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Drawing from the past to prepare for the future: responding to the challenges of food security in East Timor

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Abstract

This paper examines the challenges to food security in East Timor by drawing on information about the past history of agriculture on East Timor. The paper examines the repertoire of food crops on Timor from the pre-European contact period to the present, giving attention to the role of rice in a configuration of what is otherwise a predominantly 'dryland' agricultural system. The paper then outlines the various agro-climatic zones in East Timor and considers issues of the variability of rainfall, both seasonal and in terms of the ENSO cycle in these different growing environments. The paper concludes by considering the minimal requirements for food security planning in East Timor.

Introduction

FOR such a small nation, East Timor's agriculture is a remarkable amalgam of elements — a great variety of cultigens planted according to distinct farming traditions in diverse environments that are subject to considerable annual, as well as seasonal, climatic variability. Understanding something of East Timor's agricultural past provides a context for considering possibilities for the future. It also provides a basis for assessing contemporary issues of 'food security'. Finally, but importantly, it helps to establish an agenda for future research and thus further improved understanding of East Timor's agricultural potential.

This paper begins with a brief, general history of Timor's principal crops and their relative overall significance in present-day cropping systems. It then considers the diversity of conditions that local farmers face in East Timor and concludes with a number of observations on possible future requirements for food security planning.

The pre-European repertoire of food crops in Timor

It is possible to identify a repertoire of crops grown in Timor prior to the arrival of the Portuguese. The list of these crops is based on a combination of historical observations and comparative evidence from the region. (An understanding of the early botanical history of the eastern Indonesian region benefits from the extraordinary work of the 17th century Dutch naturalist, G.E. Rumphius, whose comprehensive six-volume study of the botany of eastern Indonesia was published after his death as the *Amboinsche Kruydboek* (1741–1755). This treasure trove of detailed information has proved a reliable baseline for all subsequent accounts of the botany of the region (see Heyne, 1950)). Timor possesses an entire suite of crops associated with the early migration of Austronesian populations and the spread of agriculture by these groups. The existence of Austronesian cognate terms (words related by their linguistic origin) for these crops among different Timorese populations[1] combined with indications of similar

[1] An initial survey of the lexical and ritual evidence on traditional agriculture can be found in Fox 1992. 'PAN' indicates that a particular term can be reconstructed to the level of Proto-Austronesian; 'PMP' indicates that a term can be reconstructed to Proto-Malayo-Polynesian, which constitutes the largest subgroup of Austronesian languages.

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patterns of cultivation found throughout much of eastern Indonesia provides some of the best evidence for the early establishment of these crops. (Occasionally, when new crops were adopted, the terms used to identify them became linguistically associated with the plants, which they have gradually replaced. Here, caution is required. So little research has been done on the ethnobotany of Timor, that linguistic designations, including the present set of Linnaean terms for these crops, may well prove to be misleading. In addition, given the history of agriculture on Timor, the whole range of local varieties of particular crops is a subject that needs much greater investigation.) The relative importance of these crops, however, has varied significantly in different parts of the island and in different periods. In historical terms, several previously important grain crops have receded to near insignificance and have been replaced by introduced crops. In short, the picture is one of considerable complexity and what follows is merely an outline.

The principal pre-European crops of Timor were 1) Job's tears (*Coix lachryma jobi L.*), 2) rice (*Oryza sativa L.*), 3) millet (*Panicum viride L./Setaria italica L.*), 4) mung bean/green gram (*Phaseolus aureus Roxb.*), 5) pigeon pea (*Cajanus cajan Millspaugh.*), 6) sesame (*Sesame orientale L.*) and 7) sorghum (*Andropogon sorghum Brot.*).

In addition, the Timorese planted in their gardens 8) onions and garlic (*Allium spp*) (not all varieties of onion now grown on Timor predate the arrival of Europeans. It is likely, for example, that shallot is a more recent introduction to the island), 9) ginger (*Zingiber officinale R.*), 10) turmeric (*Curcuma viridiflora*), 11) cucumber (*Cucumis sativus* L.), 12) sugar cane (*Sacchrum officinarum L.*), 13) banana (*Musa paradisiacal. L.*), 14) taro (*Colocasia esculenta*), and a variety of 15) yam (*Discorea elata L.*).[2]

It is possible, indeed probable, that various other beans and pulses should be included in this list but, for the moment, beans and pulses represent the least researched segment of Timorese agriculture. Some definite candidates for inclusion would be cowpea (*Vigna sinensis Endl./Vigna unguiculata*), rice bean (*Vigna umbellata*) and the lablab bean (*Dolichos lablab L.*). Similarly, if one were to expand this list to other food sources, a variety of fruit trees including jackfruit (*Artocarpus integra*) and mango (*Mangifera indica L.*) and useful palms including the Borassus (*Borassus flabellifer/sundicus Becc.*), Coconut (*Cocos nucifera L.*), Areca (*Areca catechu L.*), Gewang (*Corphya elata Roxb.*) and Pandanus (*Pandanus spp*) would need to be noted for their importance.

Not all of these crops reached Timor at the same time. Some were among the earliest crops grown in Timor while others came later. Sorghum, for example, was a relatively late arrival and was probably spreading through Timor at the time of European arrival. It is useful to consider some of these crops briefly.

*Job's Tears (PMP: *qaZelay)* Job's tears has no economic or cropping significance in East Timor today. This grain was once, however, of greater importance and may have been the earliest grain grown in Timor. A pierced seed of this cereal, apparently intended as an ornament, was discovered in excavations in the Baucau area dating back 5000 years (Glover, 1971). Job's tears thus provide a possible first hint of agriculture on the island. Interestingly, among the Kemak there is a continuing ritual significance assigned to Job's tears. In the ceremonies of the Kemak, Job's tears are 'called upon' to hold harvested rice grains to their stalks (Renard-Clamagirand, 1982). Similarly, Job's tears (and millet) are given prominence in the myths of the Bunak (Friedberg, 1980).

*Rice (PAN: *pajey)* Rice is almost certainly one of the earliest crops to be grown in Timor. But it was probably never as prominent a food crop as it is at present. Through most of the 19th and early 20th centuries, rice was grown in limited areas as a rain-fed or partially-irrigated crop. In some parts of Timor, rice is still grown on terraced fields and this form of cultivation may well have been more widespread than it is today. Rice was grown by 'run-of-river' irrigation and, on favourable sites, spring-fed irrigation was not uncommon. Only in the 20th century (and indeed only in the last quarter of the 20th century), with the construction of larger-scale irrigation systems, has rice taken on its present importance as a major food crop.

*Millet (PAN: *beCeng)* Millet (Foxtail Millet) is another one of the early grain crops of Timor that has dwindled to near insignificance in the 20th century. At one time, in the early history of Timor prior to the introduction of sorghum and maize, millet may have been the major subsistence crop of the Timorese. It is still grown in mixed gardens in some areas of Timor but for the most part the memory of millet is retained only in myth and ritual. Among the Kemak, for example, women who go out to harvest rice are supposed to wear sprigs of millet in their headbands to increase the fertility of the harvest; millet is also

[2] Throughout this paper, for consistency, the Latin terminology used in Heyne 1950 has been followed, with alternative designations, in a few instances, where there has been reclassification.

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hung in granaries to 'welcome' the harvested rice (Renard-Clamagirand, 1982). Bunaq myths recount the tale of three ancestors, one of whom planted a mixed garden of Job's tears and millet; another a garden only of millet while the third planted only rice (Friedberg, 1980)[3].

Mung Bean/Green Gram This is a food crop of both historical and contemporary significance about which there is still insufficient knowledge. Even the designation of this bean or gram as *Phaseolus aureus Roxb*. (see Purseglove, 1971) may be questioned. The Dutch botanical literature on Timor refers to it as *Phaseolus radiatus*, which distinguishes it from *Phaseolus mungo L*. (see Heyne, 1950). Others refer to it as *Phaseolus lunatus.*

This bean/gram is an important and widely grown crop throughout the region. It has a variety of cognate designations: Dawan, Timor: *fue(l)*, Roti: *fufue*, Savu: *kebui*, Manggarai: *wue*, Ende: *mbue*, Bima: *buwe*, Bugis: *buwe* (see Fox, 1992). The Tetun term for bean is *fore* and this particular bean is *fore mungo*. (On the island of Savu, mung bean is the major subsistence crop. In the 18th century, it was once exported in large quantities from the island of Roti (see Fox, 1977) but is now of lesser significance among a range of food crops.)

Mung bean has long been associated with the Tetun-speaking populations of Timor. Especially in southern coastal areas inhabited by Tetun farmers, this bean is a major crop. It is a significant crop in times of drought because it is generally planted in the late rainy season and is thus less dependent on catching the initial, and often irregular, rains of the west monsoon.

Pigeon pea Pigeon pea has never been as prominent as mung bean in the subsistence regimes of any Timorese populations. It can, however, be found widely intercropped in Timorese fields and gardens. This plant is known by similar cognate terms in much of Timor (Helong: *tulis*, Dawan: *tunis*, Tetun: *turis*).[4] The importance of pigeon pea in Timorese agriculture stems from its drought resistance. Although never bountiful, it is often available when other crops fail. The ethnobotany of pigeon pea, however, remains to be investigated.

*Sesame (PMP:*lenga)* Sesame is probably one of the oldest cultivated crops in Timor. It was probably introduced by early Austronesian-speaking settlers to the island. Cognates of the constructed proto-Austronesian term (**lenga*) are found widely in Timor: Dawan: *nene;* Tetun: *lena*.

Sorghum The introduction of sorghum began a process of change in the agriculture of Timor. The term *batar* in Tetun was originally used to refer to sorghum. It derives from an old Malay word for sorghum, *batari*, (itself possibly from Persian) and is related to cognate terms for this crop elsewhere in the region (Makassar: *batara*', Bugis: *bata*; Tana Ai, Flores: *watar*; Sumba: *wataru*). Historical evidence would suggest that sorghum came to Timor via trade-based connections in the region at sometime during the 15th or 16th centuries. In many areas of Timor, maize followed in the wake of sorghum.

When maize was introduced, the same term, *batar*, was applied to maize but linguistic distinctions were made between the two crops. In Tetun Terik, maize is referred to as *batar malae* 'foreign *batar*' and sorghum as *batar ai naluk*, 'long-stalked *batar'*.[5]

With the spread of maize, sorghum has lost much of its earlier importance. However, it is probably more drought tolerant than maize and, therefore, continues to be planted in the driest areas of Timor. Thus, for example, sorghum is still grown in mixed gardens in the coastal area of Maubara. Its potential for food security in times of drought cannot be overlooked.

'New world' crops that transformed Timor

Three crops, which originated in the Americas and were directly or indirectly introduced — perhaps it would be better to say, 'diffused' — via European contacts, have now completely transformed the agriculture of Timor.[6] These three crops are maize (*Zea mays L.*), pumpkin/squash (*Cucurbita spp*.), and cassava (*Manihot utililissima Pohl*). Together with mung bean, these crops now constitute the indispensable staples of the Timorese diet.

A whole variety of other important new world plants can also be added to this list: new world taro

[3] Claudine Friedberg has written extensively on Timorese agriculture from the perspective of the Bunaq who occupy the central border area between East and West Timor. She has also written a major ethnobotanical treatise on Bunaq utilisation of plants. See, in particular, Friedberg, 1974 and Friedberg, 1990.

[4] This particular cognate, however, resembles cognates (as for example, Javanese/Malay: *turi*, Madurese: *toroy*) for *Sesbania grandiflora*, another drought-resistant plant that is also found on Timor.

[5] Similar forms of linguistic assimilation of maize to sorghum are prevalent in the region (see Fox, 1992)

[6] The pathways by which some of these plants reached eastern Indonesia, and Timor in particular, are by no means clear. Many of these plants were already established at the time that Rumphius prepared his masterwork. This is certainly the case for maize, pumpkin, sweet potato, peanuts, watermelon and tomato. Rumphius credits the Spanish for the introduction of maize and sweet potato into eastern Indonesia and designates Japan as the source of the diffusion of peanuts.

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(*Xanthosoma*) which is now interplanted with older forms of taro (*Colocasia*), sweet potato (*Ipomoea Batatas Poir*.), peanut (*Arachis hypogaea L.*), watermelon (*Citrullus vulgaris Schrad*.), papaya (*Carica Papaya L*.) which is generally eaten as a 'vegetable', different kinds of chili (*Capsicum annuum L./ Capsicum fructescens L*.) and tomato (*Solanum Lycopersicum L*.).

To this list could also be added yet more recent introductions: eggplant, Chinese and European cabbage and the potato, which is grown in some upland areas of the island.

While the repertoire of Timorese food plants is indeed considerable, the three plants that have so significantly changed the patterns of Timorese subsistence deserve further consideration.

Maize is the most important of these three because it is now the principal staple of the Timorese. The date of its introduction to Timor is uncertain, though it was beginning to spread on the island by the end of the 17th century. Although the Portuguese are sometimes credited with its introduction, there is no clear evidence of this. Early Portuguese accounts appear to confuse maize with sorghum, which was already well established in some coastal areas of Timor. The earliest Dutch reference to maize dates to 1672 in the form of a directive to Dutch Company officials in Kupang instructing them to introduce what was then called "jagung, Spanish or Turkish wheat" (*sjagon [jagung] Spaense ofte Turckse taruw*) to improve native agriculture. This reference seems to imply that maize was not yet being cultivated. However, by 1699, just a quarter century later, William Dampier reported that maize was growing in the Kupang Bay area of West Timor (Dampier, 1703).

If this is the appropriate date for the introduction of maize, the major agricultural transformation of Timor occurred in the 18th century with maize spreading from west to east. This agricultural revolution coincided with the growing dominance of the Portuguese-speaking Topass elite (extending from Lifao in Oecussi through the Noel Muti mountains to the south coast) who maintained a close association with the rulers of West Timor, supplying them with iron tools and flintlock weapons. It is this 'alliance' that transformed Timor beginning in the west (see Boxer, 1947; Fox, 1988).[7]

Once introduced, maize spread throughout the island of Timor to become the mainstay of the diet of most Timorese. Maize is planted to coincide with, and thus capture, the first precious rains of the west monsoon. The onset of these rains varies locally; rain can occur as early as October or be delayed until December. Mountainous areas generally receive rains well ahead of the coasts; as a result, maize planted in the uplands can be well advanced before planting even begins in the lowlands. Early rain, however, is no guarantee of its continuation. Hence all maize farmers must retain enough seed to replant, if initial attempts at planting fail. In dry years it is not unusual for farmers to be forced to three attempts at planting their crop. The irregularity and uncertainty of maize cultivation is a persistent concern of all Timorese farmers.

Pumpkin/squash[8] Despite the prevalence of pumpkin and squash as a source of subsistence among the Timorese, the importance of these plants is often overlooked. They are intercropped in virtually all Timorese fields and gardens. Yet there are hardly any reliable data on production and there is even less information on the botanical history and local ethnobotany of these critical food sources. Describing conditions in the Ambon region in the 17th century, Rumphius provides an excellent description of local pumpkin and reports that it was already a common food at the time (Heyne, 1950). What can be said of pumpkin and squash in Timor is that they are now an invaluable food source both in times of abundance and in times of scarcity.

Cassava In the 1870s, the botanist Teysman reported that cassava was hardly grown in Timor and that there was, at that time, no Timorese word for the plant. In the 1890s, only migrant Rotenese, at the western end of Timor, were reported to be planting cassava. During the Japanese occupation, however, there was a major effort to force the Timorese to plant cassava, a policy which the Dutch continued in West Timor and the Portuguese may also have encouraged. In effect, once introduced throughout Timor, cassava has been taken up and has now

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[7] The fact that in West Timor there is a single large language group — the Dawan or Atoni Pah Meto — is the likely result of the expansion of this population (and its assimilation of other language-speakers) through its reliance on effective new tools, formidable new weapons and a new crop base — all initially gained by contact with Europeans, both Portuguese and Dutch (see Fox, 1988). With the transformation of their subsistence base, the Atoni Pah Meto were able to increase their local population density and were able to expand their territory by more voracious methods of slash and burn agriculture. No other comparable expansion of a particular language population occurred in East Timor.

[8] The literature on Timor uses the terms 'pumpkin' and 'squash' almost interchangeably for a variety of possible plants: *Cucurbita moschata Duch., Cucurbita pepo L*. and also *Curcubita Duch.* (see Mudita and Aspatria, unpublished draft for a discussion of current squash cultivation in Timor).

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become one of the island's most important crops, particularly in times of drought.

Historical, as well as contemporary, evidence indicates a remarkable openness on the part of the Timorese to adopt and utilise new plant material. Their existing repertoire of food plants testifies to this fundamental attitude. Timorese openness — indeed eagerness to experiment with new seeds — is based on an understanding of the need to find suitable conditions for cultivation of specific food plants. As one Timorese farmer patiently explained to me after what was (to me at least) a spectacular failure of a new variety of maize, the initial failure of newly introduced seeds should not be viewed with discouragement since conditions in Timor are difficult and therefore it takes time for any new arrival to become adjusted.

Rice in the configuration of Timorese agriculture[9]

As a result of this openness to new food plants, Timorese agriculture consists of a curious configuration of crops. Timorese dryland agriculture with its reliance on maize, beans and squash — spiced, as it were, with chilies and tomatoes — resembles Mexican *milpa* cultivation, which is based on a similar mix of intercropped plants. The major difference from a kind of 'Mexican' cropping system lies in the importance of rice, cultivated both as a rainfed and as an irrigated crop.

Rice was certainly one of the early food plants cultivated in East Timor. Throughout the island, it is regarded as a food of high status. Although for many East Timorese, rice is not consumed on a daily basis, it is essential to serve to guests at feasts and ceremonies. In the second half of the 20th century, rice has been at the centre of a further transformation of Timorese agriculture.

In the mid-1960s, the Portuguese introduced a number of varieties of high-yielding rice that had just been developed at the International Rice Research Institute (IRRI) in Los Banos. As in other parts of Asia, Portuguese agronomists were able to demonstrate that IR8 and IR5 from IRRI were more productive, with or without fertiliser, than the local *indica* variety (of indeterminate pedigree) known as *Java* (see Gonçalves et al., 1974). Whereas all varieties responded to the application of fertiliser (nitrogen and phosphate), IR 8 produced yields between 4.3 and 5.5 tonnes per hectare in almost all areas. This was at least one tonne greater than that of the local variety. These yields were reported to be over ten times higher than those from rice planted by traditional methods on rainfed fields (see Metzner, 1977). The sites chosen for the rice trials in East Timor were located on the north-eastern coast of the island where, at that time, most irrigated rice agriculture was concentrated. These sites included Laclo and Lelaia (in Manatuto), Seiçal (in Baucau) and Laivai (in Lautem). All trials required the transplanting of seedlings, a practice that was itself an innovation. Metzner (1977), whose research focused on a transect from Baucau through Viqueque, reported that on the northern (Baucau) side of this transect: "Wet rice fields are predominantly located in the floodplain of the River Seiçal and along the western and eastern escarpment of the Baucau Plateau (Baucau-Sede), as well as in the foothill zone of Mt Mata Bian in Quelicai".

More significantly still, the new high-yield varieties were introduced to the Uato Lari plain in Viqueque on the south coast of the island, which had been opened up in 1965, via irrigation, for substantial agricultural development and increased settlement. Metzner, who conducted geographical research in East Timor in 1969, noted the remarkable speed with which the new rice varieties were taken up by the East Timorese — more rapidly, however, in the Uato Lari plain than in Baucau or other sites on the north coast. By 1969, Uato Lari was exporting to Dili almost twice the amount of rice that Baucau exported (see Metzner, 1977). Metzner attributed this "rice boom" to the new varieties of rice (IR5, IR8) and the adoption of rice transplanting techniques together with the use of fertiliser (nitrogen as ammonium sulphate).

These new experiments in rice agriculture were still in their initial stages when Indonesia took over the territory in 1975. At the time, Indonesia was itself involved in a massive national program of rice intensification (BIMAS) (see Fox, 1991), and soon transferred its rice development policies to East Timor. The result was a substantial investment in irrigation in pursuit of increased rice production throughout the territory. East Timor's landscape, with a number of important rivers emanating from the mountains and flowing to the coasts — north and south — made 'run-of-river' irrigation a relatively effective development strategy.

Whereas the Portuguese colonial government had concentrated its efforts in the eastern half of East Timor, the Indonesian government shifted development to the western half because in the late 1970s and early 1980s, there was greater local security in the west than further to the east.

[9] This section and the following one draw on information from Hill and Saldanha (2001).

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The Indonesian push to increase irrigated rice agriculture was not without its difficulties. New areas for rice cultivation were developed and extended throughout East Timor but without sufficient local labour to achieve production levels that would assure food security. Farmers had to learn new skills and alter others to meet the needs for rice growing. Transmigrants from other areas of Indonesia, Bali in particular, were brought to East Timor to introduce exemplary skills and provide extra labour. Mechanisation was begun but was only partially successful. Water buffalo that had previously been relied upon for puddling rice fields declined in number but their replacement by small tractors was a mixed success. Maintaining these tractors and using them in Timor's difficult clay soils posed formidable problems. Bali cattle were introduced as traction animals with some success in the western regions but with far less success elsewhere.

The initial development of new irrigation was concentrated on the Maliana plain in Bobonaro district and these efforts resulted in a substantial increase in irrigated rice production. As a result, by 1982, according to official statistics, Bobonaro had twice as much land planted with irrigated rice as either Viqueque or Baucau. The district had the highest rice production in East Timor. By 1981, Bobonaro's rice yields per hectare were the highest in East Timor, which indicates the use of high-yield varieties of rice. By 1982, if official figures are correct, Bobonaro was producing as much rice as the rest of East Timor put together (BPS Kantor Statistik, 1982). In time, further efforts at developing irrigation were extended throughout the territory so that by 1997, rice production amounted to roughly two-thirds that of maize.[10]

Rice production is concentrated in the northern and the southern coastal areas on both the eastern and western sides of the island. Viqueque, Baucau and Manatuto are the main production areas in the east; Bobonaro, Covalima and Oecussi are, similarly, the main production areas in the west (Fox, 2001). These coastal areas thus benefit from rains that occur at higher elevations; they also gain from a fertile flood of silt that is brought down with the annual river flows. Yet, each year, these heavy river flows from the mountains play havoc with downstream irrigation systems. Damage to intake and headworks, serious erosion, heavy siltation and the undermining of concrete foundations all contribute to the need for regular, as well as immediate, repair. Under these conditions, production is always precarious and costs are relatively high. Nevertheless, rice cultivation is a critical component — an important niche component — of a diverse environment still dominated by dryland agriculture. It is this diverse environment that requires further consideration.

The agro-climatic zones of East Timor

Given its relatively small size, East Timor is comprised of a surprisingly diverse ecology. Much of this diversity is a product of the territory's complex landscape and variable seasonal rainfall. Based mainly on factors of altitude and rainfall, East Timor can be divided into six different 'agro-climatic' zones (ARPAPET, 1996) (Fig. 1). Although further differentiation among these zones is possible, and indeed necessary to a proper understanding of local agriculture, recognition of these zones provides a first step to comprehending East Timor's diversity.

The structure of these zones takes account of the fact that East Timor is divided by a mountainous spine that transverses the territory from west to east. In broad terms, 21% of East Timor is below 100 metres; 44% consists of land between 500 and 1000 metres; while the remaining 35% of land is over 1000 metres in elevation.

East Timor's mountains have a significant influence on the island's rainfall patterns. More rain falls in the mountains than on the coast. The south coast of East Timor has, in effect, a second period of seasonal rain. Whereas most of the north coast has its monsoon rain from December through February, the south coast enjoys additional rains in April, May and June. These rains can often be greater than the rains at the beginning of the year. As a result, the north coast is far drier than the south and the mountains have more rain than the coasts. These patterns are critical to agriculture and also to the patterning of local livelihood activities.

East Timor's six agro-climatic zones are set out in Table 1. It is important to realise that these zones do not necessarily define contiguous areas. A number of locations within each zone is listed and also the calculated extent of each zone. Figure 1 provides a better indication of the relative size of these zones.[11] It includes an indication of the principal catchment areas of East Timor. The dark line on this map distinguishes between these catchments.

[10] Government figures for 1997 report total rice production at 110,540 tons and total maize production at 174,553 tons (BPS Kantor Statistik, 1997).

[11] Oecussi (Ambeno), the enclave of East Timor in West Timor, requires a separate map. Basically Oecussi's agro-climatic zones are similar to the rest of the north coast of Timor.

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Table 1. Agro-climatic zones of East Timor.

	Altitude (m)	Rain (mm/ annum)	Months of Rain
1. North Coast Lowlands Maubara, Dili, Manatuto (147,045 ha: 10%)	<100	<1000	4–5
2. Northern Slopes Atabae, Dare, Baucau, Lautem (336,627 ha: 23%)	100–500	1000–1500	5–6
3. Northern Uplands Bobonaro, Ermera, Aileu, Venilale (290,553 ha: 20%)	>500	>1500	6–7
4. Southern Uplands Lolotoe, Same, Soibada, Ossu (215,021 ha: 15%)	>500	>2000	9
5. Southern Slopes Hatu-Udo, Baguia, Alas, Los Palos (304,981 ha: 21%)	100–500	1500–2000	8
6. South Coast Lowlands Suai, Natabora, Betano, Viqueque (166,700 ha: 11%)	<100	<1500	7–8

Source: ARPAPET (1996). See Fox, 2001:157.

The variability of rainfall and the ENSO cycle

Timor is located in an area that is strongly affected by the El Niño Southern Oscillation (ENSO) cycle. This means that Timor alternates, in seemingly erratic phases, between periods of drought and flood. Thus, for example, from March 1991 until April 1998 (except for a brief respite of some months in 1995–96), Timor suffered continuing dry El Niño conditions (see Fox, 1999). During 1997–98, these conditions became particularly severe. From May 1998 until recently, Timor experienced a succession of relatively good monsoonal rains associated with a continuing La Niña. Despite the flooding that occurs during La Niña phases, these periods are times of increased productivity when the land (and its people) replenish and revive. Unfortunately, for the past century, Timor has experienced more periods of El Niño drought than La Niña plenty. Moreover, not only are there indications that this pattern will continue, there are also indications that the severity of El Niño phases may increase.

A number of critical locations in East Timor are anomalous within the general zonal pattern outlined here. These anomalies have a great deal to do with the irregular pattern of mountains and their effect on rainfall. Often it is the seemingly anomalous areas of Timor that are historical sites of importance, consistently chosen by successive populations for their exceptional features.

Having outlined these agro-climatic zones and the area that each covers, it is salutary to point to several important exceptions where higher rains occur than would otherwise be expected. Thus, for example, Liquica, located in the North Coast Lowlands, at an altitude of only 25 m, has an average rainfall of 1349 mm, well above that of neighbouring Maubara. Similarly, Maliana (Northern Slopes) at 278 m has an average of 2053 mm of rain; again well above what might be expected at this altitude, as does Baguia (Southern Slopes) at 369 m with 2388 mm of rain and Viqueque (Southern Coast Lowlands) at 46 m with 1610 mm of rain.

Timor's complex topography leads to variability in rainfall from place to place, but there is also considerable variability in rainfall from rainy season to rainy season and even from month to month within any one rainy season. Table 2 shows the mean annual rainfall for 20 sites in East Timor at different altitudes, along with the highest and lowest rainfall recorded at each site. A year of very high rainfall can be followed by a year of very low rainfall, making it particularly difficult for local farmers to predict and prepare for the conditions that they must face in any one year.

A 'variability index' is used here to attempt to capture this potential inter-annual variability for each site. This is simply a ratio index of the highest to the lowest recorded rainfall. A high index number is an indication of high variability in rainfall from year to year. Based on this index, it is important to note the differences between sites but particularly the high variability in key agricultural sites: Bobonaro, Maliana, Dili, Fohorem, Manatutu and Lautem — all of which have variability indices that range from 3 (Bobonaro) to 6 (Manatutu).

Planning for food security: minimal requirements

Given the high probability that East Timor will face a variety of ENSO episodes in the future, one needs to ask what are the minimum requirements for planning. This does not refer to the response process to an emergency situation but rather the preparatory stage (or stages) that are minimally necessary to know when, where and how to respond to problems of food security.

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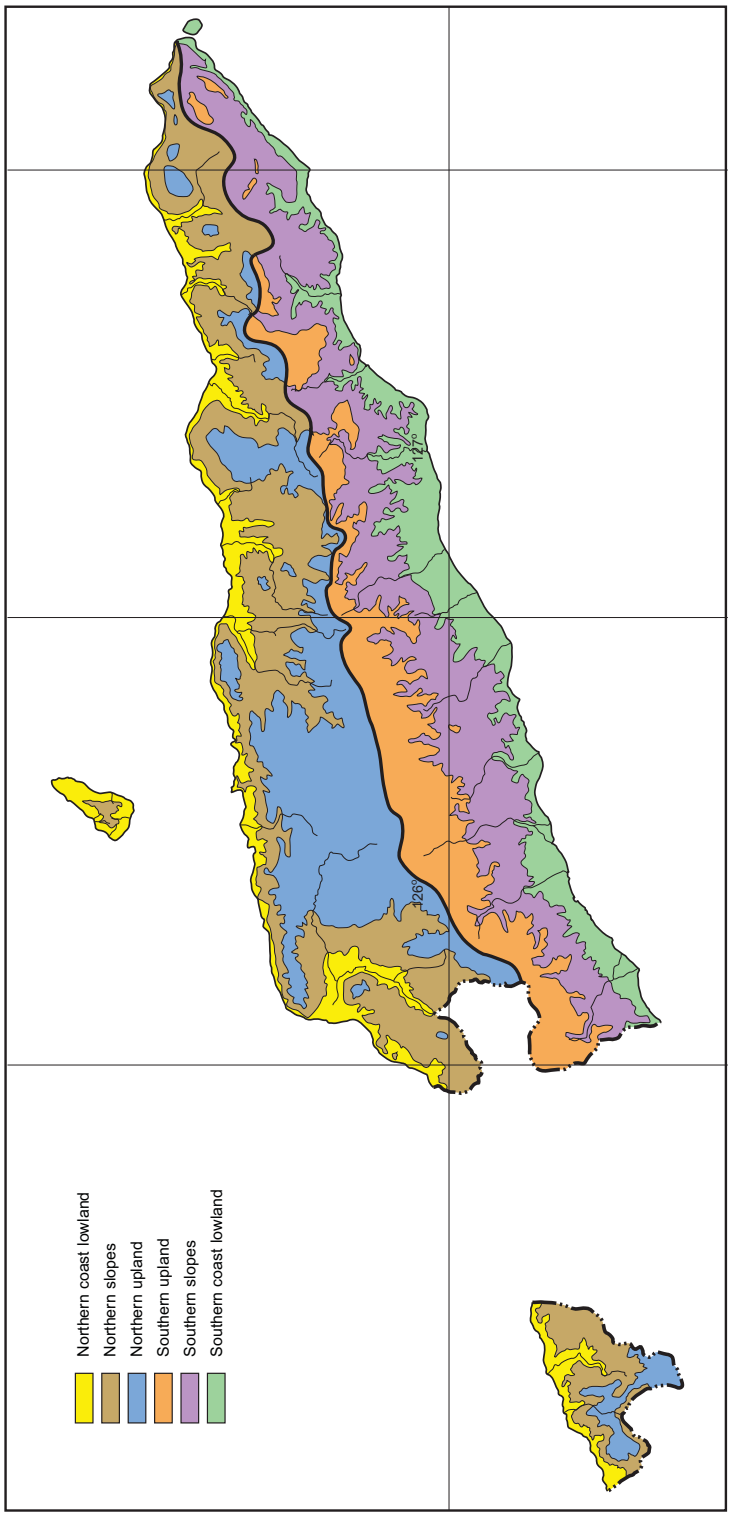

Figure 1. The Agro-Climatic Zones of East Timor.

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Table 2. Rainfall patterns in East Timor.

Site	Altitude	Mean	Highest	Lowest	Variability Index
Ainaro	809	2753	3465	2033	1.7
Alas	280	1937	2922	1033	2.8
Baguia	349	2388	3354	1622	2.0
Baucau	527	1362	1467	831	1.7
Betano	7	1329	1797	846	2.1
Bobonaro	850	2349	5229	1760	3.0
Dare	498	1742	4985	869	5.7
Dili	4	954	2821	475	5.9
Ermera	1160	3008	3601	2079	1.7
Fatu Besi	1125	2944	4410	1742	2.5
Fasenda Algare	916	1934	2565	1200	2.1
Fohorem	599	1503	2755	495	5.5
Gleno	770	1765	2431	1078	2.2
Hato Builico	1908	2537	5310	1639	3.2
Iliomar	365	2063	3004	1120	2.7
Laga	65	787	1209	468	2.6
Lautem	174	1040	1428	405	3.5
Liquisa	25	1349	1754	889	1.97
Los Palos	394	1905	3622	1313	2.7
Maliana	278	2053	3170	647	4.9
Manatuto	4	583	1700	283	6.0
Maumeta Atauro	4	969	1285	366	3.5
Oe Silo	472	1568	2338	979	2.4
Ossu	698	1956	2605	1264	2.0
Oecussi	2	1084	1458	755	1.9
Same	544	3142	4087	1445	2.8
Soibada	700	2444	3274	1527	2.1
Suai	71	1327	1760	956	1.8
Tutuala	361	1536	2412	1124	2.1
Viqueque	46	1595	2308	1115	2.0
Zumalai	100	1329	2063	861	2.4

A first requirement is a network of meteorological stations to record rainfall throughout East Timor. At the time of writing, none of the previous rainfall stations have been restored. The existing database on rainfall can serve as a guide to rainfall patterns in East Timor but to know what is actually occurring, one needs a network of stations that record rainfall and report to a coordination centre where all data is lodged and examined.

The next requirement is a database on rural livelihoods. Virtually no reliable agricultural data are being gathered on a systematic basis for East Timor. Former Indonesian data collections, which are certainly valuable and indicative but not wholly reliable, still form the basis for agricultural planning. New databases on production are needed and, in addition, there is a need to build up a systematic picture of local patterns of livelihood. These patterns are invariably based on farmers' experience and understanding of local soil conditions and rain patterns as well as different historically developed cultural practices. These practices include a range of significant features such as household structures, marriage patterns, and the control, transmission and allocation of traditional land holdings, all of which have an influence on livelihood strategies.

Awareness of different traditional cropping patterns — mapped across the landscape of East Timor — would already be a major step in an appropriate direction. There are areas where droughts occur at greater regularity — parts of the north coast, for example — than elsewhere in East Timor. Similarly, there are areas of regular flooding which can often be as devastating as severe drought.

This basic knowledge is fundamental to planning for the future and with it one can shape a response program that will be adequate and appropriate to conditions in East Timor.

The goal for every nation is to be able to assure its citizens of a sufficient supply of food, even in times of agricultural adversity. This is by no means a simple proposition. For most countries, like East Timor, food security requires reliance on both internal production and reasonable market access to food supplies from elsewhere. In addition, it requires local distribution capacities and mechanisms for

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appropriate allocations. Local self-reliance figures prominently in times of shortage. Food security, however, must be based on the recognition that in times of adversity, when local populations lack the capacity to meet their own most basic food needs, national assistance is a primary task of good governance. For food security, there is the need for advanced planning to be able to recognise emerging problems and to be able to respond to crises as quickly and as effectively as possible.

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