

SOPAC



COUNTRY PROFILE



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SOPAC



Our Vision

*The improved health,
well being and safety
of the Pacific and its peoples*

The South Pacific Applied Geoscience Commission (SOPAC) is an independent, intergovernmental, regional organisation established by South Pacific nations in 1972, and dedicated to providing geotechnical services to the countries it serves. Its Secretariat is located in Suva, Fiji, and has about 40 professional and support staff.

SOPAC's work for its member countries focusses on three key areas; resource development; environmental geoscience; and national capacity development in the geosciences. To effectively deliver these services SOPAC maintains a regional data centre, provides information services, and offers technical and field services for specific project work.

THIS COUNTRY PROFILE WAS PRODUCED TO PROVIDE A SNAPSHOT OF THE CURRENT ISSUES FACED BY THE COUNTRY AND SOPAC'S ROLE IN ASSISTING COUNTRIES TO ACHIEVE SUSTAINABLE DEVELOPMENT



Guam : Our Future

The territory is determined to find a sustainable development approach that will help foster greater economic opportunities without adversely affecting the cultural, environmental, social and natural resources. ... to fully realize this goal, all development in Guam has been guided by a Comprehensive Development Plan reflecting the goals and objectives of its people.

Government of Guam. (1996)

Capital:	Agana
Population:	149 600 (1999 est.)
Land Area:	541 sq. km
Max. Height above Sea-level:	406 m (Mt Lamlam)
Geography:	one large island; peak of a submerged mountain located in the Marianas Trench
EEZ:	218 000 sq. km
Climate:	Tropical; uniformly warm and humid
Rainfall:	Varies from 2 000 to 2 500 mm per annum
Mean Temperature:	27°C
Economy:	Dependent on tourism, federal government aid contributions, agriculture, fisheries; exports include fish
GDP per Capita:	US\$ 15 541 (1995 est.)
Currency:	US\$
Energy Sources:	Solar, wind, biomass
Freshwater Sources:	Groundwater, surface water
Natural Hazards:	Cyclone, drought and earthquake
Mineral Potential:	On-land – unknown; Offshore - unknown
Languages:	English, Chamorro, Japanese
Government:	Unincorporated territory of the USA
SOPAC Membership:	Full member since 1982
Country Representative:	Management Team
	Governor's Office
	Government of Guam
	PO Box 2950
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profile

Guam

Guam consists of one large island with a total land area of 541 sq km within an Exclusive Economic Zone (EEZ) of 218 000 sq km. Geographically, Guam comprises uplifted undersea volcanoes, with a maximum height of 406 m above sea level.

The population of Guam was estimated at 149 600 in 1999¹. It is a mixed population made up of the island's original inhabitants, the Chamorros, together with Filipinos, Europeans and Koreans among others.

Guam has a tropical climate, which is uniformly warm and humid. From December to May the weather is cooler with less rain. April is the driest month and from June to November it is wetter with gusty winds. The mean temperature in Guam is 27°C and rainfall varies from 2 000 mm to 2 500 mm.

The United States government aid contributions and tourism are the mainstays of the economy in Guam. Agriculture and fisheries contribute on a small scale to the export earnings of the country.

There are several resource and environmental issues, common to island nations, affecting sustainable

development in Guam. These include an array of issues from climate and sea-level variability, environmental

degradation and pollution to resource management. More specific challenges to sustainable development include coastal erosion, water quality, water availability and sanitation. Sustainable management of resources, such as aggregate, terrestrial and offshore minerals and renewable energy is a key issue in Guam's quest for development.

Guam has been a full member of the South Pacific Applied Geoscience Commission (SOPAC) since 1982. SOPAC is an independent, intergovernmental, regional organisation, which provides expert technical assistance, policy advice and information on the sustainable management of these natural resources. SOPAC also contributes to a variety of geoscientific training and educational opportunities at all levels to increase the country's capacity in science and resource management. Additional assistance is made available by SOPAC through technical support for the establishment and maintenance of database information systems and for electronic exchange of information. Expertise in hazard assessment, disaster preparedness, mitigation and management is also provided.

Challenges to Sustainable Development and SOPAC's role in Guam

MINERALS

For Small Island Developing States (SIDS), natural resource development and management holds the key to rapid economic development. Unwise exploitation of non-renewable resources and exploitation of renewable resources at a pace higher than the natural rate of replenishment could prove detrimental to the sustainable development plans of the country.

Offshore exploration is still at a nascent stage in Guam. Exploratory surveys, however, reveal the presence of cobalt-rich crusts and manganese nodules in the EEZ around Guam. The future exploitation of these minerals has the potential to provide great economic benefits to the country. Several exploration companies have expressed interest in these findings and have applied for exploration licences to assess the scope and potential for development.



Coast of Guam

¹SPC Demography Programme



Hakurei Maru No.2

SOPAC carried out a preliminary assessment of surveys of marine mineral resources in Guam in 1984². A bathymetric survey of seamounts was

carried out in 1985³ to develop baseline data that will help in the protection of these marine resources. Follow up work was conducted in 1986 to assist local officials in using underwater television system and to recruit additional staff in the Ministry⁴. Further surveys of the unexplored seamounts are necessary to realise the full potential of these resources.

SOPAC conducted a further compilation of basic geological/geophysical data pre-requisite to evaluation of resource potential in 1987⁵ in Guam's EEZ to assess the potential for hydrocarbons and manganese nodules. There is a need to conduct detailed studies of the unexplored parts of the EEZ to assess the potential of these resources.

Adverse social impact and economic redistribution are the biggest concerns arising out of mineral exploration. Offshore mining could unleash a whole new host of problems ranging from the irreversible destruction of the fragile ecosystem to loss of fishing grounds.

Mineral resource development often leaves indelible scars on the fabric of traditional societies through the resultant change in lifestyle, perceptions and values that it inevitably affects. While displacement and compensation for externalities form a complex range of issues on their own, the assignment of pecuniary or economic value to communally owned properties like fishing grounds has often lead to social disharmony. The loss of fishing grounds deprives many of their traditional lifestyles and the resultant unemployment catalyses alcoholism, violence and crime in the affected societies. SOPAC understands the impact of these externalities on Guam's

goal of sustainable development and has attempted to address them while framing policies. Social cost benefit analysis and social and environmental impact assessments are advocated for all mining projects in Guam.

Capacity development in the member states is one of the top priorities of SOPAC. Training in the field for technical personnel from the member countries is an ongoing process with the aim of enhancing in-country capacity to undertake assessment studies and field surveys. This training is carried out through workshops and seminars and through the courses in the Earth Science and Marine Geology Certificate Programme, which has been undertaken for 21 years. It is hoped that Guam will take advantage of these in the future.

ENERGY

Guam is somewhat different from the other Pacific islands in that it enjoys a relatively high standard of living with per-capita gross domestic product approximating US\$20 000 per year. Although mired in an economic downturn as a result of the 1997 Asian financial crisis, Guam's income level is a major determinant in energy consumption. As the table of indices below shows, the population and the number of vehicles have risen together. Gross Domestic Product (GDP) increased at roughly 7 percent per year over the 8-year period despite the slowdown in the economy of Japan, Guam's major source for visitors, since its 1990-91 peak. Visitor arrivals have increased sharply since 1980, and currently total more than 1.4 million per year. As the table indicates, visitor arrivals more than doubled during the 1988-96 period, increasing at more than 11 percent per year.

Reflecting rising incomes and more tourists, power consumption increased at an average annual rate of over 12 per cent per year from 1988 to 1996. All hotel rooms, nearly all retail and commercial facilities and government operations, and most residences are air-conditioned. This is unlike most other island countries,

²SOPAC Trip Report 12

³SOPAC Technical Report 49

⁴SOPAC Trip Report 25

⁵SOPAC Technical Report 110

where standards of living are lower than Guam's and thus air-conditioning, Internet connections, and cable TV subscribers are far fewer.

Index of Population, Power Consumption, Vehicles, Visitor Arrivals and GDP, 1988-1996

	1988	1996
Population	100	121
Power Consumption	100	258
Vehicles	100	125
Visitor Arrivals	100	233
GDP	100	173

However, growth of power consumption has slowed in recent years, consumption now approximating 1600 to 1700 million-kilowatt hours per year. One of the key issues currently confronting Guam is that peak demand is roughly 280 MW but its capacity is nearly 500 MW. This issue evolved because demand growth had far outpaced capacity growth during the late 1980s and early 1990s. This resulted in "brown/black outs," and subsequent purchase of individual generators by consumers. When capacity was increased with the addition of "fast track" generators, more consumers connected and more regularly purchased from the Guam Power Authority (GPA). With some generation units well up in years and the "fast track" generators expensive to operate, GPA has contracted with three independent power producers (Enron, HEIPowercorp, TEMES) to supply electricity from more efficient and cost-effective plants. The result is an over-capacity but some units will be retired, and the "fast track" units mothballed. Still, the temporary over-capacity means higher electricity rates.

Guam serves as the supply hub in the petroleum distribution network for the Micronesian islands. Guam's current demand for fuels has ranged between 15 000 to 20 000 barrels per day during recent years. The variations have resulted because of changes in levels of economic activity, including the use of Guam as a

resupply base for the tuna fishing fleets of other countries. GPA consumes both residual fuel oil and diesel for power generation. Other major end uses of petroleum fuels include jet-fuel for the busy visitor industry (note: Guam is also the air and sea transportation centre for Micronesia), and gasoline for motor vehicles.

With respect to renewable energy resources, Guam has an abundance of solar potential. However, with costs still high, solar technologies will remain a future option. Current application of photovoltaic energy includes monitoring and water pumping stations.

Guam also has considerable Ocean Thermal Energy Conversion (OTEC) potential. However, the technology is too expensive for widespread applications.

Although Guam suffers from frequent typhoons, the average sustained wind speeds at 12 degrees north of the equator are not sufficient to permit commercial applications. Guam has some hydropower and biomass potential but again, the costs of the technologies prevent utilisation of these resources.

Currently, Guam's greatest potential for addressing energy consumption and specifically consumption of fossil fuels is through energy conservation, whether by increasing the use of energy efficient technologies or by actually reducing use by energy end-users. GPA and the government have had a number of recent successes with the use of energy-efficient technologies. In addition, Guam's residents are increasingly aware of the costs (including environmental) of electricity consumption, and are purchasing more-efficient technologies and limiting their use when possible. Given the costs of fossil fuels and renewable technologies, it is likely that energy efficiency and conservation will continue to provide the most cost-effective avenues to limit energy consumption over the next two decades.



Energy training

The absence of reliable, consistent and up-to-date energy data on the supply and consumption of energy has been identified as a major constraint to the effective management of the energy sector. In the absence of such data, the energy sector can neither be assessed in relation to its contribution to the economic productivity of the country nor can have its future trends extrapolated.

SOPAC intends to establish and maintain a compatible, accurate, reliable and up-to-date energy supply and demand database⁶. SOPAC attempts to enhance the capabilities of the relevant authorities in Guam to monitor petroleum prices effectively so as to be able to evaluate and advise the major oil consumers in the local market.

WATER

Water is one of the most important resources for survival and the cornerstone of all development initiatives in Guam. Clean water enhances the health and productivity of the work force and has particular implications for the children and future generations.

The water supply of Guam is generally abundant because of the high rainfall and underground wells. However, due to accelerating population numbers and urbanisation, a heavy strain has been put on the resources over recent years. Therefore, as demand increases, proactive measures are needed to increase supply and reach.

The Public Utility Agency of Guam is responsible for water supplies and wastewater services. The island's principal source of potable water is underground aquifers mostly found beneath the northern part of the island. The portion of water supply coming from underground water sources is estimated to be 80 percent, with surface water supplies accounting for 20 percent of the supplies. There is no treatment for the surface water other than chlorination. Guam's water treatment plant helps alleviate the problem of water shortage in the southern part of the island during the dry season.

CLIMATE & SEA-LEVEL VARIABILITY

Global climate variability may be responsible for increasingly more-frequent and more-severe storms, interspersed with scorching droughts. The impact of this variable climate has been harsh on ecosystems and coastal, terrestrial and marine biodiversity. Economically, the impact has translated into decreased agricultural yield, death of livestock, and decrease and loss of marine biodiversity. This has caused loss of revenue, which can have detrimental effects on the social and economic system of SIDS and developing economies. As the majority of the people dependent on these sources of income are economically poor, the poverty implications of variable climate are high.

The International Panel on Climate Change (IPCC) predicts that there will be a 10-30 cm rise in sea-level by the year 2030 and 30-100 cm by the end of the 21st century. This prediction has serious implications for sustainable development in Guam. Any increase in sea-level as a consequence of global warming will have significant effects on the low-lying areas in Guam.



Coastal area of Guam

In addition, damage to infrastructure by coastal inundation, wave run-up and tidal surges could be immense. The social and economic impacts of this on a developing economy are tremendous, and can lead to persistent poverty.

Although SOPAC has not provided Guam any assistance to date with the issue of climate and sea-level variability, the increasing importance of this issue and its implications to the survival and livelihood of the country will certainly require future assistance from SOPAC. Experience and expertise in coastal management, environmental vulnerability assessment, mitigation and adaptation strategy development are all part of SOPAC's capabilities and technical resources that it is able to provide countries to help address this issue.

⁶Task Profile GU 99.009

COASTAL MANAGEMENT

Guam has very distinctive coastal areas comprising features such as coral reefs, sandy beaches and mangrove ecosystems. There is also a lake and several perennial streams. There have been rapid changes in the coastal geography associated with increasing reclamation as part of the multi-million-dollar tourism and urbanisation.

To protect reclaimed land from the onslaught of the sea, various protection systems such as concrete walls,



Erosion is prevalent in the coastal areas of Guam

groynes, jetties and riprap revetments have been constructed haphazardly. However, the success of these protection structures has been variable owing to a lack of understanding

of the wave and current pattern around the islands and the misconception that coasts are stable. Poor construction and development practices, indiscriminate reclamation and aggregate mining in the reef areas cause coastal instability and beach erosion. In addition, coastal pollution associated with shorefront and tourist developments destroys reef biota.

SOPAC with the government of Guam has addressed the coastal erosion problem through several projects. These projects included mapping workshops, field training and beach survey exercises.

SOPAC has undertaken a study in Guam in 1986⁷ to site a boat ramp at the head of the bay in the Philippine Sea, located on the western coast of the island. The survey examined the vulnerability of the design, given the condition of the sea in the region.

SOPAC also undertook a coastal mapping workshop in Guam in 1990⁸ to train local officials in mapping

techniques, beach profiling and nearshore bathymetric sample collection of the islands and interpretation of series of aerial photographs of the coastline of Guam.

Given the critical importance of sustainable development in Guam, SOPAC will continue playing a big role in coastal preservation and the development of sound policies to ensure better management of coastal resources.

STEPS INTO THE FUTURE: INFORMATION TECHNOLOGY & COMMUNICATION

For effective resource management and planning, the storage and processing of timely and accurate scientific data is critical. Island nations face the fundamental crisis of geographic isolation and high cost of communication between the various islands. Given the small size of these nations, technology providers are reluctant to supply cutting-edge technology because of poor economies of scale and difficulties in monitoring. Low human capital endowment further complicates the situation. While these problems are not as grim for Guam as it is for other Pacific countries, they have remained a constraint in its pursuit of rapid growth.

SOPAC has been monitoring and coordinating offshore research activities. The data collected have value for economic development, evaluation and logistic purposes. Therefore, SOPAC intends to compile and produce digital data sets⁹ for Guam.

As a regional data centre, SOPAC has been compiling geographical data on Guam¹⁰.



Water sampling in the field

⁷SOPAC Technical Report 74

⁸SOPAC Training Report 32

⁹Task Profile GU 98.007

¹⁰Task Profile GU 98.007

In future, the focus will be on:

- Development of appropriate, economic and scaleable technologies.
- Increasing the number of IT professionals in the local population.
- Improving Internet access.
- Further development of Geographic Information System (GIS) and Remote Sensing (RS) techniques.

continue its work to reduce Guam's vulnerability to natural disasters and improve preparedness.

Island systems management will be a future area of focus, given its ability to improve database management and decision-making processes. SOPAC intends to support the development of information technology and communication infrastructure in Guam to achieve this.

By performing its functions as the specialised scientific organisation that it is, SOPAC has been addressing some of the fundamental factors that have impeded the development process.

Future directions in Guam

In future, SOPAC will continue its partnership with Guam, to overcome the hurdles in the path of sustainable development. SOPAC will use its key 'ownership advantage' - the expertise in applied sciences - to help Guam manage and develop its non-living resources sustainably.

SOPAC will further its partnership with Guam in developing offshore resources. Policy formulation will be one of the key areas that SOPAC will develop as one of its core professional activities. Development of appropriate legislation to manage coastal erosion and regulate aggregate mining will be a priority in the near future.

Sustainable development, conservation and management will be the guiding principles in the water and energy sectors. Policy development will be an activity in both these areas as well. Training programmes, workshops and seminars will be organised regularly to assist Guam in creating a national capacity in geo-science. SOPAC will

Reference Materials

SOPAC provides access to a variety of information on Guam. This can be accessed through the library database, PIMRIS or the Internet.

Some of these materials relevant to Guam are:

- Maps of Guam
- Project Reports
- Education/Awareness Pamphlets
- Videos
- Geological samples
- General reference material on Guam

Please refer to Guam's bibliography for SOPAC's full reference and material listing.

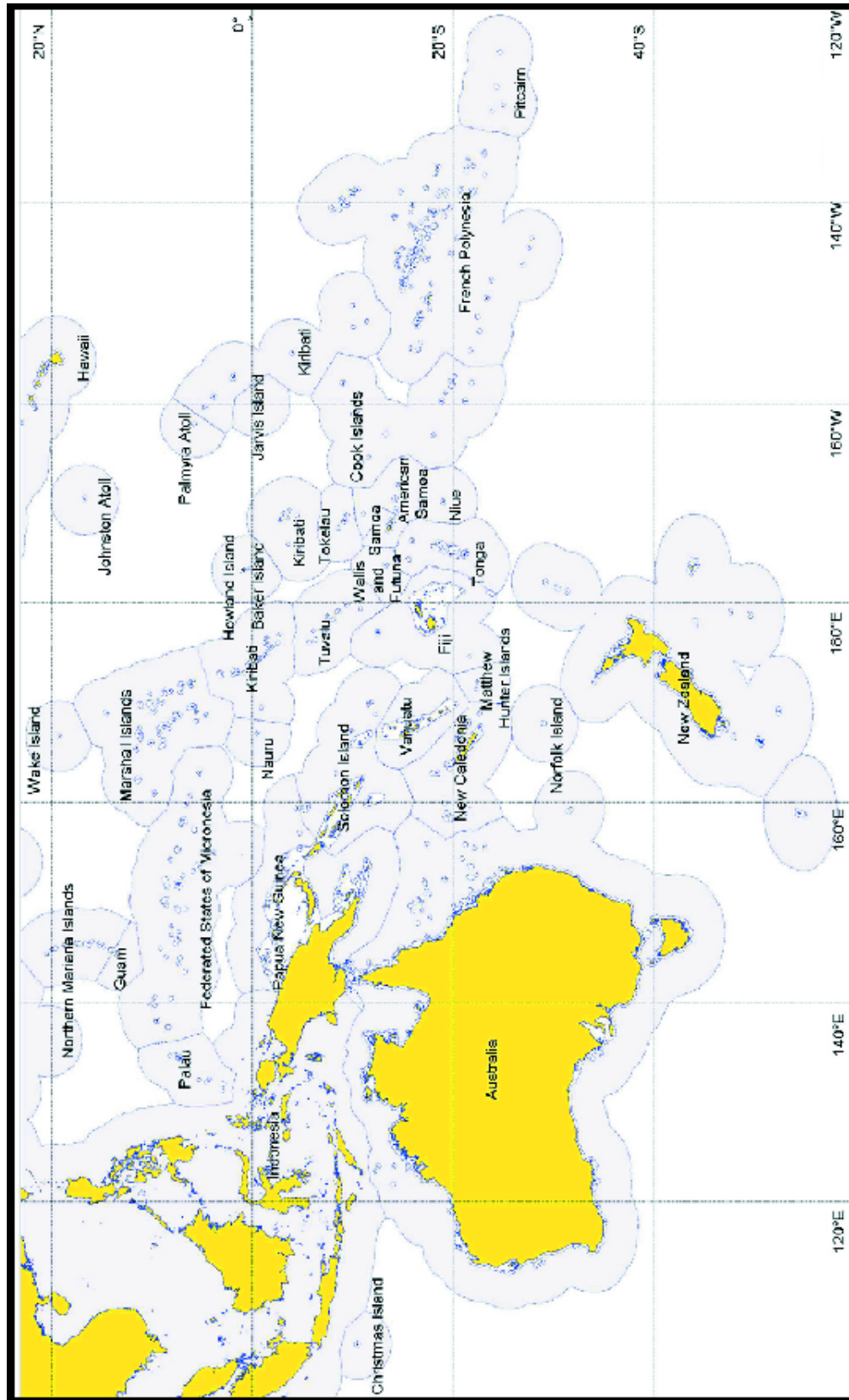


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Issues and SOPAC's Responses for Further Development

ISSUES	CONSTRAINTS	RESPONSES FOR FURTHER DEVELOPMENT
Water & Sanitation	Increasing population and urbanisation putting heavy strain on water resources	- Development and implementation of resource policy and legislation - Conducting research and feasibility studies to address water and sanitation issues - Increasing public awareness on sustainable water management through training and workshops
Coastal Management	- Inappropriate coastal development and protection works - Inadequate public knowledge on coastal-zone management	- Dialogue with the government and private sector on coastal development and management - Educating people about coastal degradation and management through workshops and field training
Minerals	- Inadequate scientific research to define full potential of resources - High risks and costs associated with acquisition of data	- Assessing the potential of offshore minerals in Guam's EEZ - Development of resource policy and advice on the development and management of these minerals - Encourage further research
Energy	- Demand exceeds supply - High costs associated with development of renewable energy	- Development of energy policies and legislation - Enhancing human resource capacity in the energy sector through workshops and training
Information Technology & Communication	- Limited availability and poor access to information - Lack of skilled man-power to manage IT sector - Lack of relevant regional and local data - High costs	- Upgrading information systems - Providing training to local staff in information technology - Organising and accessing databases - Assisting in the development of Internet access in Guam - Coordination, compilation and creation of standardised geographic data sets
Human Resource Development	- Weak human resource base - Limited financial and institutional resources - Limited expertise	- Conducting workshops and technical training programmes to improve national capacity in the geosciences - Running the Earth Science and Marine Geology course to improve the human resource base - Fellowship attachments



South Pacific Region Maritime Limits

SOPAC Member Countries: Australia, Cook Islands, Federated States of Micronesia, Fiji Islands, Guam, Kiribati, Marshall Islands, Nauru, New Zealand, Niue, Papua New Guinea, Samoa, Solomon Islands, Kingdom of Tonga, Tuvalu, and Vanuatu. French Polynesia and New Caledonia are Associate Members.