

NUSA TENGGARA TIMUR IN THE POST-COLONIAL ERA

The Japanese occupation of Indonesia lasted from 1942 to 1945. Ormeling (1956, p. 208) notes that during this period many Timorese withdrew further into the hilly and inhospitable areas of their country in order to escape doing forced labour for the Japanese. This meant that they were cultivating very steep and marginal land and helping to create an erosion problem on the higher mountain slopes.

After the Japanese were defeated, Indonesia declared its independence in 1945, although a four-year war of independence ensued before the Dutch would concede this. In a number of significant ways, however, the Indonesian government's policies towards, and methods of dealing with, the indigenous peoples are similar to those of the Dutch colonial authorities. Thus, the policy of moving populations from the hills down to settle the lowlands continues. On Lembata several lowland areas such as Kalikassa and Loang have been opened up to settlers with the express aim of developing an intensive agricultural production designed for export to other parts of the archipelago. The villagers of Waiteba, wiped out by the recent tsunami and landslides, were offered resettlement in the area of Loang as part of the aforementioned project.

Subsistence Agriculture and Cash-Crop Agriculture

The relationships between subsistence production and cash-crop production have implications for the vulnerability of communities to natural disaster on Lembata, in particular, to landslides, tsunamis and volcanic activity. This section will show the relationship between the domestic subsistence economy and a cash-crop economy, both of which exist on Lembata and involve many of the same people. The subsistence

economy is traditionally characterised by slash-and-burn practices, while cash-crop production in sites such as Loang entails a settled agriculture.

Shifting, or swidden, cultivation is the dominant method of agricultural production in Nusa Tenggara. By this method, a temporary field (ladang) is cleared, cultivated for a period of time and abandoned first to grasses (alang) and then to secondary forest growth (beleukar). The main crops grown under this system on south Lembata are rice, maize and root crops such as cassava, all of which are produced on dry fields generally situated on sloping land.

It has been held in certain circles that slash-and-burn cultivation is detrimental to the environment and that it inevitably leads to erosion, loss of soil fertility and deforestation. Pelzer notes, for instance, that while the development of beleukar can be rapid in wet areas, it can fail to become established in areas such as East Nusa Tenggara with a long dry season. Whether swidden cultivation per se is detrimental to the environment, or whether it is destructive only under certain conditions, has not been resolved. It is difficult to assess through field investigation because at the present time one is unlikely to find systems of swidden agriculture unaffected by wider society and economy. Two examples from Nusa Tenggara show how factors external to swidden cultivation can impinge upon it to become detrimental to the environment.

Rarak, a community in the middle uplands of Sumbawa (cf. Goethals in Koentjaraningrat, 1975) was settled originally by pioneers migrating from the lowlands over a hundred years ago. The land is farmed according to swidden methods. However, about 1930, the government closed large

sections of Sumbawa's uplands to swidden farming and since then Rarak's traditional tract of land has gradually been worked more rapidly (Goethals, p. 42). There was some encroachment by the lowland villagers who seek swidden in the uplands, and Rarak villagers expected the pressures on land to increase and to lead to a more accelerated cycle of burning, planting and fallowing.

The Timorese in the past practised artificial reforestation and conservation measures. Adat law, for instance, compels shifting cultivators to plant trees, mostly Indonesian pine and Australian oak, before leaving the ladang. Sacred lands were also left uncleared and in early times sandalwood and other trees preferred by bees for hiving were left untouched when beleukar was cleared. Prior to the Dutch pacification of Timor, the kin groups and tribes were confined to limited areas due to a "practically permanent state of war" (Ormeling, 1956, p. 84), and their restricted land base made such conservation measures the more important. Once Dutch action ended tribal wars, "The Timorese shifting cultivator could henceforth freely drift over his island and, in this limitless bounty of Nature, he neglected his beleukar restoration practices" (1956, p. 85).

The land base available for shifting cultivation on Timor has been reduced by population growth, forest reservation and the rapid multiplication of cattle, all of which has caused this particular mode of cultivation to become detrimental to the environment (Ormeling, 1956, p. 185). Cattle on Timor were reported to number one and one-half times the human population (Cunningham, in Koentjaraningrat, 1975).

In both of the above examples from Timor and Sumbawa, the deterioration of the environment and the creation of conditions of soil erosion

is shown to be due not to slash-and-burn cultivation per se, but rather to other factors which impinge upon it and limit it. The available evidence from Lembata suggests that swidden cultivation may be in crisis there as well:

> Farming is done on dry fields on the terraced slopes of the mountain or, in other areas, of hills or ravines. The rotation of the fields is irregular depending on the situation of the fields and the quality of the soil. On the sides of the mountain, fields are often planted year after year until they no longer return the seed. All ground within the village is planted every year without let. Irrigation is not possible in most areas because of the shortage of water.... Many people have their fields many kilometres away from their village (Barnes, 1974, pp. 16-17).

Several phrases in the above suggest that the agricultural system of Kédang may be under strain from an increase in population within a restricted land base, or perhaps from an increased rate of exploitation of land in order to trade with the coastal communities, albeit at unfavourable rates of exchange for the Kédang people.

It is not a normal and viable agricultural practice to plant fields year after year until they no longer return the seed, since the field should be left fallow long before that stage. The fact that people have to move increasingly farther afield to find cultivable areas also seems to imply a scarcity of good land.

Fieldwork on south Lembata revealed that in the coastal communities of Tapobali and Lewotala, garden plots may be left fallow for one or two years, if that, in an area which is very dry. In Ongaona (on the coast to the east of Lamalera), gardens are sown for two years and allowed to rest for three. The hill village of Puor seems to enjoy a large expanse of good land and there the gardens may be worked for two years and allowed to rest for up to five years. However, even this latter figure

nowhere near approaches the ideal of 12-year fallow periods (Ormeling, 1956, p. 185). The population pressure on land suggested by this quick rotation of fields may be due to the monopoly of some land by a minority, the arrival of new settlers in an area, as well as by an actual increase in the indigenous population.

The swidden farmers on south Lembata take certain precautions against soil erosion from their hillside gardens, although the efficacy of their methods is affected by variations in climate and the short fallow periods. They arrange thin tree trunks, thick branches or even stone barriers horizontally at intervals across the cultivated plots. Sometimes these barriers are reinforced by the planting of a root crop such as cassava along with them, with maize or rice in alternate rows. In Kédang, the cultivated hillsides are terraced.

However, another agricultural practice seems to create a potential for erosion. The practice of firing beleukar plots in the late afternoon and evening and leaving them to burn overnight at the end of the dry season is done because of the extreme heat in the middle of the day in the hottest month of the year. The result of leaving the gardens to burn themselves out during the night is that occasionally the fire spreads to other parts of the hillside and large expanses of vegetation cover can be burned rapidly with obvious consequences for erosion of the soil.

The problems of subsistence agriculture, however, cannot be considered in isolation from other kinds of productive activities, nor can they be divorced from the nature of intra-island trade. Most of the communities on the south coast of Lembata are engaged in agricultural production and fishing to underwrite their basic subsistence needs. The

exception to this is Lamalera, which has virtually no agricultural land and derives its livelihood from fishing and whaling. The products of these latter activities are then exchanged with the peoples of the interior for cereals, fruit and vegetables. Barter is the main form of exchange. In the settlements of the dry south coast, the lontar palm is also important for subsistence, providing a nutritious palm wine as well as leaves, which form the raw materials for house roofs and walls and for many woven household and personal items.

Many of these communities also possess coconut palms, from which copra is extracted to provide a cash income for the farmers. An important trader and boat-owner from Labala acts as intermediary in this trade, transporting the copra from Lembata to large warehouses at Waiwerang on Adonara. The communities in the interior of the Atadei peninsula, such as Lerek, produce peanuts for export.

Another source of cash income has been created by the Indonesian government's plans to settle the lowlands of Lembata and open them up to intensive agriculture. Two areas of particular importance in this respect are Kalikassa to the north of the island's mountain chain and Loang to the west. Both are very low-lying wet malarial areas through which until a few decades ago people were afraid even to travel. Barnes (1974, p. 2) notes for Kalikassa that, "to this day, few people live there permanently and even they return to their (hill) villages at the end of the agricultural season." The villagers from Puor, who cultivated land in Loang, worked in a similar pattern.

The produce from the land in Loang, and presumably also from Kalikassa, was sold for cash to buyers from the Muslim communities of Waiwerang (Adonara) and Lamakera (Solor). Since none of the Loang

produce was retained by the producer, the maintenance of a garden plot in Puor was important for the underwriting of subsistence needs in a way that prevented the total dependence of the peasant on the vagaries of the market. It is possible that less effort may be put into soil conservation on the hillsides now that such plots are not the peasants' only source of income. Changing relationships between agriculturalists and their land base (changes due to the penetration of the capitalist economy or due to government interventions) may lead to changes in concern for preservation of the environment.

Hewitt (1976, p. 34), writing on Indus Kohistan, an area of Pakistan affected by an earthquake and landslide in December of 1974, states that

> The situation (of environmental damage) is aggravated by the loosening of ties between people and their land. As more and more men work in the cities as factory hands, servants, drivers, and so on, farm plots are often just supplements to other income, or convenient homes for women and children who return in summer to work them. Similar loosening of ties, including the erosion of concern for the local environment in favour of hoped-for financial returns is seen throughout the high mountain areas. As in western Europe, more than two centuries ago, rural landowners and peasants moving into the urban labour force yield the land up to whoever is best able to profit by it in the market-place or, if it is 'uneconomic', to abandonment.

The above description suggests a very clear relationship between the development of a capitalist economy characterised by wage labour, and the deterioration or modification of a subsistence economy as its members become involved in the former. The implications for the local ecology and vulnerability to landslides are also clear.

The potential for soil erosion on the south coast of Lembata has been increased during this century in two inter-related ways: through the Dutch colonial policy of moving hill peoples to the coast where the climate is drier and the land would seem to have a lower population-

carrying capacity than the wetter highlands; and through population pressure on the farming land available, leading to shorter periods of fallow, deterioration of the soil and erosion. The Indonesian government's plans for colonising the wet lowlands on the western side of Lembata has not been an unqualified success because many participants still retain their hill village subsistence base and return there when lowland agricultural tasks allow.

In order to see how all this affects vulnerability, it is useful to take a particular example of a new lowland settlement such as Loang and to consider its history and how it is perceived by the hillside subsistence farmers.

Loang: an Example from Lembata

About forty years ago there were only a few houses at Loang on the west coast of Lembata. In the last four or five years, however, under government encouragement, the settlement has grown considerably. The population in October of 1979 was very mixed, and included settlers from various parts of Lembata and from the predominantly Muslim trading communities of Waiwerang (Adonara) and Lamakera (Solor). The Muslims from these latter two communities seem to be the middlemen in the marketing of Loang's produce of copra, maize and rice. The most recent arrivals at Loang are the survivors of the tsunami and landslide disaster at Waiteba. Evidence suggests that many of the "settlers" from Lembata (apart from the Waiteba contingent) have only temporary makeshift dwellings in Loang since they still maintain their family households in their hill communities.

The wet climate and low-lying terrain of Loang create certain health problems; malaria and elephantiasis are known to be endemic there. At the same time, because the settlement is relatively new, adequate health care facilities are lacking. The Loang plain is drained by four rivers.

Prior to the tsunami disaster, the inhabitants of Waiteba had been warned to move from their vulnerable location to Loang, by the regional governor, Dr. Ben Mboi. Although some heeded the warnings and went to Loang, a majority did not, and this refusal to move was represented in the press as a product of a particular "culture or attitude" which was considered unreasonable. The Waitebans knew, however, that Loang's climate was very different from that of Waiteba and that it was an unhealthy environment for living. It is likely that the nature of Loang's mixed population was also perceived negatively. Despite government pressure on the Waitebans to move, it was also known that Loang was not ready to take a large group of settlers. Three months after the disaster had meant the removal of the Waiteba survivors to Loang, most of the refugee families were reportedly living in makeshift shacks. Only 40 of the proposed 400 housing units had been built.

The farmers of Puor who produced cash crops in Loang also felt it appropriate to maintain their subsistence plots in the hills. They were not prepared to enter a situation of total dependence on the market supply and prices of food. Work in Loang provided them with a very useful cash income, which nevertheless was a supplement to, rather than a replacement for, subsistence production. This system may have led to over-exploitation, soil degradation and an increase in hazard vulnerability, but it may be argued (following Meillassoux and others) that

the maintenance of the agriculturalists' subsistence base in the hills is in fact important for the wider success of the cash-crop agriculture in the lowlands, since it means that a lower price can be paid for Loang produce given that the cash income does not have to underwrite all the costs of reproduction of the labour force.

Housing and Migration

Indigenous techniques of construction of houses are frequently adapted to a particular situation of hazard, but such techniques may be changed by external influences, leading to an increase in vulnerability to natural disaster. In long-established coastal communities such as Labala in south Lembata, the houses are well-adapted to any hazard from the sea. The house is built on a raised foundation of packed earth (two or three feet or sometimes more) protected on all sides by an outer layer of stones or rocks (in some cases cemented together). On top of this foundation the dwelling is constructed either in traditional style (bamboo walls, palm thatch) or by using concrete with corrugated iron roofing.

Foundations of this kind remained firm even in the recent tsunami at Labala, although the extraordinary height of the wave meant that the houses on top of these foundations were swept away. A sea surge of two or three feet would, however, probably have little effect even on those houses situated right on the beach.

Some migrants to Larentuka from Lamalera (where the construction of houses is similar to Labala) have built their houses along traditional lines, since the raised foundations afford some protection from flash floods which affect the city in the wet season. Lamalera migrants to

the town of Waiwerang on Adonara, however, have not followed the tradition of raised foundations, but have tended to construct small and rather makeshift houses along the waterfront. Most of the migrants are teachers or office workers and they state that their low salaries do not permit them to live and construct suitable dwellings, given the high cost of building materials and food in Waiwerang. This Lamalera community on the waterfront of Waiwerang is extremely vulnerable to high sea surge or tsunami.

Another example of increased vulnerability to sea surge due to a change in settlement is provided by Barnes (1974, pp. 38-39). He notes that within Kédang culture there is an important categorical distinction between the mountain and the sea or beach. This is expressed in certain prohibitions such as the one that wood from large trees at the crown of the mountain may not be used to construct traditional style houses on the beach. Traditional houses have house posts which are, in a sense, planted. However, to plant mountain wood on the beach would be to confuse two categories, and it is said that such "planting" would result in a flash flood. This prohibition is respected with the result that highland timber is used only in the construction of "modern-style" houses, which merely rest on the ground without embedded house posts. Such "modern" houses are obviously more vulnerable to sea surge because of their weaker foundations.

Migration within the regency of Flores can also be shown to increase the vulnerability of certain settlements to natural disaster. Migrants to Larentuka, the capital of the regency of Flores Timur, have encountered problems similar to those mentioned for the Lamalerans in Waiwerang. Larentuka is situated on a narrow strip of land between the sea and the

base of the western slopes of Ilemandiri, an extinct volcano. As the population has increased, the settlement has extended in length and also in breadth, which latter means the building of houses closer and closer to the slopes of the mountain. During the rainy season (and particularly in the month of February), Larentuka is normally subject to flash floods of varying intensity which, in February of 1979, took the form of a large and serious landslide causing more than 100 deaths on the east and west sides of Ilemandiri. Houses situated close to the mountain are obviously extremely vulnerable to this kind of hazard.

Many of the migrants work as clerical staff or teachers in Larentuka, which is an important commercial, administrative and educational centre for the area. They left their rural communities of origin in search of this kind of work and in search of a more "modern" life style, which their small salaries, nevertheless, do not permit them to achieve in its entirety. They prefer to economise on housing in order to finance their general standard of consumption (including clothes, entertainments and food). Concrete and high prestige housing materials are very expensive in Larentuka, so the migrants have generally built their own houses of simple materials in traditional style.

An increase in vulnerability to earthquake as a result of changes in housing design has been shown by Glass *et al.* in their case-study of Santa María Cauque after the Guatemala earthquake of February, 1976 (1977, p. 642). They note that all of the deaths and injuries in the community were associated with the collapse of adobe housing, and then reveal that:

> In 1924, there was no adobe in Santa María Cauque, and all of the houses were built of cornstalk, mud-covered slats (or bajareque) and similar materials attached to a simple wooden frame. Elders in the community recall that in the earthquake of 1918 there were no deaths and few injuries from

> these houses, even though every structure in the village was destroyed. In 1925, the first adobe house was introduced, modelled after the houses built by the Spaniards in Guatemala City. It was recognised that the Spanish city dwellers had suffered many deaths in 1918 from adobe brick, but to the Indians, an adobe home represented the status and prestige associated with the Spanish culture. Adobe bricks were cheap and easy to make, offered protection to the occupants from extremes of temperature, and were more permanent and finished than cornstalk or bajareque, which had to be changed periodically. By 1963, 50% of all houses in Santa María Cauque were made of adobe, and by 1971, this had increased to 85%.... the risk of earthquake-related trauma to the village had gone from minimal to maximum.

Lewis (1979) has noted in Tonga how changes in housing design for protection against one kind of hazard, increased vulnerability to another kind in an area where hazards are multiple. Thus, after experiencing damage to wooden houses in hurricane, people turned to blockwork and concrete construction which suffered most heavily in earthquake. Traditional "fale" building and sawn-timber frame constructions were not damaged. Lewis argues for "improved methods of timber construction resistant to all hazards at a place" (1979, p. 4).

Indonesian Government Policy

The Indonesian government is very aware of the problems of natural disasters and of the need not only for appropriate organisation for emergency action, but also for mitigation and preparedness measures. These issues are discussed in a recent document by the Directorate General for Social Assistance (n.d., but post-1977) which is interesting and important in a number of respects.

The document recognises the regular nature of natural hazard in its reference to "routinely or incidentally occurring natural disasters" (p. 1, emphasis mine). Different kinds of natural disasters in Indonesia are described and their geographical distribution noted. The human

population is seen to be a contributory cause of disaster in the case of landslides, floods and pollution. There is mention of the need to establish codes for land use, construction of buildings and coast and river protection. The mapping of disaster-prone areas, survey and analysis are also considered important. There is emphasis on the need for vulnerability analyses which would take into account the socio-economic conditions of a population. The problems of composing a disaster contingency plan are discussed, and it is stated that the mitigation of natural disaster is not simply a responsibility of government, but also of society in general and more specifically of the community in the vulnerable areas.

The programme for rehabilitation in the post-disaster period includes rehabilitation of buildings and agricultural production as well as transmigration (the term for resettlement of whole populations in different areas). It is also suggested that rehabilitative action should be part of the general effort for development in Indonesia and aim "to open possibilities for former victims of natural disasters to improve in concrete their conditions of life so that they'll be able to participate in actions of natural development" (p. 26). The problems of implementation of the various kinds of measures are considered.

Whilst this document represents a preliminary stage of disaster planning, it nevertheless includes many of the most important points (especially vulnerability) which can be elaborated upon. The greatest problems are likely to be found in implementation of these and subsequent proposals and there is a clear need for studies to provide the necessary information upon which to base both planning and implementation. It is hoped that this paper will contribute in a small way to filling this gap.

THEORETICAL AND METHODOLOGICAL IMPLICATIONS

This paper has attempted to outline for Nusa Tenggara Timur, and in particular for the island of Lembata, how vulnerability to certain kinds of natural disaster has been increased over a period of time. Analysis has focused on settlement patterns, housing design and construction, and agricultural production as important aspects of the problem, while attempting to see these as part of broader processes of change.

Although population pressure could be seen to be the cause of, for instance, soil erosion due to over-farming and the haphazard expansion of towns in hazardous areas, the problem is not a simple one of population pressure on finite resources. The movements of population described can only be understood in relation to the development of the national economy and to governmental initiatives motivated by political and economic considerations. Thus population pressure may more usefully be seen as a result of these latter and therefore it cannot be isolated from them as a causal factor.

Similarly, erosion cannot be seen as a simple function of agricultural practices, population and climate, since over-farming (a cause of erosion) may also be conditioned by the relationship between subsistence farming and cash-crop production in the context of the wider economy. On Lembata it is possible that subsistence farming resources may be overstretched to support the agriculturalists engaged in lowland cash-crop production, thereby reducing the costs of such production and making possible artificially low prices. These low prices mean that non-agriculturalists (such as traders) appropriate a part of the surplus value created by the producers themselves.

Finally, in the case of Waiteba an attempt has been made to show the framework within which the people made their decision not to move from a vulnerable location and to show that this decision was a rational one based on their assessment of their own resources and the alternatives offered them. Although their decision had very tragic consequences, it was not a case of indigenous irrational intransigence to change. Rather, it is an example of the lack of effective two-way communication between government and indigenous peoples, compounded by minimal mutual understanding.

There is a wealth of social scientific research relevant to natural disaster, within which body of work a number of different themes and orientations can be detected. It is necessary to comment on these orientations in the light of the Lembata case study and, in particular, to discuss the relevance of anthropology to a study of disaster-related issues.

In a recent article, William Torry (1979) criticises the abundance in disaster-related literature of unfounded, reductionist universalistic statements about human social behaviour. He argues that anthropological methods of detailed local level analysis and cross-cultural comparison have much to offer researchers into vulnerability to and responses to disaster. His bibliography includes many works very relevant to disaster issues. According to Torry, "the community is the fundamental unit of disaster analysis" and "theories about disasters are inherently theories about communities." He explains in a footnote that "for the purposes of analysis here I apply the term 'community' to politico-territorial units ranging from towns to entire nations and including localised ethnic

enclaves such as tribal populations." However, the above statements need some comment and clarification.

It seems essential to make a distinction between two concepts of the community, which Torry seems to conflate despite his extension of the term to cover politico-territorial units as large as entire nations: while it is appropriate to take the community as a convenient location for detailed fieldwork, that should not imply that the community can also be analysed as a social isolate separate from its wider context.

Much anthropological research has taken place within communities defined socially and spatially for the purposes of fieldwork, where the aim has been a detailed understanding of alien perceptions and processes of economic and social life. The fieldworker focuses on a small community and, through participant observation and other research techniques, comes to know it well. However, this heuristic isolation of the community for the purposes of fieldwork does not also mean that the community can be analysed as a separate unit. One should not be seduced by maps, administrative boundaries or even by local informants themselves into believing that the community is a self-contained entity (cf. Jeffery, 1980).

Recent work by anthropologists (cf. Friedlander, 1975) has shown that the very nature of community beliefs, social and economic structure is conditioned and transformed by that community's position in the national and international context. Work by geographers and other social scientists also demonstrates the effectiveness of this approach. As Torry himself notes, particular schools of thought transcend the boundaries of academic disciplines. Proof of this is the work by Wisner (1976; 1977), a geographer, which is a good example of community-based

research that also sets the community in its wider socio-economic context. Wisner has made clear for the case of drought in Kenya that the significant unit for analysis is not the individual peasant community, but rather the whole system of relationships between the peasant sector, large agricultural enterprises and the national government. He argues that colonialism and the penetration of the market economy in Kenya have had a significant impact on peasant modes of livelihood and on their strategies for dealing with their environment. The control by elite groups of land, capital and other resources has forced peasants to over-farm marginal poor quality land, which has led to desertification and famine. The author further defines three kinds of drought--the national, regional and the local--and states that the latter two could be avoided or considerably mitigated if the peasant population had access to the resources possessed by the elite groups. Such a penetrating analysis of the causes of drought was achieved through detailed fieldwork in peasant communities, while setting these communities in the larger social and economic system of which they formed an integral part.

Although he includes Wisner's work in his bibliography, Torry sees quite a different role for community-focused research on tribal groups. He states that "outside intervention" in the form of international aid "stands a better chance of succeeding when shaped by knowledge about risk abatement modes," and that it will be possible to assess the "complementarity of old and new modes and ascertain possible untoward consequences of undermining the latter." He focuses on the relevance of anthropological research to post-disaster relief activities.

It is only by considering such influences as land tenure and control of, and access to, key resources in relation to community socio-cultural characteristics, that one can understand how previously successful agricultural practices and frameworks for decision making become distorted or restricted with detrimental effects for the environment. In short, it is in systems of social and economic relationships that one can encounter the causes of drought. The relational aspect is the crux of the problem.

When Baird *et al.* (1975, p. 2) write that disaster is "the extreme situation which is implicit in the everyday condition of the population", they are referring to the whole process of social and economic development in the Third World. They site examples of Honduras and Nicaragua to show how, through the process of "marginalisation", certain poorer groups of society are increasingly deprived of crucial resources for livelihood while such resources are appropriated and controlled by other groups. The marginalisation of one group (which thereby increases its vulnerability to any kind of crisis) is directly related to the increase in wealth and power of the others, and the relationship between such groups is the very stuff of economic development in its present form. Certain trends in the "development" process increase the vulnerability of sections of the population to natural disasters. That such vulnerability is "implicit in the everyday condition of the population" should therefore be of considerable importance for planners, administrators and researchers.

There is a crucial difference in approach between Baird and his co-authors and Lewis, among others, and Torry and many of the authors in his bibliography. The former attempt to outline the causes of disaster

and the significant social and economic processes creating vulnerability to disaster with a view to developing adequate preventive and preparedness strategies which, the authors emphasise, must become an integral part of a nation's long-term development plans. The social scientists cited by Torry (such as Oliver-Smith, Lessa) tend to focus on the post-disaster stages of relief and reconstruction and they analyse social responses to the catastrophic events. While both approaches provide important information for planners and administrators, it has been shown in the course of this paper (and cf. Lewis, 1980) that the former must be an essential prerequisite to the latter if relief and reconstruction efforts are not to create further vulnerability to natural disaster.

Torry defines the anthropologist's "activist position" as that of "cultural translator" between victims and officials, facilitating communications between the two groups for aid administration. Yet, this emphasis on the post-disaster role distorts the very meaning of mitigation. Mitigation should surely be concerned with preventive and preparedness measures aimed at reducing the vulnerability of human populations to extreme natural phenomena. Anthropological research, if it is to be relevant to mitigation, should focus on the causes of vulnerability to natural disaster and should elaborate proposals to reduce such vulnerability.

Given that links can be, and have been, traced between "development" and disaster, the theoretical and methodological approach to disaster vulnerability must draw on the vast body of social scientific literature on development issues. Many such sources have been cited in the course of this paper. The debate on the "development of under-development" and dependency are particularly important. At the same time, and in relation

to the above, information is needed on the many different indigenous modes of relationship to the environment, in particular to natural hazard. Much anthropological work is useful from this point of view, and the techniques of local level fieldwork are essential for future investigation of the ways of mitigating, preventing or preparing for disaster.

One can identify two threads of investigation, which help identify the processes involved in the creation of vulnerability to natural disaster. These processes are easier to identify in some contexts than in others. Firstly, drought and the inter-related issues of erosion, landslides and flash-floods are a group of natural hazards with which it can be shown clearly that human actions have had causal effects. It can be demonstrated that human practices alter the environment in ways detrimental to the continued viability of the resources for livelihood in particular populations. The physical environment is transformed by human action.

However, it is rather more difficult to show how human action can create vulnerability to volcanic hazard. In this case, human action does not alter the physical environment in the same sense (except insofar as erosion on volcano slopes may affect lava flow); the discussion of vulnerability to volcanic hazard must focus on issues related to settlement. Why do people live in the vicinity of active volcanoes? The Indonesian government itself recognises that although volcanic eruptions cause disasters, they also increase the fertility of the soil and, "It is logical that these plains [in the vicinity of Mt. Merapi, Java], that are built of material of volcanic origin, are always attracting people and consequently are densely populated" (Ministry of Public

Works and Electric Power, 1976). Irrigated cultivation on the western slopes of Mt. Merapi yields two harvests a year, and higher up towards the summit three harvests are possible. Pelzer (in McVey, 1963) demonstrates a positive correlation between the distribution of young volcanic materials, soil fertility and population density on Java. He adds, "Peasants, knowing that volcanic soils are rich, would rather risk the danger of eruption than move to less fertile regions where they may have to worry about food shortage" (p. 6).

The economic realities of peasant life mean that the people see food shortage as a much more likely and serious hazard than volcanic action, and this is reflected in their choice of residence. The investigation of this particular instance of vulnerability to volcanic eruption must consider the social and economic processes which create peasant poverty and which by implication act as constraints on the peasant's choice of residence. Settlement is not random.

Government attempts to move populations from areas threatened by volcanic hazard have often met with strenuous opposition. The people of such a village as Banaran on the western slopes of Mt. Merapi, although vulnerable to lahars or mud flows from Merapi in the wet season, have resisted persuasion to move to Sumatra because they know that only one crop per year is possible there, while in Banaran two harvests per year are possible. In the same way, as already outlined for Waiteba, the people there considered that they would lose more by leaving vulnerable Waiteba with its coconut and lontar palms and excellent fishing grounds than they would gain by moving to Loang to participate in cash-crop agriculture in an unhealthy climate.

Given the situation of uncertainty which affects peasant agriculturalists on the margins of a market economy, the peasants opt to continue with the conditions that they know and have learned to adapt to. Perhaps if guarantees of an increased income and standard of living were offered to the peasants, and if these guarantees were perceived as trustworthy, there would be less opposition to the proposed move. There is an important problem in communication between the population to be moved and the administrators and governmental decision makers. Neither side fully comprehends the position of the other. The peasants may distrust government initiatives, suspecting that the motives are not related to the good of the peasants but rather towards some political end. The government, in turn, is reluctant to consider the reasons for the peasants' refusal to move and dismisses their opposition as typical of peasant irrationality and backwardness. This polarisation is obviously an impediment to the development and implementation of measures to reduce vulnerability to natural disaster.

In light of the foregoing, it can be suggested that a future investigation in the field should concentrate on elucidating in a given context:

- the social relationships of production and the nature of the relationship between the market economy and the subsistence economy,
- government policies for development in relation to the above, and
- the social distribution of ownership of access to key resources for livelihood.

An investigation of the above for a given context will provide a framework for considering such aspects of changing vulnerability to natural disaster as:

- settlement and migration patterns,
- indigenous knowledge and practice with especial regard to agriculture and construction of buildings, and
- other aspects of the general question of marginalisation of populations.

Through anthropological techniques of local level fieldwork it will be possible to carry out detailed investigation of the above elements, focusing on particular defined communities but setting those communities in the wider systems of social and economic relationships into which they are integrated.

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