

# FEDERATED STATES OF MICRONESIA

## A. INTRODUCTION

Water is the basis of all lives - an ecological resource for the flora and fauna of our earth and a fundamental necessity for all lives. Without an adequate supply of safe water, we have no hope of improving the health of the people in our partner countries. The WHO estimates that 80% of all diseases is in some way linked with contaminated water. Without a well-functioning water supply it is difficult to imagine productive human activity, be it agriculture or forestry, livestock, farming or fisheries, trade or industry.

The volume of fresh water on earth cannot be augmented. The high rate of population growth and the increasing pollution of surface and ground water, however, constantly reducing the amount of water available per capita. Water is thus becoming a crucial factor for development and the quality of life in many countries. In individual arid areas it has even become a survival factor. Any national water resources management strategies must necessarily be formulated in the context of the overall natural, socioeconomic, cultural and political environment. In this context a brief overview of the Federated States of Micronesia in terms of its location, topography and land nature, climate, people, socioeconomic, culture, water resources are highlighted in this chapter to provide the background necessary for a reader to follow the discussion of sustainable water resources management strategies.

### A-1. Location & Size

The Federated States of Micronesia (FSM) consists of about 607 islands dispersed over a million square miles in the Western Pacific Ocean. The FSM spans approximately 2,000 miles from east to west and 900 miles from north to south and two time zones. A location map is shown at the beginning. The FSM comprises a total land of 270.5 square miles and as well as a lagoon area of 2777 square miles within an east-west chain of islands known as the Carolinian archipelago.

### A-2. Topography and land

The constituent islands of FSM vary from small coral atolls to large mountains of volcanic origin. The states of Chuuk, Pohnpei and Yap comprise main islands and other outlying islands except the State of Kosrae which is a single island State. The main or island grouping in each State is of volcanic or tectonic origin, but the majority of the outer islands are coral atolls. Each of these focal islands is surrounded by a coral reef, largest in the case of Weno, where the reef encloses a lagoon area of 800 square miles, containing a number of the volcanic islands and atolls that are part of Chuuk State. The interior of Pohnpei and Kosrae have high mountains, with peaks more than 2000 feet above sea level. Weno, too has relatively high interior mountains, peaking at above 1200 feet, but the island is small, with only about a 15 mile perimeter. The elevation of the Yap Main Islands group, however, is only several hundreds of feet above sea level.

The atolls tend to be small (less than 2 mi<sup>2</sup> in area), elongated in shape and are of low relief, the highest point on many of them being less than 20 feet above mean sea level. The "high islands" comprises about 92% of the total land area of FSM, leaving only the small area of about 22.1 mi<sup>2</sup> for coral atolls.

### A-3. Climate

The main islands such as Pohnpei, Kosrae, Yap, and Weno, Fefan, Tonoas, Uman, Tol Islands (in Chuuk) etc. are of volcanic origin with high mountains, which radiate outwards from multiple volcanic centers. Owing to its volcanic origin and oceanic location close to the equator, the FSM has a tropical climate characterized by warm temperatures, high humidity and high precipitation. Mean monthly temperatures are typically in the order of 27 degree Celsius throughout the year. Both Kosrae and Pohnpei experience very heavy rainfalls, with annual coastal region rainfall in the range of 200 inches and interior rainfall of up to 400 inches in the case of Pohnpei. Rainfall in Weno/Chuuk ranges from 100 to 185 inches per year and in Yap the average is 120 inches. Rainfall is less evenly distributed over the year in Weno/Chuuk and Yap than Pohnpei or Kosrae, giving rise to prolonged periods of drought.

#### A-4. Population

A national census was undertaken in FSM during September 1994 when the following summarized population results were obtained:

State	Population	% of FSM Population	Density ( per sq mi )	No. of House holds	Mean Household Size
Yap	11,128	10.6	242	1,889	5.9
Chuuk	52,870	50.5	1,072	6,863	7.7
Pohnpei	33,372	31.9	252	5,244	6.4
Kosrae	7,354	7.0	170	1,003	7.3
<b>FSM</b>	<b>104,724</b>	<b>100.0</b>	<b>387</b>	<b>14,999</b>	<b>7.0</b>

The 1994 Census recorded the population of about 105,000 persons living in 57 islands or atoll groups. About 61,461 persons (58.5% of the total population) live on the main islands where the respective State administrative centers are located.

#### A-5. Socio-economy

The standard of living of FSM is comparable to that of the other neighboring island countries of the region. The per capita income and literacy rates also enjoy a similar status. Health standards are also similarly comparable with other Pacific island countries.

However, the decline in external assistance will have an impact on the budgetary provision and consequently will affect the economic growth as well as reduction in health, education and other sector funding. Thus, income generation opportunities will have a negative growth rate.

The utilities formed for supplying water and power will also have to increase their revenue base by increasing tariffs on water supply and sewerage or imposing the same wherever not levied so far at a concession/ minimal rate. However, such tariff structuring will need to keep in view the affordability aspect and cross subsidization amongst the different groups of consumers. The Ucs will have to therefore generate sufficient resources to meet their funding needs and accordingly fiscal reform will have to be initiated for the purpose.

The FSM is heavily reliant on external funding from U.S. under the Compact of Free Association. The country also been facing significant trade imbalance of imports over exports. In FSM, considerable inequality exists in terms of gross domestic product (GDP) per capita among the four states. The rate of population growth continuing to exceed economic growth, unequal standards of living between outer islands, migration from adjoining outer islands to Pohnpei and Wen/Chuuk pose a serious future concerns for basic amenities and infrastructures.

#### A-6. Cultures and Tradition

A good understanding of underlying cultural issues is likely to be very important when establishing water and environmental improvement programs, particularly in rural areas. Cultural tradition and beliefs are still powerful forces in the region, underpin all aspects of life, society and behavior. Cultural factors therefore affect the way groups use the environment and how they approach health and health services. The influence of customary protocols, and norms and values, should be taken into consideration in all aspects of contamination, consultations, program planning and implementation strategies. It is important to develop culturally appropriate methods to bring various stakeholders into consultation process to exchange views, share ideas and to work collectively to achieve the project goal and objectives.

The native peoples of each State may have originated from a common ancestral stock, but today each State has a unique culture and separate language. While the common language of the country is English, the native tongues are spoken by all or most in each State. There are also significant gender inequalities as shown by lower female literacy and lower educational enrollment ratios. The cultural variances also affect the water use pattern.

## **A-7. Water resources**

All four of the focal islands have coastal mangrove fringes and intermittent development along their coasts, with much less interior development. The natural vegetative cover is dense on all islands and has not generally been disrupted for intensive agriculture use. Whether planned or fortuitous, this has protected the Watersheds, helping to reduce the rapid runoff and maintaining a reasonable recharge opportunity for the aquifers that are important to each State for a portion of its water supply. The direct runoff from these intense rainfalls, even on these relatively small surface catchments, also provides one important source of water for all four islands; however, in each case, drought periods also arise when supplementation from ground water sources is important, and even critical.

About 60% of water resources exist as surface water in the form of small, intermittent streams that drain catchments areas of limited aerial extent. The streams are dry for about 20% of the year. The development of surface water is therefore inherently expensive, since it requires the construction of dams to impound the surface runoff for use during dry periods. The topography in the stream basins is not conducive to the construction of economical dams. Furthermore, surface water requires extensive and costly treatment, largely to reduce high turbidity, undesirable taste and odors, and to remove all micro-organisms.

The remaining 40% of the islands' water resources exist as groundwater in small, dispersed zones of sedimentary deposits, weathered volcanics and weathered schist. These formations are not conducive to the development of high yielding wells. Drilling through this formation involved costlier investment also. However, the hydrogeology is suitable for multiple, low to medium yielding wells in the range of 20 – 150 gpm range. The quality of the ground water is mostly excellent.

## **B. NATIONAL CONSULTATION PROCESS**

Effective solutions to complex environmental problems can not be developed or implemented in isolation, nor can they be imposed from the outside. Stakeholder participation is necessary to ensure local commitment to the project, increase the capacity of local people and organizations, and to make sure project benefits continue after the project finishes.

Management of water and environmental improvement programs requires that all involved work together; the general public, local and national governments, industry and business and non-government agencies. Inter-sectoral collaboration and multi-sectoral co-operation should be fostered. Inter-sectoral management development opportunities should be exploited at all levels local, national, regional and global levels. Unfortunately, there are limited number of organizations with in the local or state levels available with the capacity to provide certain specific expertise and technical/logistic support of different activities in FSM. In fact, they need support and assistance to be organized to identify their local needs and aspirations and develop local responses. The assistance includes provision of data collection and its analysis, facilities, technical know-how and human and material resources for them to organize Community Organization and Development. In case of Rural Water Supply and Environmental Sanitation the Approach of Community Participation is crucial for sustainable development.

Following stakeholders are responsible in the management, operations and maintenance of water and sanitation sector in the Federated States of Micronesia:

**FSM National Government:** Provides policy guidance, external assistance/funding and coordinational support to the State Governments for the planning and implementation of their various infrastructure projects including water and sanitation projects.

**State Governments:** provide funding for capital improvement and operation funds for the state water supply and sanitation. The utility corporations in each state such as Pohnpei Utility Corporation (PUC), Chuuk Public Utility Corporation (CPUC), Yap State Public Service Corporation (YSPSC) are directly involved in the management, operations and maintenance of the existing water supply and capital improvement for the expansion of their systems in each state. All the State EPA's are responsible in maintaining safe drinking water standards and public education activities.

**Municipal Governments:** Each municipal government allocate funds from its own budget for the capital improvement and operation and maintenance of the water supply. Mainly the community water systems are maintained by the municipal governments. The communities also participate in the maintenance of the water systems.

Private Sectors/NGO's: Private sectors/NGO involvement is not significant in FSM. Very few private owners are supplying bottled water for domestic consumption.

## C. VISION, ISSUES AND CONSTRAINTS

### Theme 1: Water Resources Management

Management of the freshwater resources is vital for meeting basic needs and to promote sustainable development. Many health hazards in the FSM are related to poor water quality and limited water quantity. The small low lying coral islands face severe constraints in terms of both the quality and quantity of freshwater due to limited groundwater resources and protected by a thin permeable water lens.

Water use practices, arising from the general historical availability of water from rains, are extravagant when water is available, and obviously more conserving when it is not. Roof catchments exist in all four islands, and rain water constitutes an important supplement to central water system sources in all of the focal communities except Kolonia in Pohnpei. Even there, rain water catchment is still being used by people only a short distance from the Kolonia town.

**Individual household systems** are used extensively throughout the rural areas and outer islands of the FSM. On the outer islands, these are no piped water systems and the residents rely exclusively on individual household systems.

The two main types of individual household systems are rainwater catchments and dug wells. The standard of construction and maintenance of these facilities varies considerably from island to island and even on the same island. Rainwater harvesting tanks range from simple 55 gallon drums to 6,000 gallon tanks of reinforced concrete construction. More than 90% of the hand-dug wells are simply open holes. However, there are a few adequately constructed wells with covers. A small number have been fitted with hand pumps, solar pumps or electric pumps.

**The typical rainwater catchments systems** consist of a tank of about 1,200 gallons capacity, which receives water from a roof collection area of 250 square feet. Surveys conducted have shown that about 80% of the tanks run empty during dry periods.

On the outer islands, water usage from catchment tanks is for drinking, food preparation, cooking, the washing of cooking utensils and hand washing. These needs around 10 gallons of water per person per day, or about 70 gallons per day per household. A 1,200 gallons catchment tank therefore provide only 17 days storage. During an El Niño drought, the water collected in the tank will average 234 gallons per month, which is only 3.3 days supply.

An El Niño drought is therefore a major catastrophe for person living on the outer Islands, who are forced to rely for about 90% of the time, on the contaminated water from dug wells. These dug wells are simply open holes in the ground without any sanitary protection roaming pigs, and are subject to contamination from rodents and solid waste.

During drought periods most of the wells were dry and resulted a major public health risk of cholera outbreaks in Chuuk. The full dimension of the problem can be seen from the fact that about 40% of the population of the FSM reside on the Outer islands and are totally dependent on simple household water systems to meet their needs.

**The piped water systems** are of two basic types. Systems, which utilize streams water sources consist of a small intake across the stream, a raw water main to the treatment plant (for those systems which incorporate treatment) and a transmission and distribution network. Water treatment is by rapid filtration, followed by chlorination. Only 5 systems out of about 70 have treatment facilities, and most systems supply untreated water. The main problems faced in operating these surface water systems arise from the bacteriological contamination of the water sources and supply problems during extended dry periods. In the dry season, maximum demand coincides with minimum supply and water shortages are experienced. The development of surface water is expensive, since it requires the construction of dams to impound the surface runoff for use during dry periods. The topography in the stream basins is not conducive to the construction of economical dams. Furthermore, surface water requires extensive and costly treatment, largely to reduce high turbidity, undesirable taste and odors, and to remove all micro-organisms.

### Major Water Systems in the FSM

Water System Name	Location	Population on Served	Source of Water	Type of treatment
Kolonia	Pohnpei	1,900	Nanpil River and Wells	Sedimentation, Filtration and Chlorination
Palikir	Pohnpei	1,600	Wells	None
Weno	Chuuk	10,000	Pou River and 32 wells	None
Colonia	Yap	3,150	Gitam Reservoir and wells	Coagulation, Sedimentation, Filtration and Chlorination
Gagil – Tomil	Yap	1,700	Wells	Chlorination
Southern	Yap	900	Wells	Chlorination
Tofo/Lelu	Kosrae	2,927	Tofol and Innem River	None
Malem	Kosrae	1,257	Malem River	None
Utwe	Kosrae	1,152	Pulusrik River	None
Tafuyat	Kosrae	407	Tafuyat River	None
Yekula	Kosrae	430	Yekula River	None
Mutunte	Kosrae	1,360	Mutunte River	None
Walung	Kosrae	100	Walung River	None

**Groundwater systems** usually consist of a production borehole fitted with a submersible pump, and a transmission and distribution network. A chlorine injection procedure is sometime incorporated into the system at the wellhead. The severe drought of 1983 gave stimulus to a groundwater development program, which resulted in the drilling of several dozen wells in all of the states of the FSM. A total of about 90 boreholes have so far been drilled in the main islands. The under ground formations are not conducive to the development of high yielding wells and drilling through this formation involved costlier investment too. However, the hydrogeology is suitable for multiple, low to medium yielding wells in the range of 20 – 150 gpm. The quality of ground water is mostly excellent.

### Estimate of Groundwater Resources (mgd)

Location	Estimate of Groundwater Resources	
	Average Rainfall	Drought
Kosrae	2.62	1.01
Weno (Chuuk)	3.20	2.32
Yap Proper	2.40	1.56
Kolonia Area (Pohnpei)	6.90	4.6

The above table shows that there is enough groundwater to meet the water needs of the islands during drought. The production capability of the operational wells are as follows:

### Production Capability of Operational Wells

Location	No. of wells in Operation	Production Capability (gpd)
Kosrae	4	331,000
Chuuk	32	1,600,000
Pohnpei	11	700,000
Yap	13	900,000

**Groundwater on small atolls** occurs as a thin lens, which floats on the underlying seawater. In the FSM, the relatively high rainfall and low rates of surface runoff on the atolls, results in good recharge rates. However, most of the atolls are less than 0.3 mi<sup>2</sup> in area. Furthermore, they tend to be elongated in shape and are therefore too narrow to produce the conditions that will give rise to a freshwater lens of significant thickness. The hydrogeological data obtained from the well drilling program and investigations have been carried out in mid nineties by UN Hydrogeologists, Andrew Omuri, and Keyan Zheng, and the freshwater lenses on several of the atoll islands have now been mapped and assessed for their water development potential. The groundwater potential of a selected number of atolls islands is presented below:

### *Groundwater potential in Selected Atolls Islands*

Island	Population	Land Area (mi <sup>2</sup> )	Maximum Thickness of Lens (ft)	Safe Yield During Drought (gpd)
Pingelap (Pohnpei)	518	0.68	42	55,000
Sapwafik (Pohnpei)	603	0.67	15	145,000
Satawan (Chuuk)	823	1.16	5	57,000
Fais (Yap)	301	1.08	22	52,000

In the **sanitation** sector there is not much improvement. Only limited areas in the nerve centers of the states are provided with sewerage system so far and large numbers of household still have pit latrines or other unhygienic excreta disposal system. Considerable attention is required for planned drainage in the developed areas to protect the road pavement and foothill areas from land erosion and flooding.

There are now five **sewerage systems**, which serve Kolonia town in Pohnpei, Weno Island in Chuuk, Colonia town in Yap, Lelu town in Kosrae and the Tofol administrative area in Kosrae. The largest of these sewerage systems is the Kolonia Central Sewerage System in Pohnpei, which consists of about 12 miles of sewers, a total of 7 lift stations and a package sewage treatment plant with a capacity of about 0.8 million gallons a day. The system has about 1,200 connections. The treated sewage is discharged into the Sokehs harbor through a 12-inch diameter pipeline. The sewerage system in Weno Island, Chuuk State, comprises 11.3 miles of sewer mains, 12 lift stations, 9 grinder stations and a package treatment plant with a capacity of 0.75 million gallons a day. However, the sewage treatment plant is nonfunctional and raw sewage is discharged into the Weno lagoon, through a 2,000-foot long marine outfall. The system has about 475 connections. The Colonia sewerage system in Yap provides primary treatment utilizing an Imhoff tank with a capacity of 340,000 gallons per day. The treated effluent is discharged to a sewage outfall, which extends about 560 feet into the ocean. There are about 700 connections to the system. The Lelu sewerage system in Kosrae provides small bore sewers, which receive the effluent from household septic tanks. The sewage thus collected is delivered to pumping station from where it is pumped through a 6-inch diameter marine outfall extending about 1,082 feet offshore. The Tofol sewerage system collects sewage from the Government buildings in the Tofol and provides treatment in oxidation ponds, which have a capacity of 15,000 gallons a day.

The FSM is yet to establish an organized system for the collection and disposal of **solid waste**. There are several dumpsites throughout the FSM, but none of them have been properly constructed and maintenance is minimal or non-existent. With the exception of the Yap main islands, there is no public service for the collection of solid waste, and households and commercial establishments have to transport their own waste to the public dumpsites. This encourages a considerable amount of illegal dumping in areas, which are not designated as dumpsites. Another problem is that most of the public dumpsites are either inappropriately located (as in Pohnpei and Chuuk), or are very close to full capacity as in Yap. The critical deficiencies in the area of solid waste collection and disposal constitute one of the major environmental problems in the FSM.

The disposal of solid and liquid waste (particularly of human excreta, household garbage and disposal from pigpens in urban areas) has been identified as perhaps the foremost environmental health problem. There are many pigpens located besides the lagoon, continuously contaminating the surrounding waters. In addition, septic systems, in most of the cases, are poor in design and construction. The pour-flush toilets and overland benjoes frequently overflow during heavy rains. Some toilets are located nearby or over water sources. The extent of this problem varies from settlement to settlement and found more pronounced in densely populated areas. This has resulted in public health problems including recent cholera outbreaks and a continued high mortality rate from diarrhoeal disease. Over population coupled with their increased production of wastes including human waste makes the urban centers particularly vulnerable to disease and conditions associated with waste disposal and waste management.

*FSM Country Overview On Wastewater Management:*

States	Public sewer system					Residential sewer system (population served)	
	Treatment process	Design capacity (MGD)	LPS/ GPS/ ES	Length of sewer/ size (Miles)	Population on served	Septic tank / cesspool	Pit latrine and others
<b>Pohnpei State</b>						8,500 (20%)	20,500 (57%)
PUC wastewater system	Extended aeration activated sludge	<b>0.8 – av.</b> 1.6 - max	5 – lps 2 - es	11.6	7,000		
PFC	Extended	.0066	1	0.5	12 tonnes		
	Aeration				Tuna, 1 hotel & staff		
Palikir	Septic tank w/ leaching field				700 employee		
<b>Chuuk State</b>							
Weno Island	Primary treatment	<b>0.75 – av.</b> 1.5 – max.	21 (old) 15 (new)	11.3 6.0 (new)	5,000 (8.6%)	8,300 (14.4%)	45,000 (77%)
<b>Yap State</b>						1,000 (9%)	6,400 (56%)
Yap Central	Imhoff	0.35	11		4,000 (36%)		
<b>Kosrae State</b>						4,500 (57.7%)	1,500 (19.3%)
Tofol	Oxidation on pond	0.015			1,800 (23%)		
Lelu	Small bore sewer and marine outfall						

Lps-Lift Pump Station, es-Ejector Station, av-average, max-maximum

*FSM Solid Waste Disposal*

States	Designated Garbage Dump	Collection Bins/Dumpsite	Managed By	Cost Recovery	Well managed	Proposed Plan for improvement
Pohnpei	Yes	Yes	PWMS	Yes	Yes	Yes
Chuuk	Yes	No	None	No	No	Yes
Yap	Yes	Yes	Public works	No	Yes	Yes
Kosrae	Yes	No	DP&U	No	No	Yes

In many of the islands in the FSM, several potential water resources are not yet exploited and developed. In the past decades, the US Government has been supporting the FSM for the water resources management and to attain improved water supply to each and every household, which has not yet been reached even 50% in total. The FSM States need to monitor ground water status and any affects of changes, record the information to take appropriate measures for Aquifer protection. Unfortunately, FSM is lagging in ground water monitoring system, which is vital for regional cooperation and water resources management.

## **Theme 2: Island Vulnerability**

The Federated States of Micronesia specially, the States of Yap, Chuuk and their adjoining outer islands are prone to extremely damaging natural disasters, in the form of typhoon, extended drought, landslides, tidal erosion and extensive floods. Due to climate change, the drought is perceived to be occurring with increasing frequency and intensity. Natural disasters are of special concerns to FSM due to its fragmented composition of smaller islands, dependence on subsistence agriculture and tourism, which are vulnerable to natural and environmental disasters. The natural disasters usually affect the economy and natural environment, which are long lasting and the rehabilitation costs are high.

There are offices for disaster preparedness in all the States. During the natural disaster the US Federal Emergency Management Agency (FEMA), Red Cross provide supports for disaster preparedness. The inadequacy of supplies and logistic and effective manpower usually restrict the country to work on the disaster preparedness ahead of time. The cultural barriers, superstition and lack of communication also responsible to mitigate prepare for and respond to the frequent disasters.

The State Disaster office should initiate early warning systems to take necessary precautions to make the people aware to face the natural disaster. Sound management and engineering need to be adopted including regulation of building code and water quality standards.

The islands of the FSM are particularly vulnerable to global warming and climate change, climate variability and sea level rise. The people are living very close to the seashore, the agricultural land and infrastructure are not very far from the seashore, any rise in sea level will have significant effects on their economy and living conditions, the low lying coral islands are always threatened. Inundation of coral islands results in a loss of human lives, subsistence agriculture for food and houses and infrastructure, which are not recoverable and involve always a costly rehabilitation. Global climatic change can destroy coral reefs, alter the distribution of zones of upwelling and affect both subsistence and commercial fisheries production. It may affect the vegetation and saline intrusion may adversely affect freshwater resources.

The FSM States need to monitor the climate change and any affects of changes, record the information to take appropriate measures for protection.

## **Theme 3: Awareness**

There are no national level public education policies with respect to water supply and sanitation issues. Health Department in each of the states have Health Education staff and programs that from time to time touch no water quality and water handling issues. This is particularly the case during epidemics and reports of cases of water contamination. Nevertheless, public education for a range of health issues has been carried out by staff at National Department of Health Education and Social Affairs.

Radio stations in each of the states broadcast items concerned with water supply and sanitation issues and utility matters. The Utility Corporations themselves can organize broadcasts and community awareness programs as can other departments such as Health or Public Affairs.

However, there are no continuous or coordinated programs in any of the states. Public participation in the water supply sector has historically been very low. Under the US administration piped water supplies were limited but free. Under the FSM administration water was supplied free of cost until mid 1990s with the creation of Public Utilities have introduced a fee for service scheme. However, this is variously applied, as connections are yet un-metered or meters are broken, particularly in Chuuk and Kosrae. Utilities also have time to time carried out education and communication activities, most often in connection with the electricity supply. All utilities expressed great interest in developing a better, more comprehensive, education and participation program.

The FSM States have adopted policies for public awareness for public health, protection of water resources, pollution of water resources, conservation and controlled use of drinking water. The policies need to be broadened and enforced in an effective manner. The concerned authority should develop enhanced policies so that people can follow them.

The local governments need the cooperation and support of the communities, politicians to enforce the policies. Community participation is a key approach towards environmental protection, surface water catchments, ground water and waste management. Awareness and motivation of the people are very important for the improvement and development of the water resources, treatment and distribution of water.

The communities are required to organize properly in order to participate in the improvement of their own water supply as well as operations and maintenance. Various diseases are caused due to supply of contaminated water in the FSM. In particular during the extended drought, there are incidences of cholera outbreak, which leads loss of human lives. We learnt from other countries that public awareness, community participation and political motivation supports the community for the sustainable water supply. Involvement of women is particularly important for water resources management. Women are the prime users of water and who take care of the children, food preparation and household activities. Gender balancing and equity at policy levels will enhance health and hygiene aspects as well as management issues. FSM yet to have enough qualified personnel to handle wide range of responsibilities associated with the management and development of Water and Environmental Sanitation Sectors.

The incidence of economic inequality varies widely among the four states and the lowest income households are on the outer islands where there is a chronic lack of opportunity for basic needs and formal sector employment caused by sluggish economic growth. There are also significant gender inequalities as shown by lower female literacy and lower educational enrollment ratios. The incidence of economic inequality varies widely among the four states. The lowest income households are on the outer islands where there is a chronic lack of opportunity for basic needs and formal sector employment.

#### **Theme 4: Technology**

In many of the islands, there are no appropriate actions or policy to protect and safeguard watershed and groundwater resources, which poses a threat due to the rapid population growth on the main islands, changes in economic strategies and a growing demand of freshwater. Contamination of indiscriminately discharged human and livestock wastes is a common threat too to the freshwater resources in FSM. Sound engineering and long-term management strategies for water catchment and storage areas, including the treatment and distribution of limited water supplies, are of particular economic and environmental importance.

There are persistent problems due to land access in most of the FSM States, in Chuuk in particular.

There are limited access for proper management and development of the water resources. Unfortunately except few exceptions, there are limited numbers of organizations within the municipality or state levels available having adequate capacity to provide certain specific expertise in the areas of technical, planning & design and management support for water sector development in FSM. There are also possible constraints due to low groundwater recharge resulting in saltwater intrusion during the drought. The proper operations and maintenance program require to be developed for routine maintenance of the water supply systems. Many systems are supplying sufficient volume of water without proper treatment. Sound technical and appropriate design are vital for these systems in the FSM. The above constraints need to be addressed and the present level of the management of water systems need immediate improvement in order to achieve technical capability and sustainable water supply for everybody.

**As discussed, Individual Household Systems** (Rainwater Catchment and Shallow Dug Wells) extensively used throughout the rural areas and outer islands of the FSM are not capable to meet demand during draught, require standardization and appropriate design to suit the environment and community demands. On the outer islands, there are no piped water systems and the residents rely exclusively on individual household systems. The full dimension of the problem can be seen from the fact that about 40% of the population of the FSM reside on the Outer islands and are totally dependent on simple household water systems to meet their needs.

The main problems faced in operating Surface Water Systems arise from the bacteriological contamination of the water sources and supply problems during extended dry periods. In the dry season, maximum demand coincides with minimum supply and water shortages are experienced. Special technical review and careful judgment are required to standardize theses surface water systems to fit community demand in terms of quality, quantity and environmentally friendly. These piped water systems are of two basic types. Systems, which utilize streams water sources consist of a small intake across the stream, a raw water main to the treatment plant (for those systems which incorporate treatment) and a transmission and distribution network. Water treatment is by rapid sand filtration, followed by chlorination. Only 5 systems out of about 70 have treatment facilities, and most systems supply untreated water.

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yielding wells and drilling through this formation involved costlier investment too. However, the hydrogeology is suitable for multiple, low to medium yielding wells in the range of 20 – 150 gpm. The quality of ground water is mostly excellent. **Groundwater exploitation systems** usually consist of a production borehole fitted with a submersible pump, and a transmission and distribution network. A chlorine injection procedure is sometime incorporated into the system at the wellhead.

**Groundwater on small atolls** occurs as a thin lens, which floats on the underlying seawater. In the FSM, the relatively high rainfall and low rates of surface runoff on the atolls, results in good recharge rates. However, most of the atolls are less than 0.3 mi<sup>2</sup> in area. Furthermore, they tend to be elongated in shape and are therefore too narrow to produce the conditions that will give rise to a freshwater lens of significant thickness. The hydrogeological data obtained from the well drilling program and investigations carried out in mid nineties reveals that fresh water development is potential in some of the coral islands. But the success lies in the application of appropriate technology and indigenous method.

### **Theme 5: Institutional Arrangements**

The national and the state governments are aware of the consequence of termination of US funding under the Compact arrangements particularly in the areas of utilities. All the UCs are charging the Customer reasonable rates towards electricity consumption and therefore may sustain the generation of power including cost of diesel oil which is presently being borne by the Government from the Compact grant. Since part of the cost of water supply and sanitation is also being borne by the UCs from generation of revenue against electricity, they are not confident about sustainability of these system once the grant is stopped. The state governments therefore realize that water can no longer be a free commodity and a reasonable tariff on its consumption should be imposed based on its affordability to the consumers. Ucs in Pohnpei and Yap have already introduced such policy but not the other states.

The government has identified the principal future sources of their revenue generation for sustenance of the country as fisheries and tourism industries. Supply of safe water and adequate sanitation provisions are prerequisite for promotion of these industries. The government has accordingly included these utilities as top priority in their national policies.

The national and state governments have also identified the need for institutional strengthening to make the UCs as self sustaining. Various operation and maintenance improvement programs (OMIP) and training of personnel have been implemented with the help of Department of Interior (DOI) of the US Government in the past which have shown positive improvements to some of the Ucs (PUC for example), in their functioning. Government's policy in prioritizing the sector is further confirmed by its action in approaching the Asian Development Bank (ADB) for assistance in improvements of the sector.

The government of FSM does not have any direct role in setting policy frameworks for the sector. The national government, through its Dept. of Finance & Administration, and Dept. of TC&I coordinates the mobilization of funding for water supply and sanitation projects. Further, specific funding allocations may be appropriated by the Congress under the Capital Improvement Program (CIP) for projects such as water extensions or the construction of community water systems. Usually these projects would be in response to requests from the communities to the congress members.

However, the government's recognition for human resources development for effective management of this technical sector justify its policy effort due to the improvement of overall health of its people by providing safe water and adequate sanitation facilities. The donors also recognize water and sewerage as priority sectors to develop and making effort to develop institutional frame works under which water and sewerage services can be commercialized and improved for self sustainability of the sector. With these in view the ADB has funded and considering more funding loan assistance for the government of FSM.

As explained earlier the country runs on financial support of the U.S. Government under the Compact of Free Association. In the water supply and sanitation sector while the capital investments are provided by DOI under periodic OMIPs, the operation and maintenance expenditure are partly borne by the states from their revenue. In most of the cases there is no separate revenue for water supply and the UC's are to bear the expenditure from the revenue earned from the sale of Electricity. The net deficit is funded by the compact grant.

The national government of FSM is headed by the President, elected for a four-year term by members of the national congress. The national congress is a unicameral institution comprising of ten Senators. Each

Senator represents a district and is elected by voters in each of the four states. All state representatives are also elected by popular vote.

The state government is headed by the Governor who is directly elected by the people of the state also for a four-year terms.

Both national and state governments have their independent departments to handle various activities, which include water supply and environmental sanitation. The specific institutions that directly undertake water supply and sanitation services in the states are:

- Pohnpei Utilities Corporation (PUC): for the state of Pohnpei
- Chuuk State Public Utilities Corporation (CSPUC): for the state of Chuuk
- Yap State Public Services Corporation (YSPSC): for the state of Yap
- Department of Transportation And Utility of Kosrae (DOTU): for the State of Kosrae

All these Corporations undertake additional responsibilities of generation and distribution of power, except the DOTU of Kosrae. The power sector in Kosrae is directly handled by Kosrae Utilities Authority (KUA). The state legislatures are considering legislation to transfer the responsibilities of water supply and sewerage services to the KUA.

In addition to the Utilities Corporations there are some other specific institutions connected to water and sanitation at national and state government levels.

Various training programs for different levels of personnel were provided, which were mostly on the operation and maintenance of the system. These training programs were mostly conducted off-site generally out side FSM. These training programs therefore, probably could not help the operation and maintenance personnel to effectively address the particular problems of their respective areas. In addition, some training on software for improving the current accounting system had been recently conducted for some of the UCs. No effective training in the field of public education and participation has so far been conducted at the UC's level.

## **Theme 6: Finance**

As explained earlier the country runs on financial support of the UC's by State Government under the Compact of Free Association. In the water supply and sanitation sector while the capital investments are provided by DOI under periodic OMIPs, the operation and maintenance expenditure are partly borne by the states from their revenue. In most of the cases there is no separate revenue for water supply and the UC's are to bear the expenditure from the revenue earned from the sale of Electricity. The net deficit is funded by the Compact grant.

There have been other sources of external funding also in the sector from Australia and China and of late two Technical Assistance (TS No. 2137-FSM and 2646-FSM) and one Loan Assistance (Loan No. 1459-FSM) have been approved by the Bank.

The UC's in the States have very recently assumed the responsibility of water supply and sewerage services and are in the process of development. In fact in Kosrae these services have yet to be taken over by the appropriate authority.

Due to paucity of resources and dependency on external assistance, development of the infrastructure to meet the desired needs as well as maintenance programs are generally not included in the States budgetary provisions. Therefore, the service levels in terms of quality and quantity have declined. Many of the services could not be rendered by the UC's due to non-availability of resources to acquire critical spares and carrying out adequate maintenance programs.

The UC's activities were previously funded by the respective state governments. The tariff structuring and charging of service cost to the consumers were not uniform. In Kosrae no revenue is realized for water supply from the consumers. Such differences arose out of socio-political considerations having little or no linkage with service pricing and service costing.

The utilities formed for supplying water and power will also have to increase their revenue base by increasing tariffs on water supply and sewerage or imposing the same wherever not levied so far at a

concession/minimal rate. However, such tariff structuring will need to keep in view the affordability aspect and cross subsidization amongst the different groups of consumers. The Ucs will have to therefore generate sufficient resources to meet their funding needs and accordingly fiscal reform will have to be initiated for the purpose.

Such lack of financial independence has not only affected service quality, but also acted as a hindrance for growth. The UC's have thus either been unable to provide the services or rendering the same by sacrificing the ongoing maintenance program. The effect of such diversion of funds will lead to serious effect on service capability in the future.

## D. PLAN OF ACTION

### D-1. Objectives:

FSM National Government has planned to launch a long term Infrastructure Development Plan (FSM-IDP: 2003-2017), by next year. The main objectives of this long term plan is to foresee possible investment, IDP structure, policy and institutional reform, institutional strengthening, allocation of responsibilities, and the Plan implementation approach. The IDP considers the future projects of Water, Waste Water/Solid Management need of the country including other infrastructure sectors that are:

- Electric power
- Water supply and wastewater systems
- Solid waste management
- Roads & pedestrian facilities
- Maritime transportation
- Air transportation
- Education
- Health

It is envisaged that the IDP will:

- Preserve existing infrastructure in each of the eight sectors.
- Meet demand for infrastructure and related services, in an effective and efficient manner.
- Provide a foundation for achieving the economic development and social objectives of the FSM National Government and the state governments.
- Attain technical and financial sustainability in each of the eight infrastructure sectors, or at least make progress toward achieving sustainability.

The economic and social objectives of the FSM Government that are pertinent to the IDP are:

- Realization of the tourism potential of all four states of the FSM, in a manner that avoids adverse effects on the environment and traditional cultures. This objective implies a preference for low-density tourism development and for development that can enhance protection of the environment and is in harmony with traditional culture. These objectives make it important that limitations on tourism development be taken into consideration from the very outset of that development.
- Realization of fisheries potential of all of the four States of FSM, including aquaculture development, in a manner that ensures sustainability of the sector. Like tourism, development limitations need to be identified early, in order that overexploitation is avoided, and the fisheries sector made sustainable.
- Realization of agricultural and industrial potentials, including full development of the handicrafts industry. These objectives are interrelated with tourism development.
- Acceleration of the growth and diversification of private sector economic activities.
- Prevention of environmental degradation, marine life depletion, and human health problems.
- Achievement of sustainability of the overall economy and of the individual economic sectors, including the infrastructure sectors.
- Removal of qualified indigenous manpower constraints.
- Universal education and health care.
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The implications that the Plan objectives and the pertinent government economic and social objectives have for infrastructure planning are:

- All areas of the country must be provided with adequate electric power to enable local manpower to realize production opportunities and potentials, and to preserve the value of production.

- Transportation facilities and services must be adequate in terms of pervasiveness, condition, frequency, appropriate capacity, reliability, safety, and efficiency to enable market opportunities to be realized for all areas of the country, including labor market opportunities, and to enhance the level of integration of state economies and the national economy.
- High development priority must be given to those investments and services that will help significantly to preserve the terrestrial and marine environments.
- Within the educational sector, the learning experienced must be enhanced and diversified, to improve student and faculty interest and morale, and thereby improve the effectiveness of education and significantly increase the student retention rates through graduation from elementary and secondary schools.
- Also in the education sector, constraints must be removed on the availability of high school education for all graduates of elementary school, and there must be an array of post-secondary education opportunities for all high school graduates that seek further education.
- Highest priority in regard to human health is to be given to prevention of a variety of water-borne illnesses, through the provision to FSM citizens of potable water supplies.
- To make infrastructure sectors sustainable, investment, maintenance and operation must be done in the most cost effective manner possible, entailing in many cases an expanded and diversified role for the private sector, and a redefined and developed role for government infrastructure agencies.
- Together with cost-efficient operations, new or improved revenue mechanisms must be provided, to ensure progress toward financial sustainability in all sectors, and to achieve sustainability in at least some infrastructure sectors by the end of the Plan period.

#### **D-2. Actions Already Taken:**

Most of the funding for IDP is expected from United States of America under the Joint Compact of Free Association. It is also expected that other sources of external funding like; Japan, Australia, China, EU, Asian Development Bank, World Bank will participate in the infrastructure development of the country including water/waste management sector.

As of now, under the Loan 1459 FSM (SF): Water Supply and Sanitation Project approved by the Asian Development Bank, the implementation of the project in all three participating States (except state of Kosrae), suffered from slow start since the effectivity of the loan in October 1997. With the latest closing date of 30 June 2002, only the state of Yap has now completed all activities under the loan, having made a concerted effort in expediting implementation. The implementation pace in Pohnpei state has also been good in finishing their original scope of works but slowed down with the implementation of additional scope of drilling works due to problem encountered with their only drilling rig, not foreseen beforehand. Implementation progress in Chuuk has been below expectations specially, after the departure of the General Manager in 2001. Some activities under the original scope of the project still remain to be completed and only design work has been initiated on the rehabilitation of the sewerage treatment plant that was subsequently added to the original scope. It is expected that both the states of Pohnpei and Chuuk would need an additional three months until September 2002, to complete their remaining project activities successfully. With the completion of above ADB funded project, FSM will attain a considerable achievement for its three utility corporations in terms of their expansion, Rehabilitation and development of water resources for the provision of reliable and safe water supply and improved sanitation in the main urban centers only.

#### **D-3. Future Actions Needed:**

Over a billion of dollars FSM infrastructure development plan is under finalization for investment.

Water, solid and liquid Waste management projects activities have significantly considered and included in this long term plan to cope the future increasing demands of the country. The tourism development and agriculture sector also demand a very high priority development of Water and Sanitation sector. About 30% (over US\$ 300 million) of the IDP investment was considered for the investment in various projects of this sector.

The sustainability of future water and sanitation projects largely depends upon the National/State/Municipal levels political wills and commitment to this sector.

The major prerequisite future actions are also related to:

- Political interference to Management/Board of the Utility Corporations/Agencies;
- Reform and restructuring;
- Transparency/accountability;
- Land tenure;
- Lack of human resources;
- Lack of vision;
- Lack of appropriate technology;
- Lack of consumer support;
- Lack of enforcement/regulations;
- Lack of training/capacity building;
- Lack of awareness/education;
- Lack of community participation;
- Poor public relation; etc

Areas where Regional and International help are specially welcome include:

- Bringing stakeholders together to discuss issues
- Funding the development of Sector plans
- Strengthening consultative mechanisms
- Providing technical assistance for skills transfer and capacity building
- Institutional strengthening for data collection, processing and analysis
- Developing human resources by funding education and training
- Supporting country initiatives to reform and restructure
- Stimulating development initiatives

#### **D-4. Means of Implementation and Responsibilities:**

The specific institutions that directly responsible to undertake water supply and sanitation services are: Pohnpei Utilities Corporation (PUC) for the state of Pohnpei, Chuuk State Public Utilities Corporation (CSPUC) for the state of Chuuk, Yap State Public Services Corporation (YSPSC) for the state of Yap and the Department of Transportation And Utility of Kosrae (DOTU) for the State of Kosrae. In addition to the Utilities Corporations there are some other specific institutions connected to water and sanitation at national, state government and municipal levels.

All the State level EPA's have been entrusted to fulfill the following specific responsibilities:

- Air, water and land pollution control activities;
- Ensure adequate sanitation for villages, schools and public buildings;
- Ensuring quarantine laws;
- Maintaining safe drinking water standards;
- Ensuring that food retailers comply with health and hygiene regulations;
- Public education activities;

### **E. CONCLUSIONS**

The lessons of past country projects, learning from the region and the current constraints must be considered and given due importance in planning and managing future programs of the sector. The solution of prevailing National level issues related to inadequate water resources legislation, policy, planning and fragmentation water sector management are prerequisites to the improvement and development of a sustainable water management sector.

The international and regional assistance and funding is essential for FSM in realizing effective planning and implementation of its future projects and plan required for the health and social well being of its people.

Due importance also needed for the stakeholders to working together at country level as well as regional/global collaborations are significant and crucial due to effective and sustainable management of water resources in small island countries. The cyclical nature of the problem deserves collective actions of the world nations since the National and Global efforts supplement each other. FSM is committed to its regional and global collaboration towards sustainable development of water management.