AODRO Newsletter

VOL.8 NO.2 JUNE 1990

FUNAFUTI ATOLL, TUVALU

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SEA-LEVEL RISE - implications for Tuvalu

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(Based on a field-mission for the Commonwealth Expert Group on Climate Change & Sea-level Rise 1988.)

> *Tuvalu is one of six countries, all of them island states, that "could face total destruction when sea levels rise... If sea-level rises occur anywhere near the extreme projections that have been made, we can write these nations off the map".*[1]

Scientists no longer argue about *whether* global warming will cause a rise in sea level: they want to know how much and over what period of time. Even though there is still some doubt about exactly how much warmer the world will become if the emission of greenhouse gases is not stopped, rising sea levels have been a measurable phenomenon since the 1960's, and scientists predict that the trend will continue. It is now accepted internationally that temperatures will increase by 1.5-4.5 degrees celsius and that the sea level will rise by 20-140cm before the end of the twenty-first century. The accepted assumptions for the interim are 1.5 degrees celsius temperature rise and 20cm sea-level rise by the year 2025.[2]

Tuvalu's Atolls

Tuvalu comprises a chain of nine atoll islands, all but two of which surround lagoons. Only one island encloses its lagoon entirely: the majority are made up of innumerable pieces of land (*motu*) surrounding their lagoons and each piece separate from the next. One other island has no lagoon but a swamp at its centre. Distances across each island lagoon are 15-18km and distances between each island are 125-150km. The entire atoll chain extends over 700km of ocean, but the total national land area is only 25sqkm. The largest single island is 5sqkm, and the highest point of all islands is 4.5m above sea level - most land areas are appreciably lower.

The population of Tuvalu is 8,500 of whom 2,700 live on the principal atoll of Funafuti at a density of 1,150 per square kilometre - equal to that of Malta. Tuvalu's national population density per square kilometre is 347, one third greater than that of the U.K. A fragile economy, of which the only export income is from copra (A$35,000 in 1986), is stabilised by the Tuvalu Trust Fund (created by Australia, New Zealand, the United Kingdom, Japan, the Republic of Korea and Tuvalu), income from the sale of postage stamps, and remittances from Tuvaluans overseas. Tuvalu's economy, like its topography, is small, fragmented and vulnerable to external influences.

Divergent Views

If internationally accepted assumptions are correct, most of Tuvalu will be inundated by the end of the 21st century. Uncertainty about the future will prevail for the greater part of 100 years, so two points of view are expected. One is that, with a sea already rising, any continuation of investment in the development of a fragile existence is now doomed, and has no usefulness other than to induce people to stay in an increasingly hazardous environment. There are many Tuvaluans who would agree, and who see the urgent need for the easing of immigration restrictions in New Zealand and Australia - where, they feel, a few thousand more people would not be noticed.

Others will point to the uncertainty itself and the 100 years in which that uncertainty could be prolonged. Evacuation itself would not be without problems, and in past crises there have been many who have preferred defiant and hazardous isolation to the unknowns of relocation. The Tuvaluans' experience of the sea and its hazards might enable them to adjust to additional hazards over time. The image of possible ultimate catastrophe should not be made to preclude what might be relatively minor measures on behalf of the islands in the interim.

The Effects of a Rising Sea

The first effects of rising sea level will not be new to Tuvalu. The construction of the Funafuti airstrip by American forces in WWII destroyed the lens of fresh water in the coral rock substrata. Ancient pits, which are filled with vegetable mulch for the growing of root crops in otherwise infertile coral sand, were the first to show the effects of the consequent salination that has been worsening ever since, and which a rise in sea level will exacerbate. Efforts to introduce the cultivation of sweet potatoes, grown hydrophonically in mounds of sand at ground level, will introduce alternative root crops - for the time being less vulnerable to rising sea salination.

Neither is sea-water flooding a new phenomenon; during the bi-annual high tides, parts of Funafati atoll are flooded to depths up to 0.6m. Traditional houses are designed with a floor level 1m off the ground - appropriate to land prone to flooding. New 'western' houses have concrete floors at ground level and these have displaced what were considered outmoded traditional forms. New building codes are, however, likely to reintroduce floors significantly raised above ground level.

These innovations in food production and building are being made with regard to long-recognised hazards. Similarly, construction to prevent coastal erosion has commenced - not on account of a rising sea, but a normally aggressive one. Sea-level rise will not at first present hitherto unknown conditions, but these known hazards will be exacerbated, arise more frequently and perhaps more severely, with periods of 'normality' in between.

Cyclones & Vulnerability

In this context, it is useful to review times when Funafuti

was flooded in the past to see how best to provide for future events. Funafuti atoll was overwhelmed in 1972 by the 15m waves of TC 'Bebe', riding on an exceptional spring tide and accompanied by winds of up to 150 knots.[3] Nearly all of the 125 village houses were destroyed and government buildings were damaged beyond repair. Five people died and 700 were made homeless: crops were annihilated and copra production fell by 80 per cent. An enormous ridge of coral reef rubble, 19km long and up to 4m high, appeared overnight on the ocean-facing coastline, enclosing a new inland lagoon.[4] Similar banks appeared on other atolls.

Vulnerability to hazards of this and lesser kinds requires a people able to cope and an infrastructure able to support them. It is essential that these conditions before catastrophe enable them to survive and recover afterwards. The provision of fresh rainwater for drinking and cooking; the removal of breeding places for mosquitos and other vector; rubbish disposal and attention to environmental health are all factors that become crucial to survival and recovery after any disaster. The incidence and intensity of disasters are likely to increase and these factors will become even more crucial.

Strategy for Development

On Funafuti atoll, around the capital Vaiaku, there exist conditions of overcrowding, environmental degradation and consequent environmental health hazards, comparable in their aggregation more to some urban peripheries of major cities than to other atoll islands.

Tuvalu currently receives development assistance from Australia, New Zealand, the United Kingdom, the EEC, Canada, USA, and the Federal Republic of Germany.[5] A strategy for development is required to accommodate a comprehensive approach to the implications of sea-level rise in the atoll islands. As well as the physical aspects of sea defences, social and cultural aspects that will help

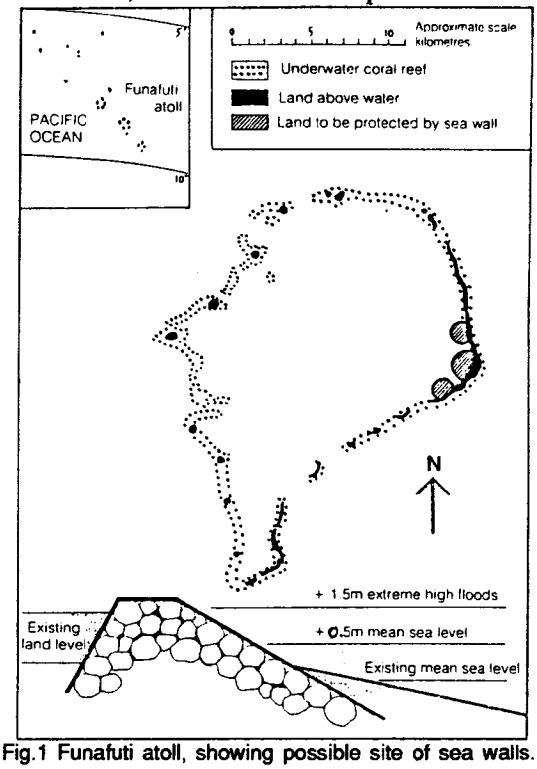

Fig.1 Funafuti atoll, showing possible site of sea walls.

vulnerable communities to adjust to their hazardous environments must be considered. Only when there is a national policy for development which takes account of the early implications of sea-level rise, can a balanced long-term strategy effectively commence. Matters of long-term consequence would best be considered when short-term threats have been accommodated.

Sea Defences

The land form of Funafuti atoll is so narrow and attenuated that in order to protect its 2.5sqkm, 54km of sea defences would have to be constructed. Moreover, so narrow is the land for much of its length, that sea defences on one side would be protecting the back of sea defences on the other - with nothing in between. For the sea defence to be feasible, the land itself would have to be modified so as to maximise the areas surrounded by a given perimeter of wall. Clearly a circular land area is the ideal shape (see Fig.1). Furthermore, because the coral rock substrata is porous to depths beyond conventional sea-defence construction, the land forms within their defences would have to be raised so as not to be flooded from within as sea levels rise - temporarily or permanently. What kind of lifestyle would be possible in these 'citadels of the sea'; and what kind of social, cultural and physical upheaval would be necessary for their construction and occupation are questions likely to displace those of economic evaluation. The breadth of the proposal reflects the enormity of the problem posed by sea-level rise in its ultimate extreme.

Ultimate Issues

Evacuation would be preferable to many Tuvaluans; but there are issues beyond those of national consideration. Both international strategic and cultural issues are raised by the threatened disappearance of islands in the midst of vast expanses of ocean. International assistance is vital, therefore, for the conservation of both strategic and cultural values; but it will only be by encouraging and assisting the cultural adaptation to locally understood hazards of the sea in the short and medium term, that longer term strategic requirements may also be met.

Rather than dismissively 'writing these nations off the map', the field examination of their context, conditions, and culture may lead to more creative assessments of their future - certainly for the short and medium term, and possibly for the more uncertain long-term as well.

References

1. Geoffrey Lean, reporting J C Pernetta in **The Observer.**

2. United Nations Environment Programme (UNEP): **Report of the Joint Meeting on Implications of Climate Changes, Split, October 1988.** These assumptions were accepted and the UNEP/ICSU/WMO International Conference, Willach, October 1985 and incorporated into the work of the Commonwealth Expert Group.

3. David Ball, **Funafuti Ellice Islands: Physical Development Plan.** BRE :Department of the Environment, 1973.

4. Graham Baines and Roger McLean, 'Sequential studies of hurricane deposit evolution at Funafuti Atoll'. **Marine Geology,** volume 21, Elsevier, 1976.

5. **Tuvalu: National Development Plan IV;** 1988-91.