NEEDS ANALYSIS AND STRATEGIC DIRECTIONS
FOR METEOROLOGICAL SERVICES IN
SAMOA

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Table of Contents

Executive Summary.................................................................................................................................
Overview......................................................................................................................................................
Requirements for Meteorological Services.................................................................................................
1.0 Introduction:..........................................................................................................................................
2.0 Background............................................................................................................................................
3.0 Current Meteorological Services ........................................................................................................
   3.1 History: .............................................................................................................................................
   3.2 The role of Samoa Meteorological Service Division (SMSD): .....................................................
   3.3 Key Programs: ................................................................................................................................
   3.3.1 Surface Observation Program..................................................................................................
   3.3.2 Upper Air Observation Program: ..............................................................................................
   3.3.3 Climate Observations ................................................................................................................
   3.3.4 Climate Information and Prediction Services ..........................................................................
   3.4 General Forecasting: .......................................................................................................................
   3.5 Severe weather and tropical warnings: ..........................................................................................
   3.6 Marine and Coastal forecast and warnings: ..................................................................................
   3.7 Structures and Staffing: ..................................................................................................................
4. Opportunities of areas for assistance .....................................................................................................
5. Future Strategic Directions....................................................................................................................
   5.1 Strengthen the Basic Infrastructure ..............................................................................................
   5.2 Capacity Building .........................................................................................................................
   5.3 Development of new areas of services .........................................................................................
   5.4 Enhance Delivery of Services ........................................................................................................
6. Conclusions and Recommendations ...................................................................................................
References.....................................................................................................................................................
ANNEXES....................................................................................................................................................
Annex I: SCOPE OF SERVICES .................................................................................................................
Annex II: People Consulted .....................................................................................................................
Annex III: Questionnaires .......................................................................................................................
Annex IV: MAP ...........................................................................................................................................
Executive Summary

Overview

The independent state of Samoa lies between latitudes 13 and 15 south and longitudes 171 and 172 west. It is made up of two large islands, Upolu and Savaii, two smaller islands, Manono and Apolima, and six other smaller islets, Nuula, Nuutele, Nuulua, Namua, Fanuatapu and Nuusafee. The islands, which are of volcanic origin and mountainous, have a total land area of 2,935 square kilometers and a maritime exclusive economic zone (EEZ) of 12,000 square kilometers. Samoa has a population of approximately 161,298 (1991 census).

Samoa's economy depends largely on its natural resources, foreign aid and remittances, though there have been recent contributions from the tourism and manufacturing industries. Main exports are predominantly agricultural-based with recent increase in significance of manufacturing and fisheries products. Due to its geographical location, Samoa's socio-economic and export commodities are highly dependence and therefore vulnerable to weather and climate, as well as external factors such as price instabilities, high transport costs of overseas markets, and harsh meteorological conditions.

Extreme weather events, such as tropical cyclones and droughts have devastating effects on Samoa's socio-economic well being. In 1990, Tropical Cyclone Ofa caused an estimated US$120 million in damages, about 25.5% of Samoa's GDP. A year later (1991), Tropical Cyclone Val caused a further US$200 million of damage, about 45.5% of Samoa's GDP. These two cyclones alone set back the development of Samoa some twenty years. The 1997/98 drought, triggered by the most intense El Nino in the twentieth century, also resulted in major damages and losses to the country.

Requirements for Meteorological Services

Samoa has recently been through a major reform program of its public service, the result of which is a strong economy, cost-conscious and efficient public sector. The Samoa Meteorological Service Division (SMSD), although struggling to secure a reasonable portion of the national budget pre-1996, has largely benefited from the reform. Since its restructuring in 1996, the SMSD has seen its budget increase three fold in 1997 and has remained the same since. The increase in the budget, coupled with clearly targeted and defined technical assistance from its development partners, has resulted in a lean and effective meteorological service.

The establishment of a fully fledged national forecasting unit in 1998, the addition of a new meteorological office at Faleolo International Airport, the installation of eleven automatic weather stations (AWS) around the Samoa Islands between 1991 and 1997 by the US National Weather Service Pacific Region, the re-establishment of its climate division and putting in place new procedures for issuance of tropical cyclone warnings jointly with American Samoa, has resulted in the much improved services now presently provided by the Samoa Meteorological Service Division. The 3-5 day forecasts now issued by the Samoa Meteorological Service since
February 2000 is a testimony to this. This was not possible prior to 1999. In comparison to other Pacific Island Countries, Samoa is fairing much better than most islands. Samoa’s move to work closely with the NOAA Weather Service Office (WSO) in American Samoa forms the basis for the much-improved services.

Observations around the two main islands are nearly all provided by way of automatic weather stations (AWS), funded by the United States government as part of its assistance to both Samoa and American Samoa in the aftermath of Tropical Cyclones Ofa and Val in 1990/1991. The installation of more AWS around the islands would strengthen the observational network, particularly for the domestic airports at Fagalii, Upolu and Maota and Asau, Savaii.

Notwithstanding, the Samoan Meteorological Service would benefit from its continued association with the American Samoa WSO and US NOAA NWS Pacific Headquarters, Honolulu, the training of its senior staff to be fully Class I forecasters, completion of the telecommunication upgrade project between Samoa and American Samoa presently underway, the installation of a weather radar and construction of a new office building. A list of findings is included in this report.

As a result of the consultations held during the February 16 to 18, 2000 Expert Team visit, they identified a number of areas in Samoa that would benefit from quality weather services (forecasts and warnings) as well as enhanced information on climate variability and change. The very nature of the geographical characteristics of the islands and its location in the tropical cyclone prone area, as well as the threat of climate change and sea level rise require a NMS that can provide services throughout the country. For example, there are four main airports in Samoa and only one, Faleolo International Airport, has meteorological observations or specific terminal forecast to support flights into and out of these airfields.

The basic communications infrastructure and observation equipment are lacking at the other three main airports, particularly at the Fagalii (which is used as an international link with American Samoa) and Maota (main airport in Savaii) Airports. More can be done to support the marine community with better specialized forecast and warning services in support of the fishing, tourism, and commercial enterprises, and additional climate and weather reporting locations throughout Samoa would be helpful to long term research needs on climate change and climate variability.

As in many Pacific Islands, the most significant meteorological phenomenon that affects their people and their economy are the tropical cyclones and droughts. It is imperative that programs and activities that serve to mitigate their destructive effects are prioritized. Information on weather and climate is and will continue to be important to the future of Samoa’s people, economy and valuable natural resources. Clearly, there is a continuing need for basic weather forecasts and warnings to protect life and property, including specialized weather services in support of aviation, marine and other elements of the transportation sector. Supporting the safe and efficient movement of people and commerce is particularly important given the geographic isolation and resource limitations that characterize island communities like Samoa. The continued growth of the tourism and fishing industries, for examples, adds an important
dimension to the need for adequate weather and climate services to the country.
1.0 Introduction

This report was commissioned by the South Pacific Regional Environment Programme (SPREP), in close collaboration with the World Meteorological Organization (WMO), the US National Oceanic and Atmospheric Administration National Weather Service (NOAA NWS), Pacific Region, Honolulu, the Australian Bureau of Meteorology (ABM), the Australian International Assistance Agency (AusAID), the Met Service NZ LTD, the Meteo France, and the Fiji Meteorological Service, as part of the Pacific Meteorological Service Needs Analysis (PMSNAP). Annex I provides the Scope of Services for the PMSNAP.

The goal of the PMSNAP is to identify strategies for the improvement of National Meteorological Services (NMS) across the Pacific, including Samoa, to ensure they meet national, regional and international obligations, particularly in weather services, climate change and variability, international cooperation and national development needs.

This report is based on findings from a fact finding mission carried out by an Expert Team, which visited Samoa from 16 to 18 February 2000. The Expert Team consulted a number of major industries, including marine, aviation, shipping, power utility, tourism, regional and United Nation organizations based in Samoa, members of the diplomatic communities, other government departments, disaster management office, the media, as well as staff of the Samoa Meteorological Service Division (SMSD). Annex II provides a list of people consulted during the visit.

2. Background

The independent state of Samoa lies between latitudes 13 and 15 south and longitudes 171 and 172 west. It is made up of two large islands, Upolu and Savaii, two smaller islands, Manono and Apolima, and six other smaller islets, Nuuloa, Nuutele, Nuuluia, Namu’a, Fanuatapu and Nuusafee. The islands, which are of volcanic origin and mountainous, have a total land area of 2,935 square kilometers and a maritime exclusive economic zone (EEZ) of 12,000 square kilometers. Samoa has a population of about 161,298 (1991 census).

Samoa’s economy depends largely on its natural resources, foreign aid and remittances, though there have been recent contributions from the tourism and manufacturing industries. Main exports are predominantly agricultural-based with a recent increase in significance of manufacturing and fisheries products. Due to its geographical location, Samoa’s socio-economic and export commodities are highly dependent and therefore vulnerable to weather and climate, as well as external factors such as price instabilities, high transport costs of overseas market, and harsh meteorological conditions.

Extreme weather events, such as tropical cyclones and droughts have devastating effects on Samoa’s socio-economic well being. In 1990, Tropical Cyclone Ofa caused an estimated US$120 million in damages, about 25.5% of Samoa’s GDP. A year later (1991), Tropical Cyclone Val caused a further US$200 million of damage, about 45.5% of Samoa’s GDP. These two cyclones alone set back the development of Samoa some twenty years. The 1997/98 drought, triggered by the most intense El Nino in the twentieth century, also resulted in major damages.
and losses to the country.

3. Current Meteorological Services in Samoa

3.1 History

The meteorological office of Samoa is the oldest Pacific Islands' meteorological station in the South West Pacific. The earliest climatological records\(^5\) for Apia were made by German meteorologists at Sogi between 1890 and 1902.\(^6\) The meteorological office was used to be a part of the Apia Geophysical Observatory, which is located at the end of Mulinu'u Point, Apia. The Apia Geophysical Observatory was established at Mulinu'u Point in 1902 by the Royal Society of Sciences, Göttingen, Germany and recording has continued on the site since then. In 1914, the observatory was taken over by the New Zealand government but continued under the direction of the German director until 1920. From 1920 to 1938, a New Zealand-based honorary board of advice controlled the observatory, and funding shared between New Zealand, the Carnegie Institute and British Admiralty. In 1938, the observatory was transferred to the control of the New Zealand Department of Scientific and Industrial Research (DSIR) and on 1 September 1939, the New Zealand Meteorological Service assumed sole responsibility for all meteorological observations.

In 1988, the Samoan government assumed sole responsibility of the office when the New Zealand government withdrew its support. The meteorological office was renamed in 1996, "the Samoa Meteorological Service Division (SMSD)", after the restructuring of the Apia Observatory. The new SMSD continues to be a division of the Ministry of Agriculture, Forests, Fisheries and Meteorology. A review of the Department in 1997 led to a Cabinet decision in 1998 that the Department of Agriculture, Forests, Fisheries and Meteorology investigate options for positioning SMSD as a department on its own. However, the investigation has not yet been carried out and the review is still pending.

3.2 The Role of the Samoa Meteorological Service Division (SMSD)

Since its establishment in 1890, the Samoa meteorological service has provided invaluable weather and climate data for Samoa and the region. These long climate data sets have provided Samoa and the region better and improved understanding of weather and climate patterns in the South-West Pacific. The SMSD will continue to be a strategic climate research station in the future, particularly in relation to better understanding of climate variability and change. The primary function of the meteorological office since its inception was serving as an observing station. These data were sent to New Zealand and Fiji (Regional Specialized Meteorological Service) for data management and analysis and then used for preparation of daily weather

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\(^5\) These records included rainfall, mean sea level (MSL) pressure, and maximum and minimum temperature. The exact location and details of exposure and instrument types at this earliest site are not know, but an early map indicates it was near the center of present-day Apia.

\(^6\) Bronwen Collen, "South Pacific Historical Climate Network", Climate Station Histories, Part 1: Southwest Pacific Region, New Zealand Meteorological Service, PO Box 722, Wellington, New Zealand, Published by the National Climate Center, New Zealand Meteorological Service, under the Priority Research Contracts Scheme (PRCS) research program, funded by the New Zealand Foundation for Research Science and Technology, May 1992.
forecasts and climate prediction services. Changes came into effect in 1988 when the Samoa government took sole control of the meteorological service.

Since 1988, the SMSD has expanded its functions to become a fully-fledged national weather forecasting service (public, marine, aviation, and other specialized weather forecasts), and warnings of tropical cyclones and other severe weather conditions. The SMSD’s proposal to become a National Forecasting Center was formally endorsed at the fifth Session of the WMO Regional Association V (RA V) meeting held in Bali, Indonesia in September 1998. This new arrangement was put in place to ensure Samoa would benefit from jointly working together with neighboring American Samoa to issue their own weather and climate services rather than relying on Fiji or New Zealand. The new arrangement has been hailed as a great success and model for other countries with similar situations as the two Samoa. The once climate sub-division, fully operational during the German and New Zealand eras, was non-operational between 1989 and 1996. The climate division was re-established with clearly defined functions and new operational procedures in 1996 as part of the restructuring of the Apia Observatory.

3.3 Key Programs

3.3.1 Surface Observations

Manual synoptic observations are presently carried out at Mulinuu and Faleolo International Airport every six hours. Observations from eleven (11) Handar Automatic Weather Stations (AWS), strategically located in and around the Samoa island group, and one in Tuvalu, are received by staff of the Samoa Meteorological Service Division via satellite using the EMWIN and AFTN systems. Locations of the AWSs serving the Samoa group are detailed in Table 1.

\footnote{Ausetalia Titimaea, “Samoa Meteorological Division: Meteorological Services National Report”, presented at the Fifth SPREP Meeting of Regional Meteorological Services Directors, 11-13 November 1998, Honolulu, Hawaii.}
### Table 1: Installation Details

<table>
<thead>
<tr>
<th>STATION</th>
<th>INSTALLATION DATE</th>
<th>Latitude</th>
<th>Longitude</th>
<th>GMT TIME</th>
<th>WMO IDENTIFICATION (ID)</th>
<th>CHANNEL</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Funafuti</td>
<td></td>
<td>08 31</td>
<td>179 13</td>
<td>B</td>
<td>00:14:00</td>
<td>91644</td>
<td>18W Funafuti, Tuvalu, Swains Island, American Samoa</td>
</tr>
<tr>
<td>2. Swains Island</td>
<td>Nov 3, 1999</td>
<td>11 03 19</td>
<td>171 05</td>
<td>00:41:00</td>
<td>91735</td>
<td>02W</td>
<td>Swains Island, American Samoa</td>
</tr>
<tr>
<td>3. Asau Airport</td>
<td></td>
<td>13 30 22</td>
<td>172 37</td>
<td>W</td>
<td>00:25:00</td>
<td>91755</td>
<td>20W Asau, Savaii, Samoa</td>
</tr>
<tr>
<td>4. Avaq</td>
<td></td>
<td>13 27 172</td>
<td>22</td>
<td>W</td>
<td>00:24:00</td>
<td>91757</td>
<td>20W Avaq, Savaii, Samoa</td>
</tr>
<tr>
<td>5. Faleolo Airport*</td>
<td>Sept 10, 1991</td>
<td>13 49</td>
<td>171 59</td>
<td>W</td>
<td>00:57:00</td>
<td>91758</td>
<td>16W Faleolo, Upolu, Samoa</td>
</tr>
<tr>
<td>6. Lata</td>
<td></td>
<td>13 45</td>
<td>172 31 06</td>
<td>W</td>
<td>00:20:00</td>
<td>91761</td>
<td>24W Lata, Savaii, Samoa</td>
</tr>
<tr>
<td>7. Cape Tapage*</td>
<td>Sept 7, 1991</td>
<td>14 03</td>
<td>171 27</td>
<td>W</td>
<td>00:59:00</td>
<td>91763</td>
<td>16W Lalomanu, Upolu, Samoa</td>
</tr>
<tr>
<td>8. Cape Taputapu</td>
<td>October 21, 1991</td>
<td>14 19</td>
<td>170 50</td>
<td>W</td>
<td>00:43:00</td>
<td>91764</td>
<td>50W Poloa, Tutuila, American Samoa</td>
</tr>
<tr>
<td>9. Cape Matatula</td>
<td>October 21, 1991</td>
<td>14 15</td>
<td>170 34</td>
<td>W</td>
<td>00:42:00</td>
<td>91766</td>
<td>50W Tula, Tutuila, American Samoa</td>
</tr>
<tr>
<td>10 Ofu</td>
<td>May 1, 1991</td>
<td>14 09 43</td>
<td>169 41 04</td>
<td>W</td>
<td>00:23:00</td>
<td>91767</td>
<td>24W Ofu, Manua island, American Samoa</td>
</tr>
<tr>
<td>11 Tau Airport</td>
<td>May 5, 1991</td>
<td></td>
<td></td>
<td></td>
<td>00:54:00</td>
<td>91768</td>
<td>28W Fitiuta Airport, Tau, American Samoa</td>
</tr>
<tr>
<td>12 Cape Ninato’l*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>00:24:00</td>
<td>91769</td>
<td>24W Togitogiga, O le Pupu National Park, Upolu, Samoa</td>
</tr>
</tbody>
</table>

* Plans are underway to relocate these stations due to severe corrosion problems.

A 24-hour METAR/SPECI aviation-observing program is maintained at Faleolo Airport to meet International Civil Aviation Organization (ICAO) requirements.

#### 3.3.2 Upper Air

Cost cutting measures resulted in the closure of the only upper air program, the pilot balloon wind measurement program in Samoa, operated out of Mulinuu, Apia in 1990. Prior to 1990, two flights were carried out twice a day. At present, SMSD relies on the upper air program operated by the US NOAA Weather Service Office (WSO) at Tafuna Airport, American Samoa.

#### 3.3.3 Climate Observations

At present, there are 15 rainfall manual stations operated by SMSD throughout the country. More than 20 stations were operational up until 1990 but most were closed down. There are other rainfall stations presently operated by the Samoa Water Authority (SWA), but SMSD does not
receive these data.

3.3.4 General Forecasting

Weather forecast bulletins for the general public are prepared and issued two times a day (5 am and 5 p.m. Local Time). However, only the 5 a.m. (Local Time) bulletin, including weather charts and satellite imagery are hand delivered to the clients.

The Regional Specialized Meteorological Center in Nadi (RSMC – Nadi) in Fiji prepares weather forecast for Tokelau and sends these messages to SMSD. These messages are translated into local language by SMSD, then sent via radio (2AP and FM stations) for the Tokelau groups. SMSD is designated as a tropical cyclone warning center, responsible for preparing and issuing tropical cyclone warnings for Samoa.

3.3.5 Severe Weather and tropical cyclone warnings

Due to their geographical proximity between Samoa and American Samoa, the populations of both countries have easy access to radio and television broadcasts from both jurisdictions. Prior to 1998, Samoa and American Samoa meteorological services used two different systems and terminology for issuance of daily weather and tropical cyclone warnings to their respective population, causing confusion among the public. After a series of consultation meetings between SMSD and US NOAA NWS WSO-Pago Pago, new procedures for issuance of warnings on tropical cyclones for both Samoa and American Samoa came into effect in December 1998.

RSMC – Nadi provides Special Advisory messages for Samoa for use by SMSD (Note: the US NOAA WSO-Pago Pago receives guidance from the US NOAA NWS Weather Forecast Office in Honolulu), and these are guidance products only to SMSD. In addition, SMSD also receives guidance products from other centers, including the US NOAA NWS Central Pacific Hurricane Center, Honolulu, Hawaii, and the Australian Bureau of Meteorology Brisbane Tropical Cyclone Warning Center, in Australia.

Warning bulletins are hand delivered to the clients. If the weather condition is very bad, bulletins are sent by facsimile to 2AP-radio station, all FM radio stations, and the National Disaster Management Office (NDMO). SMSD has an excellent working relationship with NDMO.

3.3.6 Marine and Coastal Forecast and warnings

SMSD, in close consultation with American Samoa WSO, issued daily marine and coastal forecasts and warnings under the new agreement agreed to in 1998 as described in 3.3.5 above.

3.3.7 Climate Information and Prediction Services

American Samoa NOAA Weather Service Office (WSO) uses the American warning system and terminology while Samoa National Meteorological Service uses the New Zealand and WMO warning system and terminology. Both systems are correct although the American system is far better and more accurate than the WMO (NZO system due to accuracy in equipment (e.g. AWS). The new procedures for both Samoas put in place in December 1998 helps eliminate public confusion.
The revival of the Climate Division within the new SMSD structure in 1997 has seen the update of the climate data set for Samoa. A basic CLICCM version 3.0 and DataEase 4.5.3 are used as a climate database, operating on a Pentium PC with good backup facilities. However, full climate analysis of the Samoa data is still being carried out by the National Institute of Water and Atmosphere Research Ltd. (NIWA) of New Zealand due to lack of a professional climatologist within the SMSD.

3.3.8 Present Organizational Structure

The Assistant Director heads SMSD, carrying out line responsibility for all programs, in addition to corporate management responsibilities. His corporate responsibilities include coordination of Samoa's involvement in international meteorology, through the Prime Minister's Department.

SMSD has 5 main sections, namely, the meteorology and climate, geophysics, geology and workshop, hydrology and administration. The workshop and administration programs provide technical and management and administration support to all other programs.

Meteorology and climate program has two sub-sections, namely, weather and operations, and climate. The weather and operations sub-section is responsible for weather forecasting, tropical cyclone warnings and weather monitoring and observations. The climate sub-section is responsible for archiving climate data and maintaining the database.

4.0 Opportunities of Areas for Assistance

SMSD has expanded its functions over the last 5 years. For instance, it is designated as a national meteorological service, national forecast and tropical cyclone warning center, with responsibility for the preparation and issuance of weather forecasts (public, marine, aviation and other specialized forecasts), warnings of tropical cyclones, and other severe weather conditions. In addition, climate variability and climate change information are becoming increasingly requested of the SMSD. This report addresses issues and makes recommendations, which will assist SMSD to perform its responsibilities effectively and efficiently to meet users of meteorological information.

Meteorological services for the protection of life and property, services for aviation (safety and commercial reasons), and services for the marine community emerged as the priorities for day-to-day meteorological services. In all weather affected industrial sectors, the most common comment is for SMSD to improve its products and accuracy of forecast.

4.1 Severe Weather Warning Services

Samoa's population is vulnerable to the effects of severe weather events such as tropical cyclones, prolonged heavy rain, droughts, and severe thunderstorms. Tropical cyclones and their effects, such as strong wind and floods, can destroy villages, gardens, damage roads and disrupt communications, electrical power generation and distribution, and water supplies. Fatalities and property losses can be substantial and the cost of recovery can be very high.
Samoa is in the region impacted by tropical cyclones and tropical cyclones Ofa (1990), Val (1991), and Lynn (1993) were prime examples, causing massive damage, setting back Samoa's economy 20 to 30 years. The drought of 1997/98 was another prime example, causing shortages of water supplies, which seriously impacted crops, and caused bush fires in some parts of Samoa. Very heavy rain, thunderstorms, floods, and strong-wind, all affect Samoa.

The close proximity of the South Pacific Convergence Zone (SPCZ) to the islands of Samoa during the southern-hemisphere summer months can result in periodic episodes of strong winds. Heavy rainfall throughout the country and strong winds characterize these periods during the cyclone season.

Prolonged episodes of heavy and excessive rain can cause flash flooding, and can be devastating to infrastructure and, commercial and subsistence crops. The brief torrential rains that bring flash floods are usually associated with thunderstorms. Severe thunderstorms can also cause damage and disruption to telecommunication lines and towers, and power lines.

During the tropical cyclone season (November to April), SMSD operates on a special contingency basis whenever there is a threat of a tropical cyclone affecting Samoa. SMSD has the responsibility for preparing and issuing warnings for any tropical cyclones within its area. Warnings of other types of severe weather are issued, as required throughout the year.

Deficiencies

Severe weather warnings are beset by the same sort of problems that affect other SMSD forecasting operations. Observation are not adequate and forecasters lack the necessary tools and training. SMSD currently has 2 forecasters working operational shift (as opposed to those in management or other non-shift or part-time shift positions), and neither of them are WMO Class I qualified. One has an appropriate university degree and has completed WMO Class II courses. As a result, forecasters often first know of a severe weather event when reports start coming in from the observing stations. Normally, these reports trigger the issuance of warnings that predict the future extent and duration of the severe weather. Clearly, this is not nearly as valuable as a proactive warning that predicts the onset of the event.

Forecaster effectiveness in Samoa is still hampered by inefficient and unreliable communication systems. The receipt of observations, the exchange of information between SMSD Head Office, and the delivery of products within the country are all seriously affected.

Samoa does not operate an upper air observing station, but use upper air data from Tafuna airport, operated by the Weather Service Office, American Samoa. The upper air station in American Samoa is about 100 kilometers from Faleolo International airport, and the SMSD does receives these data on a regular basis, but only via the EMWIN system only.

Solutions
The solution will require a strengthening of the observation network, forecasting tools, in particular high resolution satellite imagery needs to be provided, along with on-the-job training in their use, and obtaining suitable computer model outputs.

An option for setting an upper air station in Samoa could be considered, and SMSD should liaize with US NOAA NWS WSO - Pago Pago to insure timely receipt of upper data available from them.

There is an urgent need to address the lack of Class I meteorologists working operational forecasting shifts, as SMSD faces the real risk of being held accountable for any aircraft accident or similar event that could be attributed to inadequate weather forecasts and warnings resulting from the lack of professional expertise. However, this situation will take sometime to remedy.

The first priority must be to contract an experienced tropical meteorologist from either New Zealand or Australia to work alongside SMSD forecasters in assisting, skill transfer and mentoring role for a period of 24 months. During this period, existing staff attends post-graduate meteorologists training course and SMSD to undertake its human resources development.

Secondly, a program of building Class I forecasters must be implemented. Postgraduate training should be arranged for the two graduates who have not yet had this training. In addition, SMSD should be proactively recruiting appropriate university graduates and send them away to attend post graduate training courses in meteorology, and this can best be achieved through its internal review and new organizational structure.

Establishment of communications between forecasters at SMSD Head Office and briefing officers at Faleolo International airport, and also enabling transmission of satellite images and other products is required.

SMSD should liaise with other government departments, Samoa Water Authority, and Samoa Civil Aviation Authority to acquire data from their observational programs.

The creation of observing networks should be carefully designed according to the following criteria, users of meteorological services' requirements, location, cost-effectiveness, and pragmatism.

4.2 Aviation Services

There is one international airport - Faleolo International airport - located on the island of Upolu. There are 3 domestic airports - Maota and Asa' airports both on the island of Savai'i, and Fagalii airport on the island of Upolu. The Fagalii airport is also used for flights between Samoa and American Samoa, particular the twin otter fleet and smaller aircraft. On average, 4 to 6 international flights operate through the Faleolo International Airport and 10 domestic flights through the Faleolo and Fagalii airports every week. There are three airline companies operating international flights in and out of Samoa, particular from Faleolo International airport, namely, Polynesian Airline, Air New Zealand and Air Pacific Airlines. Samoa Air and Air Polynesia, both operate twin otter fleets and smaller aircraft, between Samoa and American Samoa via
Fagali and Faleolo airports.

Samoa Air will move its flight operation from Fagali airport to Faleolo International airport if the weather conditions at Fagali airport deteriorate, particularly heavy rain, poor visibility and strong winds across the runway. This also applies to all of the operation of Polynesian Airlines twin otter fleet.

There are three requirements that the aviation industry has for meteorological services in Samoa, accurate observations, accurate forecasts, up to date information available when and where required, and sufficient lead time and notice of significant weather conditions.

METARs and SPECIs for Faleolo International Airport are prepared and issued by the SMSD staff. The information is sent via AFTN to Kelburne, New Zealand for broadcasting as a VOLMET. Facsimile and HF radios are used as backups if AFTN fails. METARs and SPECIs for Fagali airport are prepared and issued by SMSD Head Office. No METARs and SPECIs for Maota and Asau airstrips. The SMSD prepares and issues Area Forecasts. RSMC – Nadi prepares and issues Terminal Forecasts (TAFs) for Faleolo International airport.

Deficiencies

Generally, the aviation industry is satisfied with services, however, there is a need for improvements. In some occasions, METARs and SPECIs are not available or late.

No weather observing systems at Fagali, Maota and Asau airports.

METARs and SPECIs for Fagali airport are prepared using observational data from Mulinuu, SMSD Head Office.

No METARs and SPECIs for Maota and Asau airstrips.

There is an expressed need by the aviation industry that weather observers and forecasters alike do not appreciate the needs of the industry.

These deficiencies can essentially be traced to the observations that are unreliable, i.e. the non-availability of data from observing systems, inadequately trained observers and fragile communications.

Solutions

Upgrade the office at Faleolo International airport to a briefing office, with adequate resources and facilities. The staff will face their clients on a daily basis and hear, directly, their criticisms and compliments. There has been a trend away from face to face briefings in many countries in recent years, with increasing reliance on electronic delivery, but in the case of Samoa there is a very important reason. SMSD recently began providing weather forecasts and warnings to airlines and have initiated face-to-face contact with flight crews, which will promote greater awareness of weather forecasts and warnings services to aviation.
The recommendations are,

*Establish observing systems at Fagali airport and at all airstrips in the islands.*
*Improve communications between weather observers at Faleolo International airport and SMSD Head Office.*
*Arrange training and mentoring for forecasters and observers.*
*Strengthening aviation awareness by relocating establishing a briefing office at the main terminal of Faleolo International airport.*

### 4.3 Marine Services

There are over 100 fishing boats (called Alia), 35-40 Feet long and 8-14 feet wide and powered by 40 horsepower, out in the Samoa's waters fishing every day and their operations are highly weather dependent. They often make voyages for considerable length and period. Such boats are extremely vulnerable to even moderate winds and seas.

Samoa's export commodities are vulnerable to constraints generated by external factors, including harsh weather condition.

SMSD provides routine marine weather bulletins, consisting of forecasts of sea states, waves, swells and visibility, and are issued two times a day (5am and 4pm Local Time). Strong wind advisories are issued whenever winds are expected to reach 25 knots or more.

### Deficiencies

The main criticism is, and also acknowledged by the forecasters, that sustained winds less that 25 knots, already cause difficulties to fishing operations.

The weather forecasts are not representative of the actual weather conditions.

Poor dissemination of marine weather bulletins to fishermen. Although it is the responsibility of the Fisheries Department to relay marine weather forecasts to fishermen on their boats out at seas, SMSD should try and assist in ensuring that fishermen have ready access to the forecasts.

### Solutions

Many of the actions required to improve marine forecasting are the same as what is required for severe weather warnings and aviation, forecasters tools and training, and strengthening the observing network, and in particular reports from the fishermen. SMSD should coordinate the collection of reports from fishermen with the Fisheries Department.

### 4.4 Seasonal to inter-annual climate variability and change information and prediction services

An area of increasingly significance is ENSO and La Nina associated climate variability in
combination with climate change. New technology and a number of new products are now available from international sources to monitor and provide advice and information to the community in the form of seasonal outlooks, e.g. rainfall, drought, temperature, and the occurrence of tropical cyclones. Such information and advice are of great significance to planning, and therefore to the community and social and economic activities, e.g. water resources management, disaster management, etc. It is recommended that the capability and capacity of SMSD to provide climate information and services urgently needs attention.

Climate variability and climate change are important issues, especially following the 1998 drought coinciding with ENSO and La Nina severely affected the country. Sea level rise is also a concern.

**Deficiencies**

Prediction of droughts, such as the event in 1998, was possible, but the SMSD did not become aware of the severity of the drought until it reached its peak.

Lack of a professionally trained climatologist.

**Solutions**

It is possible to make broad predictions based on trends in SOI and monitor international scientific literature on these trends.

Climatological advice is important to the government and industry planners in Samoa, and SMSD needs to increase it capacity and capability in this area. However, the Climate sub-program need not be large, and efforts should be focused on building its capacity and capability.

5.0 **Future Strategic Directions**

As in the case in all Pacific Islands countries, information on weather and climate is and will continue to be important to sustainable social and economic development. There is a continuing need for basic public weather forecasts and warnings to protect life and property, including specialized services to support aviation and marine transport industry. Supporting the safe and efficient movement of goods in and out of Samoa is particularly important given its geographical isolation and resources limitation. The continuing growth in the tourism industry adds an important dimension to the need to provide adequate weather services to ensure safe arrival and departure as well as providing warnings of severe weather events and accurate and reliable weather forecasts so that visitors can plan accordingly.

The consultation by the Expert Team identified the following strategy for enhancing weather and climate services in Samoa:

5.1 **Strengthen Basic Infrastructure**

*Improved regularity, quality and time and space coverage of meteorological observations.*
Improved communication of data and guidance material for national and international use.

Improved management including archiving of data to provide services (including climate variability and climate change).

A severe weather–resistant and secure tropical cyclone proof accommodation for the storage of valuable climate records and uninterrupted operation of the cyclone warning center and specialized equipment.

5.2 Capacity Building

Recruitment of the necessary additional staff at appropriate levels.

Provision of training in specific skills.

5.3 Develop new areas of service provision

Development and delivery of new services, in particular seasonal and inter-annual climate prediction.

5.4 Enhance delivery of services

Public education and awareness programs and communication of services.

Improvement in inter-sectoral co-ordination within Samoa.
6.0 Conclusions and Recommendations

Producing weather forecasts and warnings to meet the requirement of its clients – the public, the airlines and seafarers is the fundamental reason for SMSD. An effective NMS must be carefully structured, and managed in such a way that everything that is done is recognized as supporting the weather forecasters' objective of delivering the most timely and accurate weather forecasts and warnings possible to the clients who depend on these products. Directors, Managers and support staff all, exist, simply, to facilitate the production of these products.

To achieve the strategic objective, SMSD should focus primarily on the following priorities.

Functions

- Develop an Act or legal instrument for meteorology and climate, clearly establishing SMSD functions as a national meteorological service, forecasting center, and tropical cyclone warning center.
- Develop Co-corporate Plans.
- Review structure.
- Designate SMSD as the Meteorological Authority for Samoa.

Office accommodation

- Constructing SMSD a new office building.
- Installing a standby generator.

Weather observing systems

- Establish means to get data from the Samoa Water Authority (SWA) rain gauges to the forecasting center near real time for warnings of flash flood.
- Arrange with at least some of the fishing boats to report on sea conditions.
- Arrange with the inter-island shipping operator to install meteorological equipment on at least one of their boats.
- Install raingauges along major rivers and interior of islands.
- Replacing basic meteorological equipment.
- Redesign the network to ensure it is appropriate to users of weather forecasts and warning requirements.
- Access upper air data from American Samoa on a regular basis.

Satellite data

- Install a high-resolution satellite data processing system.

Telecommunications

- Install a multi-address or a dial-in telex machine for dissemination of weather forecast and warnings.
Upgrading the communication link between Apia and Faleolo International airport. Establishing a communication link between the SMSD Weather Office (WO) - Faleolo International airport, SMSD Head Office, and the Air Traffic Control Tower.

Weather forecasting and tropical cyclone warning services

Contract an experienced operational tropical meteorologist to initially set the direction of the forecasting center, and at the same time conduct job training coaching and mentoring.
Release the Scientific Officer (weather) for the meteorologists training course (WMO Class I) at the Australian Bureau of Meteorology.
Send staff for Assistant Weather Forecasting training course at the Australian Bureau of Meteorology.
Establish at least 3 more positions for university science graduates.
Establish at least 3 positions of full time weather forecasters for operational shifts,
Obtain suitable computer model output for tropical cyclone analysis and forecasting for Samoa.

Climate Variability and Change information and prediction services

Contract an experienced climatologist to establish the climate information and services section and set the direction for its operation. Initial contract could be for 2 years and with further extension of contract if necessary.
Upgrade the CLICOM system.
Having regular access to ENSO model outputs, such as the Southern Oscillation Index (SOI), and latest and keeping regular update on scientific literatures on SOI.
Developing a PC-based system for providing the basis for seasonal to inter-annual prediction.
Develop a climate bulletin for Samoa.
Establishing at least 1 position for a university science graduate in the Climate sub-program.

Human resources development and training

Management training.
Professional meteorologist training, specializing in weather and tropical cyclone forecasting.
Professional training in climatology.
Training in weather forecasting, electronics, etc.
Training in information technology.
Training in designing weather presentations to suit clients’ requirements.
Contract an experienced tropical meteorologist to work alongside forecasters in assisting, skill transfer and mentoring role.
Contract an experienced climatologist to set up the works of climate information and services, and work alongside local staff in assisting skill transfer and mentoring role.

References


iii) Needs Analysis and Strategic Directions for Meteorological Services in Papua New Guinea, Balus Program, Project 2.1.


vii) SPREP, First, Second, Third, Fourth, Fifth, Sixth SPREP Meeting of Regional Meteorological Service Directors (RMSD) reports, SPREP.

viii) The State of the Environment Report, SPREP.

ix) Samoa National Report, PICCAP, SPREP
Annexes

i) Scope of Services: The Pacific Meteorological Services Needs Analysis Project.
ii) List of People consulted in Samoa.
iii) Questionnaires used to gather information and data
iv) Map of Samoa
1. Project

Description
This project involves an analysis of needs of National Meteorological Services (NMS) of Pacific Island Countries to ensure they meet national, regional and international obligations, particularly in weather services, climate change and variability, international cooperation and national development needs. The project will also develop a set of coordinated activities, which could be picked up by donor agencies to develop NMSs in the region. The Sixth SPREP Meeting of Regional Meteorological Service Directors (RMSD) held in Tahiti in July 1999 identified this project as high priority.

1.1 Duration
SPREP shall commence the agreed activities outlined on 10 January 2000, and complete them by 31 May 2000.

1.2 Location
The analysis shall look at NMS in the following countries: American Samoa, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Nauru, New Caledonia, Niue, Northern Mariana Islands, Palau, Samoa, Solomon Islands, Tokelau, Tonga Tuvalu, Vanuatu and Wallis and Futuna.

1.3 Goal
The overall goal of the Needs Analysis Project is to identify strategies for the improvement of NMSs across the Pacific.

1.4 Objectives
The main objectives of the Needs Analysis Project are:

- To identify the national, regional and international obligations relevant to meteorological services in the Pacific Island Countries participating in the analysis
- To determine the capacity of each service to meet these needs
- To present a range of options for projects suitable for donor agencies to undertake in order to address the needs identified.

2. Project Outputs

2.1 Project Outputs
- A single report identifying the national, regional and international obligations relevant to meteorological services in the countries specified above and assessing the capacity of each service to meet these needs.
- The report shall also detail an integrated range of projects concepts which address these needs, in a format which would give donor agencies sufficient information to determine the
resources, approximate costs, duration, location, risks, sustainability, objectives and expected impact of each project.

- Presentation of the results at the seventh SPREP meeting of RMSD in 2000.
Annex II: List of People consulted during the visit to Samoa, February 2000

Samoa Meteorological Service Division

Mr. Faatoia Malele, Assistant Director
Mr. Taala Liae, Senior Scientific Officer
Mr. Sagato, Scientific Officer (Weather)
Mr. Niko, Scientific Officer (Climate)

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Samoa Airport Authority

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Samoa Air (Samoa)
Mr. Billy Meridif
Manager Operations – Samoa
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New Zealand High Commission
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Mr. Mike Walsh, Second Secretary
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Australian High Commission
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Department of Trade, Commerce and Industries

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NATIONAL METEOROLOGICAL SERVICE NEEDS ASSESSMENT

COUNTRY: __________________________ DATE: __________________________

User: __________________________ Organization: __________________________

- Do you use the National Meteorological Service and for what primary Purpose?
- How often do you receive/obtain these services?
- How do you receive/obtain these services?
- Does the service provide you with the information you need?
- If not, what services would you require?
- How often do you need the services?
- What other services would you like to see or recommend?
- Do you need weather services for other areas?

Remarks:

29
Annex IV – MAP OF SAMOA