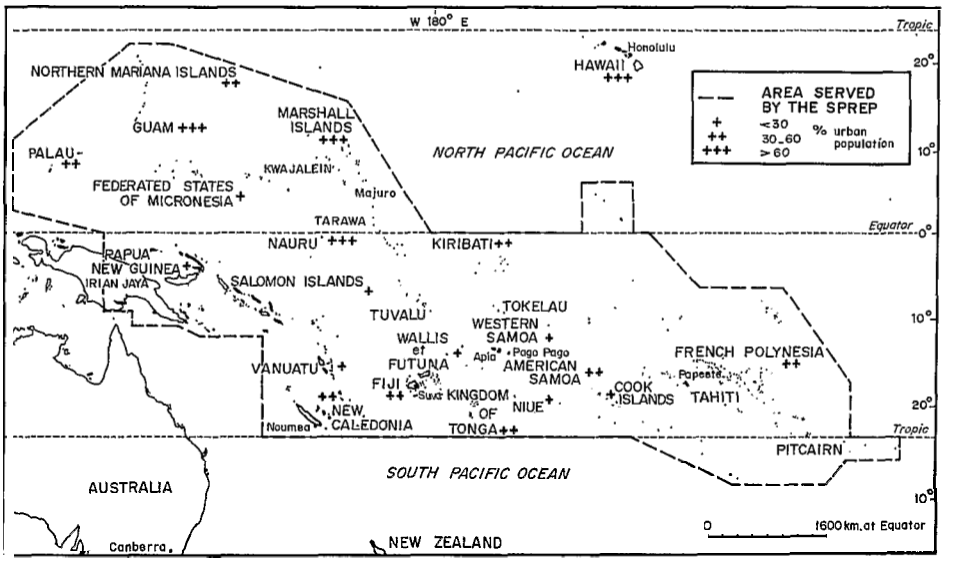
Environmental Case Studies

Study No. 6

Not Always a Pretty Face: Urban Growth versus the Environment in the Pacific Islands

By the end of this decade, the world's urban population, now over 3,300 million, will be more than the rural population. Half a century ago, there were only 700 million town-dwellers, only half as many as rural people.

1. Airborne pollution in Noumea.



The Global Situation

The negative impact of human activity on a global scale is sorely evident, especially in densely populated urban areas. Despite their relatively small populations, the Pacific island countries have not escaped this trend.

It is in the fast-growing major towns and cities in the region that the environment has suffered the most severe damage, because of the concentration of damaging factors, and the primarily coastal siting of urban areas (1)-(2)-(3).

The total Pacific island countries' population seems modest compared to elsewhere in the globe (6.6 million, including Hawaii, in 1985). However, some countries have high urbanisation rates (Nauru, Guam, Hawaii, Northern Marianas are over 80%; French Polynesia, New Caledonia, Palau and the Marshalls are 50 to 60%). At the other extreme, Papua New Guinea's urban population is under 15% of its total, and Solomon Islands is barely 10%.

More often than not, the capital is the country's only significant town, and self-stifling effects accentuate difficulties in development planning, and the resulting environmental degradation. Most of these towns could see their population double by the end of this decade.

Urbanisation impacts on all factors which, in any given place, govern the well-being and characteristics of living things. Soils and relief are changed. Natural slope erosion can be temporarily increased 10 or 50 times by construction -related activities. Sedimentation caused by run-off can have severe consequences on the function of wetlands down stream. Undisturbed wetlands normally regulate Ihe drainage of the heaviest rains and act as a natural treatment plant for waste water. If they are filled in, coastal water pollution can be aggravated by the direct outflow of effluent.

The accumulation of many industrial and organic waste in town soils has been investigated many times.

It has been known since the 18th century that towns are hotter and drier than their rural surroundings, and that this is often due to the proliferation of impermeable surfaces. Vegetation in towns becomes poorer, first in quantity and then in quality. Then the only survivors are undemanding, fast-growing plants that tolerate urban conditions. The cyclone hazard requires tall trees to be cut down to avoid the risk of damage if they are blown over.

However greenery is not just attractive: it also has many benefits. It reduces noise and heat. It acts as a wind- break and reduces evaporation, improving the balance between heat and humidity. The main advantage of having trees in an urban environment, however, is to create different micro-climates for evapotranspiration which, especially in tropical climates, are sources of comfort for town inhabitants.

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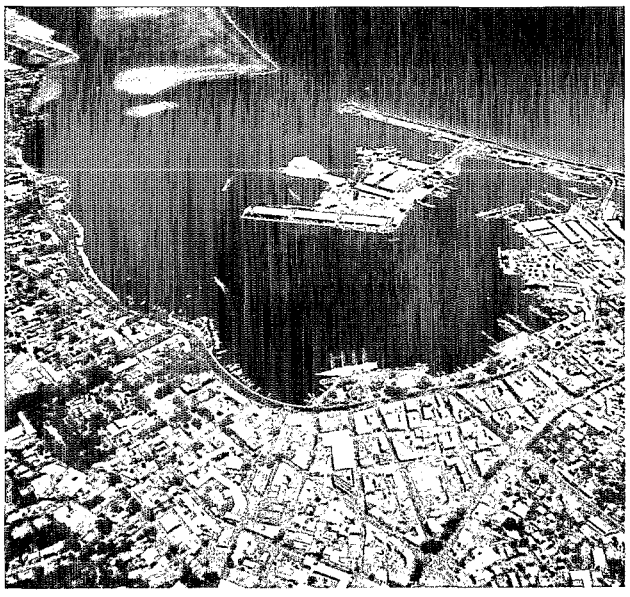
The first "environmental revolution" last century paved the way for an unprecedented expansion of the largest cities in the industrialised countries. This was made possible by mastering four factors which are critical in maintaining an adequate environment for harmonious growth: housing, water supply, waste water disposal and solid waste disposal. Poor control over these in the towns of developing countries does not stop them growing, but leads to environmental damage, which jeopardizes these cities' very future.

In Micronesia and Polynesia, the larger islands of Fiji and some small islands of Melanesia high urban populations along the coasts can cause a range of attacks on the environment. Population growth, and internal migration, has quickly worsened this damage on the atolls, some of which have very high population densities in a fragile natural environment.

Similarly, in the main high islands the development of historic capitals around the major port has encouraged trade and industry. There is often similar development around the international airport, if the topography allows it.

Finally, in most Pacific islands, urban development has disturbed the nearby marine environment on which these towns depend, in varying degrees.



3. Close-knit urban area and lagoon reclamation: Papeete.

The forecasted effects of global climate change on coastal zones are an other challenge with the already pressing threat of rapid urbanisation, especially on atolls.

The challenge of change, as shown by the urgency of saving environments jeopardized by urban spread in Pacific islands, can only be met by education and a voluntary coalition between the community and the policy-makers. The former is the key to a collective awakening and to controlling population growth. The latter are needed to give public interest precedence over individual greed and selfishness, and to restore community spirit and resources on which the survival of previous island populations depended.

The Atoll Situation

The limited resources of the atolls and their fragile natural environment make these islands incompatible with urban spread. Today, many Pacific atolls, especially in Micronesia, show high urbanisation rates. These urban centres are constantly increasing in pressure on land resources (especially groundwater) and inshore lagoon resources. As with other islands, these towns offer attractive facilities, and paying jobs. This favours rapid growth, by adding migratory movements to already strong natural population growth.

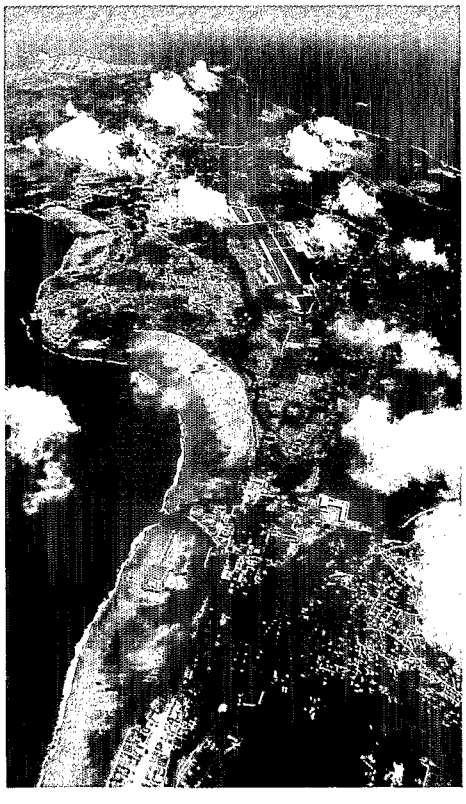
The population of Tarawa, for example, is mostly concentrated on this atoll's urbanised southern motus, gathering one third of the population of Kiribati. This population has increased more than tenfold in the past thirty years, from under 2,000 in 1950 to over 21,000 in 1985. In some localities, the population density is almost 8,000 inhabitants per sq. km (4).

The three motus of DUD (Dalap, Uliga, Darrit) forming Majuro, in the Marshall Islands, contain almost half the country's population, with a density nearing 20,000 people per sq.km.

In the same country, on Ebeye, more than 9,000 islanders have in recent years been living in a 30 ha urban area in even worse overcrowding, since the people of Kwajalein were relocated here when the huge Kwajalein lagoon began its use for U.S. military purposes.

In the early 70s, the circumstances of the Micronesian atolls, with settlements destined to become towns, was far from encouraging. Water supply was non-existent and people relied solely on collecting rainwater. There was no waste water treatment plants or sanitation system anywhere in the country. The most common arrangement was latrines on stilts over the lagoon (5). There was no organised household waste collection service, even though waste production greatly increased.

2. Urbanisation in northeast Guam.



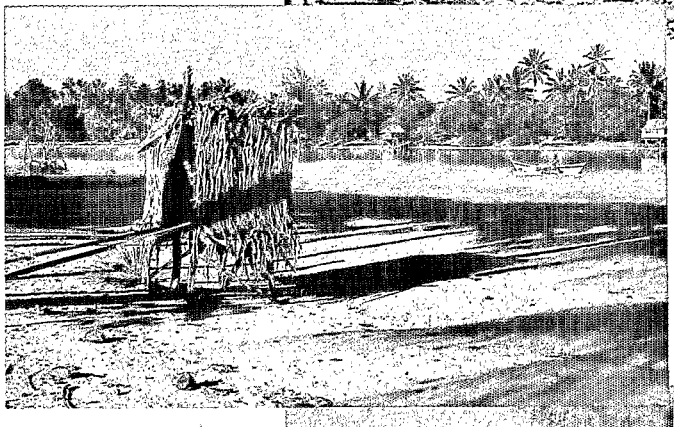
Hurried action in response to a deteriorating natural environment which had become hazardous for humans was not totally satisfactory. For example, a cholera epidemic on Tarawa caused about a hundred deaths. This led to the construction of a drainage system channelling untreated waste water into the ocean (between 1976 and 1983), coupled with shared latrines, using a saltwater gravity-feed system. There is still serious faecal pollution in the lagoon. Population increases and the continuing use of the lagoon for subsistence fishing drove up morbidity and mortality, in children particularly, from intestinal infections. This was worsened when a permanent road link was built between Bonriki and Betio motus, which now hinders water circulation between ocean and lagoon in this section of the atoll.

There are also problems with supplies of drinking water. The sweet water lenses of the motus sustaining urban development in South Tarawa are now polluted and too brackish to drink. From 1982, the supply had to be supplemented by water pumped from the atoll's northern motus, which needed chlorination. Since today's needs are only barely covered, plans are emerging to go back to water storage in tanks at every house. This option, which prevailed in all atolls before partially giving way to a pumped supply, also appears to be the best preparation for the gradual changes needed to conserve groundwater resources if sea levels rise due to global climate change (6).

Lastly, solid waste management is another unresolved issue. This waste builds up along the coastlines and worsens the pollution of the lagoon.

The situation is worse in Majuro, Marshall Islands. Beaches are contaminated by faeces and indiscriminate waste disposal, should be closed for swimming and inshore lagoon fishing should be banned, says the local Environment Protection Agency (EPA). In an environment where avid consumerism multiplies durable waste of all kinds, the waste disposal problem is still not solved. The town and water's edge, on the lagoon side in particular, are starting to look like a refuse dump (7).

4. Damage to the shore in Majuro.



5. The threat of unsuitable sanitation on Tarawa.

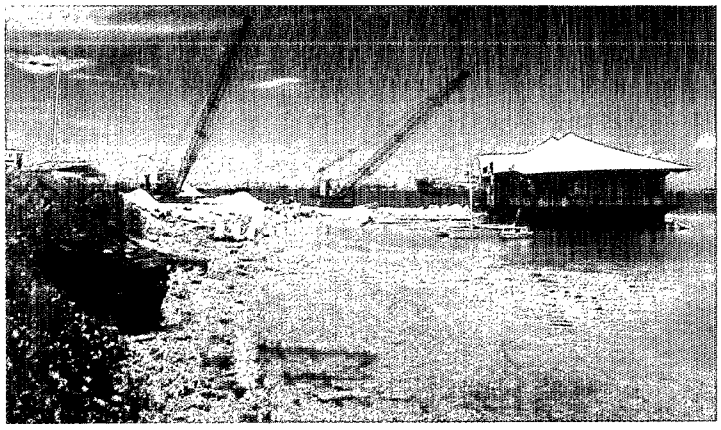
6. Atoll fresh water: a scarce and vulnerable resource (Tarawa)

Water supply reflects the same realities. The lens is polluted. Now that it is unusable, it must be replaced by water from the airport runway catchment, by pumped supply from distant, non-urbanised motus, and by desalinating seawater.

Ebeye is a similar, if not worse example, but one which concerted action is now relieving. After the population of Kwajalein was settled there in the early 60s and quickly grew, the situation gradually deteriorated. In the early 80s, the urban area was supplied with water by barge from Kwajalein 3 times a week. Electricity supply was virtually non-existent. The waste water disposal system was unserviceable and waste water flowed away freely, totally polluting the lagoon. There was no solid waste management system and refuse built up around houses, impressing observers as the general overcrowding in such a small land area.

The atoll's inhabitants protested, following destruction caused by a tropical cyclone in 1988, and a relaxation in the military regulations governing life on the atoll. This led to the creation of a management body responsible for restructuring the urban zone. Ebeye is to be linked to 6 other motus by a causeway, which will double the land area available. Landfill will add 4ha to the usable area of the main motu, reducing overcrowding. A new waste water system is also planned, under EPA control, with effluent to be pumped out to sea. And the water supply problem should be solved in 1990 with the commissioning of a new power station coupled to a sea water desalination plant producing 160,000 gallons per day, or just less than 80 litres per person per day.

7. Refuse builds up on an atoll shore: Majuro



8. Urbanisation directly threatens lagoons: coral quarrying on Marujo.

The High Island Situation

The more diversified environment of the high islands, offering more resources than the atolls, suffers the same multiple depredations of an essentially coastal urbanisation. Here, the towns are larger. They are dominated by the capital, in proportions expressed by the "primacy index" which is the relationship between the population of the capital and the urban population as a whole. This falls below 60% only in Papua New Guinea, Hawaii and Fiji.

Papeete urban area contains almost 80% of the population of the island of Tahiti, along 40km of a coastline so steep that only a strip an average one kilometre wide has so far been settled.

The rapid growth of the urban strip has rapidly increased land-based, biological and chemical pollution in the last thirty years.

Half of Papeete's coastline is artificial, much of it reclaimed land, to the detriment of the adjacent lagoon biotopes. Quarrying for coral materials and disturbance of the seabed have been instrumental in increasing turbidity, which the coastal currents encourage. This has killed off the neighbouring macropode colonies, especially between Arue and Punaauia. Here at least 1.6 million tonnes of fill materials were extracted from the lagoons up to 1987, when this practice was then outlawed.

Today, the urban area boasts a hundred hectares of disturbed lagoon floor from which marine life has completely disappeared (8).

Settlement of sloping land has contributed to land-based pollution of the lagoon. Roads have been built to reach the most accessible parts of the upland plateaux, where terraces cut into weathered soils are subject to heavy and sustained rainfall. Inadequate precautions have often been taken, and the watercourses carry down large volumes of mud into the lagoon. This causes higher turbidity and sedimentation and suffocates the coral to death.

Runoff was also increased by land clearance. Half of the town's 32 sq .km is accounted for by these terraced slopes, from which a substantial solid load was carried downhill when they were carved out. Only proper compacting and rapid turfing of these platforms could slow the adverse effects of excess runoff, which has greatly increased because of the proliferation of impermeable artificial surfaces such as roads. The lower-lying parts of central Papeete are now regularly flooded during heavy rain (10).

Runoff is no doubt a major source of chemical and biological pollution registered in the port of Papeete, and to a lesser degree in the surrounding lagoons. As in Suva and Pago Pago harbours, oils, hydrocarbons and detergents contaminate the upper layer of water in the port area to a degree that the marine life cannot tolerate. Heavy metals (mercury, copper, lead and zinc) are present in the seabed sediment in concentrations up to 12 times higher than normal. The dyking-in restricts water circulation between port and ocean. It traps both these elements and the solid load in runoff (3).

Lastly, faecal pollution rules out swimming from most of the beaches within Papeete urban area, because of the lack of a coherent, integrated waste water collection and treatment system, and because effluent is still often disposed of straight into the lagoon. In the outskirts of Papeete, there is also highly polluting waste from semi-industrial livestock enterprises operating in the valleys. The preponderance of single-home systems may hinder the implementation of the sanitation master plan. This scheme includes projects for four major purification plants to treat urban effluent before disposing of it.

Papeete is also faced with the problem of managing its solid waste. This is produced at a rate similar to industrialised countries (over 2kg per person per day, or 75000 MT per year). Six official dump sites in the valleys and dozens of unlawful dumps contribute to the physical, chemical and visual degradation of the environment (11). The lack of sorting and the frequent fires spread evil-smelling and toxic fumes over the town. These have led to the construction of an incineration plant producing methane, currently being trialled. It is doubtful whether this costly plant, which is almost working to capacity, will satisfactorily solve the refuse disposal problem.

With the privilege of abundant resources of sweet surface water,

Papeete has grown without a central household water supply and treatment system. Users use 1 000 l. each per day, ten times that available on many low islands. This water is piped from many open, above-ground catchments that have uneven degrees of protection and control, and is often untreated and not potable.

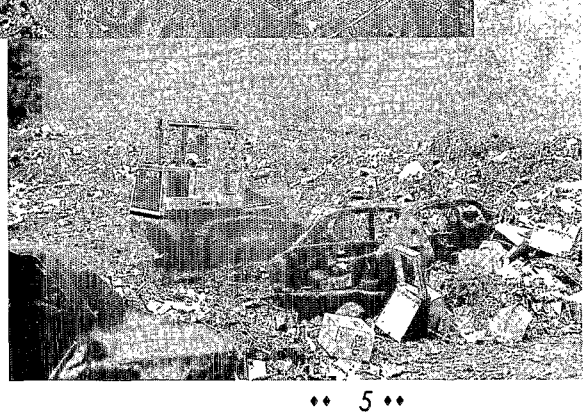
The expansion of the urban area of Suva, whose population (180,000) has grown fivefold since 1950, has been accompanied by environmental damage similar to that in Papeete, apart from solid waste disposal in the lagoon (12).

The coral biotopes have also come under a wide variety of attacks from quarrying and reclamation works. Several million metric tons have been extracted since the 1960s. Between 1962 and 1983, 17.5 ha of reef were destroyed. 100,000 MT of coral materials are consumed annually by Lami cement works. In a reverse process, coastal land reclamation schemes commenced in the 1930s have damaged the lagoon and mangrove environments. Some mangrove swamps have become receptacles for effluent and solid waste. There are also concerns with chemical and biological pollution of coastal waters in the Suva port area and Laucala Bay; near the Walu Bay and Vatuwaqa industrial areas; areas close to the Kinoya and Raiwaqa waste water treatment plants; and near the Lami dump which lies on landfill. (9) -(13).

Indeed, in many Pacific island towns, as in some large cities in Pacific Rim countries, the same picture recurs.

10. An urban area unable to cope with increased runoff: Papeete.

9. Port areas concentrate pollution: Suva.



11. Piles of solid waste that cannot be recycled locally: Papeete.

The high cost of waste water treatment plants is a factor in their absence or inadequacy. As nutrients build up in coastal waters where effluent is dumped, there is a proliferation of toxic algae and increase in water turbidity, which affects coral growth. Eutrophisation and solid deposits combine to kill off the seagrass beds. A links exists between greater turbidity, higher nutrient content and the proliferation of the ciguatera-bearing dinoflagellates which cause several thousand cases of fish poisoning annually in the Pacific islands.

Effluent dumping is directly responsible for diseases (cholera, hepatitis), whose spread is favoured by the dietary habits of island -dwellers, which they do not give up when they move to town. Industrial waste from fish canneries can also contribute to the biological pollution of the marine environment close to the towns where they operate. This is the case with Pago Pago, for example, and to a lesser degree at Levuka (Fiji) and Tulagi (Solomon Islands).

Many Pacific island towns are, in fact, facing insurmountable planning problems. This is because there are no proper regulations and no strict land use rules laying down occupation densities, as determined by the activity.

The examples of Guam and Hawaii, and that of the city of Honolulu, show, however, that deterioration can still be remedied.

Guam

The island of Guam, with 541 sq .km and 130,000 inhabitants, has had rapid urbanisation in recent years, especially in the northern half of the island which is made up of the elevated coral limestone of an ancient reef. While agriculture now accounts for only 0.4% of the active population, urbanisation is gradually creeping out over the mountainous southern part of the island, which is volcanic in origin. The spectacular growth in tourism and the shift of the population from the centre of the island towards the northern part over the last 30 years, left no option but to rapidly adopt a strict sanitation and

water quality control policy. This governs a water supply pumped mainly from the lens underlying the limestone in most built- up areas. Here, local population density often exceeds 1300 per sq .km in neighbourhoods of the capital, Agana, which in 1 980 had an average density of 200 per sq .km (2).

At the end of the 1 980s, more than 99 % of houses were connected to a piped water supply and a common sewage system. 70% of drinking water was supplied by over 100 wells, inspected by the Guam EPA, the local branch of the federal US body. The tradewinds, Guam's relief and its small size spare it the unpleasantness of airborne pollution, despite the existence of economic sectors producing toxic waste (the most dangerous of which is regularly sent to the American continent), the highest car ownership rate in the world and heavy civilian and military traffic.

The 1979 development plan recommended strict zoning addressing the restricted ability of the island's resources to cater for certain activities in the urban, rural and agricultural zones and in conservation areas. The plan also recommended priority attention for the coastal areas where population density was too high.

Guam has a serious solid waste disposal problem. Average daily production is over 2kg per person, or more than 150,000 MT annually for the whole island. With a population of almost 170,000 by 2000, Guam could be generating over 200,000MT of solid waste each year.

At the time of writing, 5 to 10,000 abandoned vehicle bodies were dotted around the island. It is not possible for Guam, as with other Pacific island countries, to recycle many components of solid waste. It does not also have the right industrial infrastructure nor enough waste materials to cover the cost of transport to possible user countries.

Despite these worrying signs, the actions taken to counter the effects of rapid urbanisation of Guam over the past 20 years has greatly helped limit pollution and environmental damage.

12. Slope colonisation is dangerous for low-lying suburbs: Papeete.

13. Industrial pollution along the shore in Suva.

The groundwater management plan which came into effect in 1985, is thought to be the major source of improvement. The plan includes quality control and monitoring of above-ground activities liable to have an impact on Guam's resources.

A range of improvements were also designed, such as constructing percolation trenches and tanks, and restoring plant cover in catchment areas. These ensure that the groundwater reserves enjoy the best possible conditions for replenishment, and counter the adverse effects of urbanisation on water quality.

Hawaii

The State of Hawaii boasts the largest urban area in the Pacific islands. It has over a million inhabitants, with over 800,000 living in Honolulu City and County on Oahu, and 400,000 in the city proper.

The total urban population of Honolulu is nearly 600,000 people. The average population density exceeds 1,725 people per sq .km, but the density varies greatly from neighbourhood to neighbourhood. The Waikiki area, where most of the hotels are concentrated, has a density greater than 32,000 people per sq. km. With over 6 million visitors annually, (183,000 in 1958), at any one time, there are as many tourists in Honolulu as there are residents in Noumea or Papeete.

The population of Honotulu County, over half of whom live in the city itself, grew by 1 49 % from 1930 to 1960, 29% during the following decade and a further 44 % between 1 970 and 1 980.

The urban areas of the State of Hawaii grew from 470 to 666 sq .km. between 1964 and 1988. The car ownership rate (I car for 1 .5 people) has doubled in the past thirty years.

The urban environment of Hawaii, especially in Honolulu in particular has significantly improved over the last two decades. The rapid population growth and the diversification of activities dictated the introduction of very complete and strict regulations between the 60s and the 80s, along with zoning.

14. As the town claims the sloping land, risks are multiplied: Tahiti. Planning rules are the answer.

In 1974, Chapter 344 of the Statutes of the State of Hawaii laid down an environment policy which was gradually implemented from 1975 onwards by the Environmental Quality Commission, and subsequently by the Environmental Council.

In 1988, a new department, the Environmental Management Division, was given responsibility for surveillance, conservation and management, particularly in the urban context, and also for public education and communication. Its activities are coordinated with the US Federal EPA.

The 1974 Safe Drinking Act, which laid down new potability standards for drinking water, was designed particularly to ensure that groundwater is not contaminated by refuse dumps.

In 1988, the drive for safe water for certain uses and resource protection led to the adoption of a new classification for inland and marine waters in the State of Hawaii. The application of quality standards and the efforts to adjust use to existing resources have also led to waste water recycling for irrigating plantations. The use of treated effluent for irrigation began in 1967 and came into general use in the late 1970s.

Because of urban expansion in Honolulu and Pearl Harbour, and increases in demand due to industrial and tourism activities, it became necessary to pipe in water from outlying districts and to introduce a variety of economy measures from 1977.

Despite improvements in water quality monitoring and sanitation, the City of Honolulu itself also caused surface water and neighbouring coastal water pollution with the growth of sealed surfaces and consequent increase in runoff.

This type of pollution is directly linked to the increase in roads and roofs in the urban area. These can represent almost 60% of the surface area of an individual home, and almost 100% in a totally urbanised area (E.T. Murabayashi and Yu Si Fork, 1979). The infiltration rate into the soil, which depends on the frequency, intensity and duration of rain, can be reduced by more than 90%. On the other hand, maximum runoff after heavy rain can drop by 80% when comparing an entirely urbanised to a grassy area.

One of the most notable results of increased runoff is to increase the risk of flooding in low-lying areas by the stronger flow through drainage pipes, which must be sized accordingly. This risk is relevant for a large part of central Honolutu at the mouth of the Manoa River.

Since 1977, the City and County of Honolulu have gradually introduced regulations for draining runoff in the urban area, and for land clearing and levelling on construction sites to limit erosion risks (14). Strict provisions apply to any building site of 1,300 sq meters or larger to prevent erosion.

Lastly, the urban district of Honolulu has had to deal with a constantly growing solid waste problem, which has increased because of the high standard of living and tourism activity on a limited land area.

In the mid-70s, solid waste management began with an integrated set of regulations, due to the extension of Federal and special legislation to the State of Hawaii, in the same way as for other environmental matters. The number of dumps has been considerably reduced. Keehi collection and sorting station was completed in 1977. From there, waste is transported either to an incinerator at Waipahu, or to controlled dumps on the leeward shores.

In the middle of the last decade, the shortage of suitable land on Oahu for refuse dumps remained a major problem, due to the large volume of waste produced.

Between 1980 and 1987, annual solid waste production on the island of Oahu increased by almost 40,000 tons. By 1990, it reached 750,000 tons, most of which came from Honolulu urban district. Processing, sorting, recycling and general incineration of waste was then considered. A $190-million waste management project is scheduled for funding by Honolulu City Council, using a public loan.

Despite the provisions of the Oahu General Development Plan (February 1977), suggesting a population limit

of 1 million inhabitants on the island by 2000, the urban growth of Honolulu is likely to jeopardize the environmental balance. Hawaii, however, is in an enviable situation for a Pacific island country: the local government wishes to achieve harmonious coexistence between the city and a natural environment, to keep it as unspoilt as possible. So to protect the image of Eden offered to tourists, the state has adopted a wide range of infrastructure and regulations at an early stage (15).

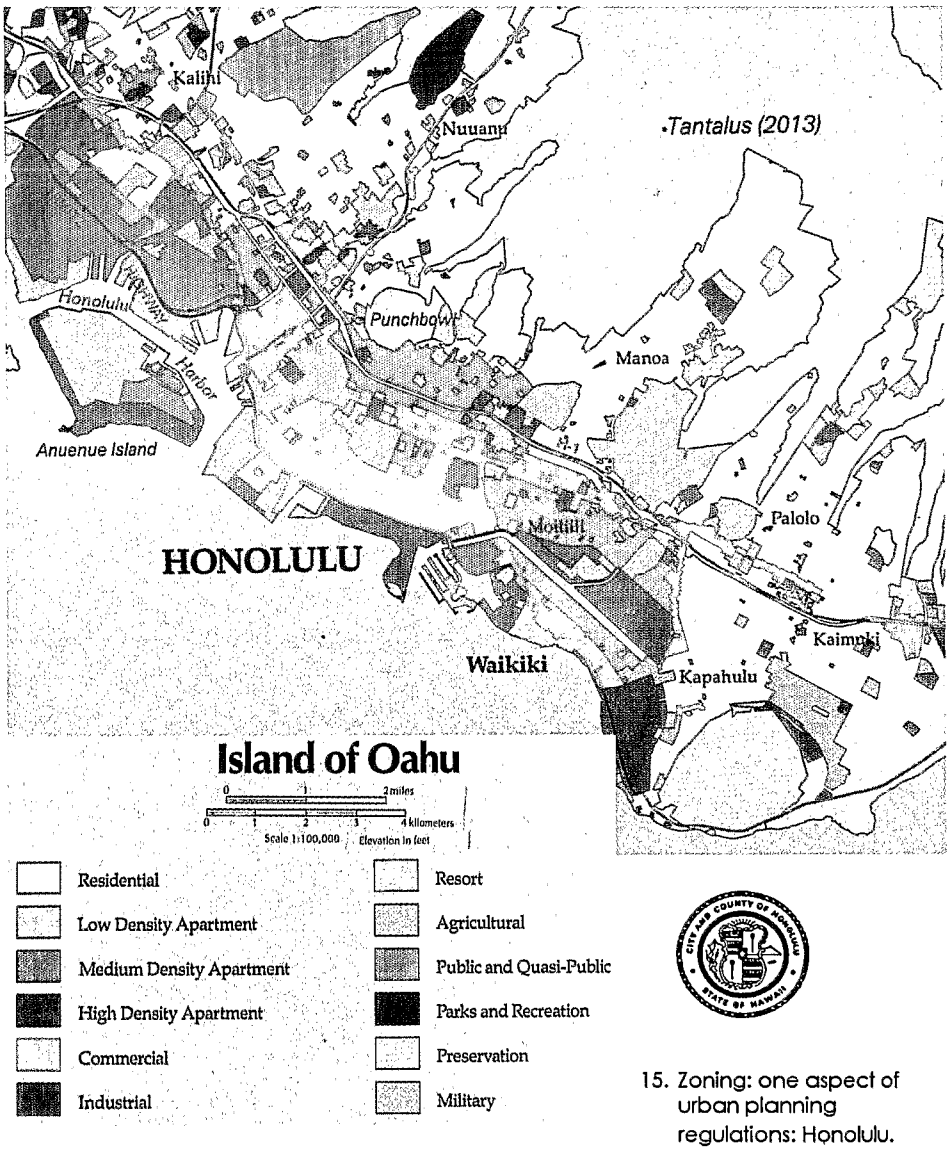
In the 1970s, this policy was instrumental in preventing a situation which most Pacific island country capitals are experiencing today.

Conclusion

To guarantee absolute protection, any project must be limited by its possible impact on the environment, and cannot be carried out unless mutual concessions are made by conservationists and developers. It must combine official commitment and public awareness.

Control of population growth is another factor in success. This same degree of commitment is required to question unsuitable consumer goods - above all, the motorcar.

In the Pacific islands, economic interests and the requirements of urbanisation must be reconciled with the quality of life, not only of town dwellers but of island communities in general. There must be a conscious and deliberate inclusion of environmental concerns in the general aims of sustainable development. ■■■



15. Zoning: one aspect of urban planning regulations: Honolulu.

References

Aerial photographs: 2 - Guam (Perry 1989), 9 - Suva (RAAF 1986), 3,14-Papaete (Polynésie Aérocarto-1991).

Other photographs: 1,6 (J-F. Dupon), 4, 5, 7, 8 (C. Morhange), 13 (E. Waddell), 10, 11, 12 (Douche, Tahiti).

Brodie, J.E. et al. 1988. *State of the Marine Environment in the South Pacific Region.* UNEP Regional Seas Reports and Studies No. 127. UNEP, 1990. SPREP Topic Review No. 40, 59 p.

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