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CLICOM Inventory and Review Project

by

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Foreword

The environment, people and culture of the Pacific islands are intimately related to the climate of the region. The prevailing winds guided the first people to this region and shaped the migration and settlement of people throughout the islands. The distribution of rainfall determined which areas were suitable for agriculture and which crops could be harvested. The occasional tropical cyclone brought destruction, hardship and even death.

Today, much of the social and economic activity of the Pacific islands remain at the mercy of the climate. Tropical cyclones are still a feature of the region, and the El-Nino phenomenon regularly brings extreme climate variability leading to flooding and droughts across the Pacific region and throughout the world. The threat of climate change adds to the climate concerns. Global warming and rising sea-levels, together with the potential for increasing frequency and distribution of climatic extemes poses the greatest threat to the very survival of many Pacific islands.

The most basic, and yet the most important, tool for assessing the impacts of climate, climate variability and climate change in the Pacific is the climate data base. Every day hundreds of meteorological staff take many thousands of measurements of rainfall, temperature, humidity, wind speed and direction, and many other climate elements. The long term monitoring of these indices provide the only means of determining if the climate of the region is varying or changing. For this reason it is difficult to over-estimate the value of this information.

Effective management of this information demands a sound system of data archival, analysis and dissemination. In the past data management has often been inadequate, leading to lost records and providing little opportunity for analysis of the information. The CLICOM system has been especially designed for meteorological services operating with small networks and only basic resources. The involvement of WMO and other regional partners in providing and supporting CLICOM presents the best opportunity for Pacific island countries to manage this information in an efficient manner.

SPREP is committed to assisting its members establish a complete and robust climate data management system. The information it will provide is vital for national development planning, particularly for those sectors such as agriculture, fisheries, public works and utilities, and tourism, which are closely linked to the climate of the region. This report summarises the state of CLICOM in ten Pacific island countries who use the system, and provides guidance for future work to establish CLICOM to the level needed. The information in this report will be used by SPREP to develop a Regional CLICOM Support Programme, in partnership with WMO and other interested parties.

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Vili A. Fuavao

Director

CLICOM INVENTORY AND REVIEW PROJECT

Report of a consultancy study conducted for the

South Pacific Regional Environment Programme
P O Box 240, Apia, Western Samoa

under funding from the

New Zealand Government

by

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Executive summary

This CLICOM Inventory and Review Project provides a detailed appraisal of the state of the CLICOM climate data processing systems present in the meteorological services of ten South Pacific island countries. The CLICOM system is designed to capture, process, analyse, and archive climate data. It comprises one or more personal computers, with data storage devices and a printer, and a set of necessary software packages needed. The CLICOM concept, and the unique CLICOM software, has been promoted and developed by the World Meteorological Organization for use by small less-developed countries.

The present project was initiated by the South Pacific Regional Environmental Programme in response to member concerns that the CLICOM systems had been obtained in largely ad hoc fashion without proper support and training and were generally not functioning well. To survey each country, a fact-finding mission was undertaken to the following countries: Papua New Guinea, Solomon Islands, Vanuatu, Fiji, Kiribati, Tuvalu, Tonga, Western Samoa, and Cook Islands (in order of itinerary). Niue was also part of the study, but could not be included in the mission.

Overall, the situation we found is rather disappointing, in that only one of the ten countries was close to having CLICOM operating completely effectively. Some countries were very new to the system and could not be expected to have made great progress, but others had had it for years and were still far from having it working properly. Although CLICOM has its difficulties, it has been made operational in small countries elsewhere in the world, and we believe that there is no other better option for the Pacific islands.

We attribute the lack of success in the South Pacific as primarily due to (i) the piecemeal approach to its introduction, and (ii) the absence of appropriate training and technical support. On-site training and support has been quite insufficient in all countries. During the mission, the Consultant was frequently asked for help, and in some instances was able to provide training and to re-establish failed systems. There is a serious lack of knowledge of the practices of computer systems management and data base management, for example in basic procedures such as backing-up data and software. There are also some shortages of necessary hardware and software.

Specific development recommendations have been made for each country. In many cases only a relatively small effort and cost is required to bring the CLICOM operation into working order. However, in all cases there is a need for a long-term commitment, by both the country and its donor or supporting partners, to ensure that staff skills and capacities are developed and the system is well supported.

There is a great opportunity for regional cooperation on CLICOM, for sharing of expertise among the countries, and assistance with trouble-shooting, training, and applications of data. A regional development assistance programme would provide an umbrella for the design and channelling of external aid, and for the coordination of between-country collaboration.

- The programme should be well designed to target the identified needs of individual countries, yet it also must be flexibly managed to ensure it responds as these needs change.

- A bigger and more integrated effort than we have seen in the past is needed. We estimate that the three-year total cost of the required assistance is about $900,000, most of which would be spent on training and support. However, the average annual cost amounts to only $30,000 per country.

- The programme must focus on the requirement for managing climate data and providing users with useful climate information. CLICOM is a means to do this, not an end in itself.

- The programme should strongly emphasise local capacity building, and self-help within the region. Mutual collaboration and support could be developed by means of a locally-based regional CLICOM support officer, for example.

- Periodic visits by a expert CLICOM support person are essential, especially in the initial stages to get systems running properly and to build staff capabilities. Such visits will overcome many of the short-term problems.

- There is a pressing need for on-site training and support in office practices of climate data management and computer data processing, covering such things as station information files, records design, data security, software back-up, operations logbooks, etc.

- Some software developments are needed to meet tropical Pacific islands needs, such as data applications (like Fiji's existing PC-based summary) and software to import island data from overseas archives.

- Various items of hardware and proper registered copies of software are needed. The current needs of each country are detailed in the report.

1 INTRODUCTION

1.1 The South Pacific Context

The South Pacific islands region contains many island countries or territories, whose land areas and populations range from small to minuscule, and whose economic bases are generally very small and undeveloped. All are members of the South Pacific Regional Environment Programme, which is the regional inter-governmental organisation charged with the responsibility of coordinating and managing a shared environment of the region and responding to the environmental issues affecting the region, including climate and climate change.

Table 1 lists some basic features of the ten countries studied in the CLICOM Inventory and Review Project. While there are some common features, for example in small size and oceanic situation, there are also some marked differences that are critical to the design and implementation of any technical aid projects. For example, some countries, particularly Papua New Guinea and Fiji, have considerable economic self sufficiency, and technical capability, while others such as Tuvalu and Niue are largely dependent on foreign aid and foreign technical expertise.

Table 1: Basic Statistics of Countries in Study

(Data approximate, mostly from around 1990)

Country	Geography	Population	GDP per capita (A$)	Aid as % of GDP
Papua New Guinea	Very large mountainous islands	3,600,000	1400	11%
Solomon Islands	Large high islands	330,000	730	26%
Vanuatu	Large high islands	150,000	1300	26%
Fiji	Large high islands	750,000	2200	3%
Kiribati	Small remote atolls	75,000	670	47%
Tuvalu	Small remote atolls	10,000	770	111%
Tonga	Mostly small islands	100,000	1300	26%
Western Samoa	Large high islands	160,000	950	27%
Cook Islands	Mostly small islands	17,000	4000	24%
Niue	One raised atoll	2,500	1600	180%

The need for climate data in the region is much more significant than just information for local development. The Pacific region is the home of the El Niño Southern Oscillation phenomenon, and makes a major contribution to the globe's great tropical heat engine that powers the circulation of the atmosphere. Data from this part of the world is critically important to understanding global climate processes and to detecting global climate change. Support of climate monitoring and climate data processing and archiving therefore serves not only the island territories themselves, but also international needs for global change information.

The development of climate data services in the Pacific islands has mostly occurred within the historical long-term relationships each has had with a patron country, particularly New Zealand, France, Great Britain, USA and Australia. To the degree that these relationships were strong and close, and are still present, the climate data networks, archives and services are in reasonable shape. However, there have been significant changes in the last decade or so, with an increasing shift toward more equal relationships and greater responsibility by island countries for the setting of priorities and the management of services. However, in some cases climate data collection and processing has not been seen as a development priority and have fallen into a state of neglect. Furthermore, the computer technology that is now used for climate data management is rapidly developing and requires a considerable level and commitment of technical skill that is very scarce in small countries.

As is described in more detail in the next section, a microcomputer (PC) based climate data processing system, called CLICOM, has been developed under the guidance of the World Meteorological Organization to inexpensively meet the climate data processing needs of small countries. Most of the island countries in the South Pacific have acquired this system, which comprises one or more PCs and various specialised and commercial software, but few of these have reached the stage of effective operation. It is the prime objective of the present study to take an inventory of the situation in the countries concerned and to point the way toward bringing each country into effective operation.

1.2 CLICOM and its Development

Whereas in the past all climate data processing was done manually, with the advent of microcomputers, it has became feasible for even small countries to develop computer-based pr cessing and archiving of climate data. To assist less developed countries to build the capacity to do so, a project entitled "Transfer of Technology in Climate Data Management and User Services", was developed as part of what is now World Climate Data and Monitoring Programme (WCDP), which is a major programme of the World Meteorological Organization (WMO). The project aims to achieve a transfer of technology in climate data management and use, firstly, by developing software designed specifically to handle climate data, and secondly, by providing countries with a package which includes computer hardware, software, and training. The resulting system is known as CLICOM (an acronym for Climate Computing).

Development commenced in 1984 in response to a request from WMO which initiated the WCDP-CLICOM project and laid down general objectives and specifications. These were subsequently refined through hardware and software

reviews and through expert meetings held by WMO. Most of the development and production work was done by the US National Climatic Data Center, in Asheville, North Carolina, USA) as a USA voluntary contribution to the WCDP. This CLICOM is sometimes referred to as US-CLICOM to distinguish it from others, such as the French CLICOM.

The system provides for the following functions: keyboard-entry of data and associated data quality control; data management, archival and retrieval; data import and export; reporting station history sub-system; data dictionary system; production of summaries, graphs, and data products; libraries of subroutines to enable the development of data products and application programs.

The system is based on the use of IBM-compatible PCs. The hardware in most cases now consists of 3 PC's (1 server PC and 2 data-entry PC's), a local area network (LAN) to link the PCs, a high capacity optical disk drive as the data archive device, and a printer. Sites with a small observing network can operate with just one PC. The software consists of three parts: (i) PC/MS-DOS operating system; (ii) commercial software comprising the DataEase database management system, the COSORT data sorting utility, the LAN software, and a text editor; (iii) a set of control programs and application programs written in FORTRAN, DOS batch control procedures, and graphics routines. The current recommended technical specifications may be found in Annex 2.

The initial system tests were completed in December 1985. The CLICOM software system was also checked out on an experimental basis at the RA II/V Training Seminar on Climate Data Management and User Services, in Yogyakarta, Indonesia, October 1985, to determine its ease of use and ease of training. Supply and installation in various countries commenced in 1987. Worldwide, most CLICOM systems have been supplied under WMO/UNDP projects, or by through the WMO Voluntary Cooperation Programme (VCP). WMO has assisted with providing system specifications to those countries wishing to purchase equipment themselves, and with the provision and coordination of installation and training support.

Several versions of the software have been released. The latest, version 3.0, was released in 1992. A number of faults and problems present in the previous version 2.1 have been removed in this version. It also provides a better graphics facility and a number of other improvements. However, the system is not perfect and continual improvement and development can be expected in future. Routine operational users of the system can play an important role in identifying shortcomings, amendments and enhancements, rather than relying solely on groups of CLICOM experts.

We believe that it would be desirable to expand the very limited number of application programs to produce data summaries and climate information products, and to better tailor these to suit the needs of the user. At present, it is necessary in many cases to export CLICOM data to some other processing facility such as spreadsheets, statistical packages (INSTAT is often used), other databases, graphics systems. Users can of course develop their own computer programs and integrate them into CLICOM, but only if they have the expertise and time to do so. There are few if any such users in the Pacific islands at present. It is important to be aware that CLICOM by itself is not a complete "push-button" solution to climatological data processing needs.

The latest CLICOM Newsletter, July 1994, reports that CLICOM is installed in 116 WMO Member countries, with 23 other countries having approved funding and a further 23 having submitted VCP requests. We have no information as to how many of the 116 sites are actually operational. At the WMO RA II/V CLICOM training seminar at Manila in August 1993, (attended by Mr Ereckson), representatives from some 15 countries each provided a report on the state of their CLICOM system. The reports were quite varied, with many sites reporting problems and limited success for various reasons. (WMO Regional Associations (RA) II and V cover Asia, Southeast Asia and the Southwest Pacific.)

Two sites stood out at the Manila meeting as being clearly successful, firstly that of the Malaysian Meteorological Service (reported on by Mr. Tan Lee Seng), where CLICOM was established in 1989 on a trial basis, then later on a fully operational basis for some 300 observing stations; and secondly that of the Sri Lanka Meteorological Service (reported on by Mr Lalith Chandrapaia), which commenced in 1987 and is now handling data from some 26 agrometeorological stations and 780 rainfall stations. It appears that their success is due to their training and background experience; personal dedication to the work; sufficient numbers and stability of staffing (uninterrupted service); and ability to develop computer programs in FORTRAN and the DataEase query language DQL.

The future of CLICOM was recently considered during a meeting of experts held in Washington D.C. August 1994, to discuss the long-term evolution of climate database management systems, and how WMO can facilitate the design and implementation and coordination of an integrated climate data system. The recommendations related to CLICOM were that the US CLICOM Project Office should continue its maintenance of the CLICOM 3.0 software, and should add the enhancements that were proposed at the second CLICOM experts meeting in May 1992 (WMO, 1992). However the meeting recommended no further development beyond this enhanced version 3.1 at this stage.

1.3 Brief Summary of Use of CLICOM in the Region

Table 2 gives a brief summary of the current situation with respect to CLICOM in the region. Several of the countries are members of WMO and have obtained CLICOM systems and support assistance through WMO's Voluntary Cooperation Programme, through which WMO's encourages and coordinates meteorological donations of larger members. The Solomon Islands Government purchased its system itself. Papua New Guinea, Solomon Is, Vanuatu and Fiji have had systems for some time, and have built up a good deal of experience, but none has their CLICOM operations in a totally satisfactory state yet.

The remaining countries, which are generally smaller, have had their CLICOM systems for a shorter time and are further from being operational. Most were donated by Australia, some under the COMCIAM programme. The study does not deal with the French or US Flag territories of the Pacific as they have climate data processing systems provided by France or the United States respectively. Similarly, Tokelau's climate data needs are serviced by New Zealand.

It is important to recognise that CLICOM is not a simple, single piece of software that can be loaded into PC and run without further complication-it is a concept, a package of methodology, software, and hardware designed to serve the complex needs of national climate data processing and archiving. A good knowledge of the practices of climate measurement and manual data record keeping are still essential, but to this must be added a good knowledge of computer systems, and computer data base management, including such things as file management, security, backing-up, etc.

Unfortunately, too often items of hardware and software have been gifted to countries without recognition of the need to simultaneously build the knowledge and experience needed to properly run the system. Section 2 give full details of the history and state of each country's operations, while Section 3 gives an overall regional summary.

Table 2: Regional Summary of CLICOM Systems in South Pacific Islands

Country	Installed	Supplied by	System	Status
Papua New Guinea	Oct. 1993	WMO/VCP	3-PC	Semi-operational
Solomon Islands	Nov. 1991	S.I. Govt	3-PC	Operational
Vanuatu	Oct. 1988	WMO/VCP	3-PC	Semi-operational
Fiji	Sep. 1988	WMO/VCP	3-PC	Semi-operational
Kiribati	Jun. 1994	Australia	1-PC	Just started
Tuvalu	Jun. 1994	Australia	1-PC	Just started
Tonga	Jun. 1994	Australia	1-PC	Just started
Western Samoa	1991	Australia	1-PC	Just started
Cook Islands	Jun. 1994	Australia	1-PC	Just started
Niue	Oct. 1994	Australia	1-PC	Not started

1.4 Project Origin and Objectives

The project was initiated by the South Pacific Regional Environment Programme (SPREP) as a project proposal drafted in early 1994. SPREP recognised that climate data had a key role to play in the national development of its members as well as in global, regional, and local environmental issues, and was aware that the present capacity of its island members to effectively deal with their climate data was very limited.

SPREP has recently concluded a Working Arrangement with the World Meteorological Organisation (WMO) to provide a framework for its regional coordinating role in respect to climate activities, and to ensure close coordination with existing international meteorological programmes and activities. To facilitate regional cooperation, it has

organised meetings of regional Meteorological Service Directors, in Port Vila, 19-21 October, 1993, and in Nadi, 3-5 October, 1994.

In the AIDAB-funded study of climate monitoring needs in 1991 (Brook et al, 1991, The Changing Climate in Paradise), climate data processing and CLICOM were identified as an important area needing development, and several projects relating to these were defined. Subsequently, the matter was discussed at the First SPREP Meeting of Regional Meteorological Service Directors at Port Vila (SPREP, 1994.) The meeting noted that the introduction of CLICOM, while holding promise for computer-based data handing, had been done on an ad hoc basis, and that this had led to confusion as to which organisations were committed to or responsible for its development in their countries. A clearly inadequate level of technical support was evidenced by the poor progress in developing properly functioning CLICOM systems in the region.

One of the present authors (Dr Basher) drafted the meteorological recommendations of the Paradise report and at the Port Vila meeting proposed some strategies for regional cooperation in climate services through which countries might more quickly and efficiently develop their climate services. Regional cooperation is particular appropriate to the development of CLICOM, owing to the specialised knowledge involved and the need for accessible trouble-shooting advice. The Port Vila meeting made the following recommendation: "Encourage implementation of CLICOM system throughout the region and improve its efficiency by regular exchange of development reports."

At SPREP's request, NIWA developed a project definition in March and April 1994 for SPREP's consideration. After its acceptance, the New Zealand Government agreed to fund the project. The proposed project had a staged approach: determining the current situation with respect to CLICOM in each country, defining what should be present, identifying the gaps between these two, and providing some guidance on the form of a programme to reduce the gaps.

Greatest priority was put on obtaining accurate information about the state of the hardware, software, operations and staff training, and on using this information to provide recommendations on what needed to be done for each country. A very considerable detailed inventory of each country is presented in this study. Less priority was put on defining a regional plan of action in response to this, partly because of time constraints and partly because there is still a need to digest and integrate the information presented.

1.5 Country Missions

The missions to countries were carried out by CLICOM expert Mr Ereckson. A period of five weeks (30 working days) was initially budgeted, but the final period was longer because of air schedule constraints and changes, aircraft delays, and repeated requests to assist with CLICOM problems en route. Nine countries were visited from 18th August to 25th September 1994. A summary of the itinerary and work schedule is given in Annex 1. Niue (the 10th country), had to be excluded owing to a lack of suitable air connections and the lack of a CLICOM system. The mission schedule was very punishing. Of the total of 39 days, only 3 were rest days. Two days were spent on

re-arranging the itinerary, owing to cancelled or re-scheduled flights (including having to fly to Auckland to get from Western Samoa to the Cook Islands), and 2 were spent on an extension of work in one country.

A wide-ranging questionnaire sheet was prepared as a basis for interviews with the heads of each Meteorological Service, to canvas their views on broader issues such as the trends in the use of climate data in their country and the desirability of regional collaboration amongst Pacific Island Meteorological Services in climate matters. A copy of the questionnaire is given in Annex 3. This survey was not a required part of the project and has not been analysed in detail yet, but the views expressed have been incorporated in the report where appropriate.

To ensure that all the technical information required for the inventory was systematically obtained, a set of detailed query forms were prepared in advance of the missions. Copies of the blank forms are presented in Annex 5. These cover such things as hardware and software details, local support facilities, staff and their training, data resources, network numbers, etc. In many cases the data sought were not readily available and could not be accurately estimated. A set of forms was filled out by hand for each country during the mission. In addition, a form was prepared to enable the calculation of the volumes of historical data and currently collected data (Annex 4). The present report contains summary information from the forms, and copies of all the originals are deposited with SPREP.

One part of the query forms (section 5 and 6) sought information on the use of CLICOM features and facilities and CLICOM products and applications. The aim was to obtain users views and experience on the usage, benefits, and problems in using these, and to get a clear picture of whether users thought CLICOM was in fact living up to their expectations and needs. Very little information was obtained from this section as few of the countries had reached this stage of operation and there was relatively limited use of CLICOM's capabilities. There was general satisfaction with the performance of the most familiar features of data-entry, data-verify, and data loading systems. One concern was the inability to compute normals from monthly values, which are readily available and can be quickly entered (CLICOM uses daily data, which comprise a much greater volume of data to be entered.) Most sites had tried out the CLICOM V3 graphics, and comments noted the slow processing and contouring speed, the rough and distorted outlines of the small island countries, and the inability to map over the date-line (which Fiji spans, for example).

In most locations, the meteorological staff were hoping that Mr Ereckson would be able to get their CLICOM systems operating or otherwise solve CLICOM problems. Such assistance was not allowed for in the contracted project, but Mr Ereckson was often able to give some help, either in the evenings or weekends, or as a result of extra time allowed by the revised air schedule or specifically approved by SPREP. In some cases he was able to re-establish the CLICOM to working order and provide training to allow staff to continue with data entry and other routine operations. These contributions underline the importance of roving on-site support visits by CLICOM experts.

2. COUNTRY SUMMARIES

The following set of ten detailed country summaries are presented in a standard format under the following headings.

Mission details
Supply and installation
Hardware
Software
Technical Faults/Problems
Operations
Observation network and data volumes
Training
General summary
Development requirements

This format follows the standard query sheet (Annex 5) approach that was used during the mission to capture the detailed information required for the inventory, which is the key part of the project.

A summary of the countries' networks and data base sizes is given in Table 3, in Section 3.2. The development requirements of the countries have been included with the section on each country, rather than being separated from the relevant information about the country. However, a comparative summary and regional overview of what is needed is given in Table 4, also in Section 3.2.

It can be noted that, as an extension of the project, a preliminary report on the project was specially prepared for the Second SPREP Directors of Meteorological Services Meeting, at Nadi, 3-5 October 1994. Mr Ereckson participated in the meeting and presented the report.

2.1 Papua New Guinea

Mission details: Discussions were held in Port Moresby, 19-21 August 1994, with Mr Paul Penua (Acting Director, Papua New Guinea National Weather Service), Mr Ken Onno (Deputy Director), Mr Kevin Luana (Acting Director Research and Climatology), and Mr Vele Kula (Meteorological Officer, CLICOM).

Supply and installation: The CLICOM system was supplied through the WMO under the VCP, early 1992. WMO funded the installation, and on-site training was done 18-29 October 1993 by WMO CLICOM expert, Mr Tan Lee Seng. The delay of some 20 months from delivery to installation was due to the need to wait for completion of a new purpose built building to house the CLICOM system, the climate section, and the agro-meteorology section.

Hardware: This comprises a full 3-PC CLICOM system of a 486DX-33/130MB HD as server; and two 386SX-25/80MB HD as data entry PC's (to be networked using PC-LAN). Other hardware included an optical disk drive (WORM type, 800MB storage) as the archive device, an HP LaserJet III printer, and a uninterruptible power supply (UPS). The Climate section also has two DELL 486DX-33 and a DG DASHER 386.

Software: DOS V5.0, CLICOM 3.0 and associated software, but not PC-LAN (see below). FORTRAN V5.1 available but not yet installed. Other software in the Climate section includes LOTUS 123, Multiplan, and WP51.

Technical Faults/Problems:

- One of the 386SX reader PCs had hard-disk failure at time of installation. This 80MB HD was replaced by a 200MB HD funded locally by the Weather Service.
- The Hard-Disk on the 486DX Server PC failed one week after installation and could not be fixed locally, no parts. Not fixed yet, 10 months after installation time. WMO apparently advised November 93; nature of follow up action unclear (Note that the hardware warranty may have expired due to the delay in installation.)
- The LAN equipment (cables, MUX boards, PC-LAN software & manual), were not in the original supply and have still not been received. The nature of follow-up action was unclear.
- No manuals were supplied for the DOS V5.
- Some system software had earlier been corrupted by viruses, but is now reported as clean.
- There is a serious fault in the CLICOM software which causes the system to crash and lockup every time on exit from DataEase. This apparently happens on both the 386SX PC's.

Operations: The CLICOM operations are run by Mr Vele Kula, with two other officers, all full time. The facilities are in an excellent environment in a new purpose-built building. Stricter security and access control are now in force since the virus attack was detected. Some data has been entered in the 10 months since installation, but not much. There is backup of the current data entry files; but no backup of the DataEase database files yet. No archiving of data has been done because the optical disk drive cannot be used as it is driven by the unserviceable 486DX PC; and also because there is not enough data set up yet and ready for archiving. In previous years, data was archived in Multiplan spreadsheets and stored on disk, but now the Multiplan

software has been lost and there is a problem in reading the Multiplan formats when trying to access the data to import it to CLICOM.

Data volumes and observation network: About 0.8MB data has been entered, which is small compared to the available back data of 720MB, and an annual increase of 32.5MB. The monitoring network comprises:

Daily climate observations at 12 stations.
Daily rain only, at 150 stations.
Three-hourly synoptic weather reports at 33 stations.
Hourly reports at 12 stations.
Upper air radiosonde and wind at 1 station.

Training: The main relevant training has been as follows.
Mr Vele Kula: Computer course on programming using COBOL, 8-weeks, 1986, in Wellington NZ; CLICOM and Statistics course, University of Reading, UK, 10-weeks 1991 (the benefits of this not well exploited as the CLICOM system was not installed until October 1993); CLICOM V3.0 training seminar, Manila, 1-week, August 1993. Ms Justina Kameata (part time tutor at University of Papua New Guinea before joining NWS two years ago): CLICOM training, Bureau of Meteorology, Melbourne, 3-weeks, 7/1993. Currently undertaking some post/graduate training (in meteorology?) in Melbourne. Mr Puana Wavuri (T/O): Basic CLICOM training, Bureau of Meteorology, Melbourne, 3-weeks, June 1994.

CLICOM training for at least six other people is yet to be given. Additional advanced training is also wanted.

General summary: The system has not been properly operational almost since installation. An on-site support visit is badly needed. Mr Tan Lee Seng in his mission report to WMO recommended a follow-up visit. The Weather Service has requested WMO to assist with this. We understand from later advice that a visit from Mr Tan Lee Seng had been approved and would take place soon, and that a new 486 computer is about to be purchased to replace the failed machine. Weather Service staff had hoped Mr Ereckson would have been able to give some training and do fault fixes during the mission but the visit timetable did not allow for this. A considerable amount of time was required to obtain necessary detailed inventory information such as the observing network composition, start/end dates, what data is available, what is entered into CLICOM, hardware and software details, and technical problem status.

Development requirements: Papua New Guinea is well organised to obtain required additional equipment through existing means, and little if any additional hardware or software is needed at this stage. The Weather Service has submitted a case for local funding for the purchase of additional equipment to expand their CLICOM, (at least 1 server PC, and 3 reader PC's plus the software, etc), and approval is expected soon. There is also a 1.8 million Kina fund available ex WMO/UNDP for a 3-year development plan for agrometeorology, climate services and CLICOM. This will provide for the hire of an expert climatologist among other things. They will use the data sets from the CLICOM, and expect to start the project in January 1995.

The principal development assistance needs are for

- On-site support and training visits.
- Training in the practices of database management and data archiving.
- Training in the use of FORTRAN and DataEase to write product and application programs.
- Provision of back data held in computer records in Australia, and the development of custom software to enable their import to CLICOM.
- Assistance to access Multiplan data, and provide a computer procedure to fix problems with this access.

As with other countries, the development of software for the routine production of a monthly climate bulletin would be desirable.

2.2 Solomon Islands

Mission details: Discussions were held in Honiara, 22 August 1994, with Mr Festus Ahikau (Principal Meteorological Officer, Climatology), and Mr Douglas Yee (Met. Officer, Climatology). The Director of the Solomon Islands Meteorological Service, Mr Mike Ariki, was absent from the country, but had discussed the project with Mr Ereckson by phone beforehand and had briefed his staff.

Supply and installation: The system was purchased by the Solomon Islands Government in October 1991. WMO funded installation and on-site training was done over a week in November 1991 by Mr Tan Lee Seng.

Hardware: A full 3-PC CLICOM was obtained, consisting of an IBM 55SX/80MB HD as the server, two IBM PS2-30(286) machines with 30MB HD for the data entry PC's, all networked together by PC-LAN, an IBM 3510 optical disk drive with re-writable 128MB cartridges for the archive device, diskette drives, printer, plotter, UPS. A 386SX/120MB HD was obtained in 1993; and a 486DX-33/127MB HD in 1994; both under local funding. Other PC's in the Climate section are; a COMPAQ 386SX LTE provided under a COMCIAM project in about 1991.

Software: Software is all satisfactory. DOS V5 and CLICOM V3.0 now being used.

Technical Faults/Problems: The 3 original processors have had no problems, except for occasional 3.5" diskette drive troubles. The IBM 3510 optical disk drive has read errors at times. The disk heads have been cleaned a few times now (the disk problems may be largely due to the dusty environment.) There was a need for an adaptor to connect the optical disk drive to the 486 PC, but at the time of writing we have been advised that this has now been provided through the AIDAB-supported Pacific Meteorological Services (PMS) project.

Operations: The system is run by Festus Ahikau (part-time amongst his other duties), with 2 other officers, Douglas Yee and Lloyd Tahani, almost full-time. Operations in general are working well. The new 486DX-33 PC now replaces the IBM 55SX as the main CLICOM processor; and now supports the CLICOM V3.0 as a stand-alone operation. The two IBM PS2-30 PC's originally used as readers on the network have been assigned to other sections of the Service.

The use of the PC-LAN network has been discontinued owing to problems in sustaining its use without problems. It has been found more convenient to enter data either directly on the 486 or to enter data on one of the other PC's and then transfer to the 486 by use of diskette. A second optical disk drive is being sought. This must be able to read the existing cartridges from the Model 3510.

Data volumes and observation network: About 21.3MB of data has been entered, compared to the available back data of 100MB, and an annual increase of 7.2MB. The monitoring network comprises:

Daily climate observations at 8 stations.
Daily rain only, at 40 stations.
Three-hourly synoptic weather reports at 7 stations.
Hourly reports at 1 station.

Upper air radiosonde and wind at 1 station.

Training: Mr Festus Ahikau, (PMO (C)): CLICOM & Statistics course, University of Reading, UK, 12-weeks, 1990. Workshop on data management, AIDAB, Melbourne, September 1991. Climate Impact on Coastal Zones, course under COMCIAM, Townsville, 3-weeks February 1992. CLICOM training, Bureau of Met. Melbourne. 3-weeks, June 1994.
Mr Douglas Yee. (SMO (C)): CLICOM & Statistics course, University of Reading, UK. 12-weeks, 1991. Installation of CLICOM V2.1 on-site training, 5-days, November 1991. Workshop on Computerised Data Processing, (mainly NWP), Bangkok, 2-weeks, October 1992. CLICOM 3.0 training seminar, Manila, 1-week, August 1993. COMCIAM workshop on Database Development (GIS mainly), Colombo, 1-week, October 1993. Fellowship, Australian National University, Canberra. (follow up to the COMCIAM workshop), 3-months, Feb-May 1994.
Mr Lloyd Tahani: Installation of CLICOM 2.1 on-site training, 5-days, November 1991. CLICOM training. Bureau of Met. Melbourne. 3-weeks, July 1993. CLICOM & Statistics course, University of Reading, UK. 10-weeks, 1994.

An on-site training and development mission was undertaken by Bruce Ereckson, over five weeks, April-May 1992, funded under the New Zealand development co-operation programme in the Solomon Islands. A detailed mission report was prepared (Ereckson, 1992). Mr Ereckson has continued to maintain an interest in the Solomon Islands CLICOM operations and has provided voluntary help by means of fax and correspondence, including the provision of programs to enable the import of digitised data. Regarding additional training, Meteorological Service staff have noted that they need people who understand statistics and computer programming.

General summary: In November 1991, Tan Lee Seng had to cope with a number of problems caused mainly by incorrect supply of the software, some items not supplied, some supplied to operate under the operating system OS-2 instead of DOS, and some with the incorrect version. While awaiting resupply of the correct software he was able to go to Vanuatu for a 2-week support visit. On his return to Honiara some of the software had still not arrived, but he was able to use copies from the Vanuatu CLICOM and so got the system fully up on these. However operational problems soon arose. His mission report suggested that a follow up visit would be desirable.

Following a brief visit by Dr Basher in late 1990, the Meteorological Service asked for help from New Zealand, which eventually resulted in Mr Ereckson's 1992 support visit. This visit provided training and problem solving that was most definitely needed at the time. Progress has been good in the two and a half years since then, partly reflecting the amount of training received at various courses, (much more than other Pacific sites), the on-site help by visiting experts, and the excellent support given by the directorate. The mission's one day was barely enough to do the inventory and system review. The Questionnaire for Directors was left with a covering letter for Mr Ariki, who later faxed us his response.

Development requirements: No additional hardware or software is needed for the present operation. Sufficient equipment is in hand to see the system through the next two years, after which a new processor to replace the 386SX may be needed. A new optical disk drive (e.g. IBM3511) may be worthwhile, as a backup to the existing drive. As with other countries, the development of software for the routine production of a

monthly climate bulletin would be desirable. It would be useful and beneficial if at least one officer (e.g. Mr Yee) was given programming training using FORTRAN and DataEase. An on-site support visit should be considered for late 1995.

2.3 Vanuatu

Mission details: Discussions were held in Port Vila, 23-25 August 1994, with Mr Henry Taiki (Director, Vanuatu Meteorological Service), Mrs Mercy Nalawas (Sen. Met. Officer (C)), Miss Patricia Mawa (Asst. Met. Officer (C)), and Mr Wilson Tari Vuti (Principal Forecaster).

Supply and installation: The system was supplied through the WMO under the VCP, in October 1988. Installation and on-site training was done over a two week period in October 1988, by WMO CLICOM expert, Mr Ian Dale, of the University of Reading, UK.

Hardware: A full 3-PC CLICOM system was supplied, with an IBM PS/2-60/44MB HD as the server, and two IBM PS/2-30 (no HD) as the data entry PC's. These were networked using the Token Ring PC-LAN. Other equipment includes an IBM 3363 Optical disk drive with 200MB WORM type cartridge as the archive device, diskette drives, printer, and UPS. Other PC's in the Climate section are a SONICA 8890 486 / 240MB HD, which was locally funded.

Software: DOS V5.0 is used, but with DOS V3.3 on the data-entry Model 30's. CLICOM V2.1 and associated software including the original DataEase V2.53 supplied are still installed on the IBM PS/2-60 PC with CLICOM V2.1 data entry system on the Model-30 diskettes. CLICOM V3.0 and associated software, but using DataEase V4.2, is installed on the new 486 PC. No manual was available for DataEase. Other software includes LOTUS 123, Harvard Graphics, XTreeGOLD, and Windows 3.1. These are on the new 486 PC. Staff thought that a FORTRAN V4.0 was provided some years ago, but Mr Ereckson could not locate it. (In any case, this version is not very suitable for use with CLICOM V3).

Technical Faults/Problems: Both of the IBM 8512 display screens for the Model-30 PC's have a faulty display (a white background and horizontal lines). The local computer firm advises that the fault cannot be fixed. These PC's have not been useable since early 1994. The Model-60 PC has given little trouble except that sometimes at start-up an error occurs, necessitating a re-boot. The IBM3363 optical disk drive (on the Model-60) gets little use, only about once per year; and the last time was about March 1993. Mr Ereckson used it to examine some disk cartridges and it operated well.

Operations: The system is run by Mrs Mercy Nalawas part-time amongst other duties, and with 2 other officers, part-time. The CLICOM is sited in the main office of the climate section, which is a rather dusty environment in spite of air-conditioning. The security of the system is reasonably acceptable but the building is old and probably not very secure in a cyclone. A local computer firm can do some repairs to PCs and some can also be done by the Meteorological Technical Officer. Operational problems were dealt with by fax to Ian Dale, UK, 1988 to 1991, and now if necessary to Tan Lee Seng in the Malaysian Meteorological Service. The only documentation seems to be a set of instructions detailing procedures for data entry, loading to DataEase, and archiving. These were developed in 1991 by Tan Lee Seng while on a support visit. Staff advised that the system and data is backed up by copies onto 3.5" diskettes, and described the data entry, backup, and archiving procedures to Mr Ereckson. These may require review on-site and documenting.

It appears that the CLICOM data are not being used operationally. Requests and enquiries are currently processed as paper summary listings or on diskette from the monthly data and summaries held in the LOTUS 123 data system. No CLICOM products are produced, apart from demonstration purposes. Data are not exported to LOTUS and are not used to produce other applications. Staff reported that they felt unqualified to develop or apply data applications.

The two different CLICOM versions complicate the system. CLICOM V2.1 is still on the original Model-60, with data-entry not able to be done on the data-entry PC's due to the failed screens. However, if the network is not loaded the data-entry can be done on the main processor. This system is now virtually not operational. CLICOM V3.0 is installed on the SONICA 486 PC, as a stand-alone system, along with all the other software the Service has. Currently this is mainly a trial system and cannot be classed as fully operational. No data-entry was being done at the time of the mission. It is not known whether the IBM3363 optical disk on the Model-60 could be interfaced to this 486. This needs to be checked out.

Data volumes and observation network: About 21MB of data has been entered, compared to the available back data of 200MB, and an annual increase of 7.2MB. Many of the years have incomplete data sets. Only about 1.5 years of data are held in DataEase format and archived to directories on the optical disk and also filed on diskette. The rest are held only in ASCII format in directories on the optical disk and also on diskettes. The monitoring network comprises:

Daily climate observations at 7 stations.
Daily rain only, at 48 stations.
Three-hourly synoptic weather reports at 6 stations.
Hourly reports at 1 station.
Upper air radiosonde and wind at 1 station.

Training: Mrs Mercy Nalawas, (Sen. Met. Officer (C)): Attended a Pacific Islands Advanced Course (Met. Tech), Wellington, New Zealand, 3-months, 1984 (no computer training). Attended a course on FOX-PRO database in association with GIS, 1-month, Brisbane, 1991 (not closely relevant to CLICOM needs). CLICOM installation and on-site training, 10-days Oct. 1988. CLICOM support visit and training by Tan Lee Seng, 10-days approx. Nov. 1991.
Miss Patricia Mawa, (Met. Obs. (C)): CLICOM training, Melbourne, 3-weeks, June 1994. No prior computer experience.
Mr Fabrice Coulea, (Met. Obs). Started employment in July 1994. No prior computer experience.
Mr Allan Kaltapau. (Met. Obs. (C)): Met. Observer who moved to climatology. Attended some of the on-site CLICOM training 11/1991.
A French National Service officer, M. Thery Laurent, works part-time in the Climate Section and has offered his assistance with CLICOM.

Mrs Nalawas, when commenting on additional training needed, felt that CLICOM was not easy to follow and that it would be highly desirable to have someone visit every few months to support staff, look into problems, and work with staff by giving personal training on the job in practical aspects of CLICOM. There is also a desire for training in FORTRAN and DataEase.

General summary: The system suffered right from the outset, having being badly supplied, with equipment sourced from Rome, instructions and manuals in Italian, and some items missing. Over the three years following installation in October 1988, considerable committed efforts were made by several people to overcome many problems and difficulties experienced, but progress has been limited by inexperience and lack of training in computers and data processing. The only support was by fax and letter from the University of Reading, UK. Three years elapsed before an on-site support visit took place, in November 1991. Training and practical instruction have been inadequate.

Mr Ereckson visited the site for a day and a half in April 1992, while en route to Honiara. He was able to fix some problems then, but others remained, and in his mission report in June 1992 he recommended further help and on-site visits. These have never occurred.

The difficulties have been compounded by losses of CLICOM experienced officers, and staff shortages and low morale associated with a six months strike by Government workers. It appears that no climate or CLICOM work has been done for some time. The last data entry to CLICOM was for October 1993 data, and the archiving of data has been discontinued. The staff were very helpful and spent considerable time in looking for information on hardware, software, data resources and observing network needed for the inventory and review.

Among the procedures that could be improved, one we specially recommend is a change to the current practice whereby daily data are entered into the LOTUS system to produce monthly values and are then deleted (without being imported to CLICOM.) Instead, the daily data should be first entered to CLICOM, where they can be retained for permanent keeping. They can be then exported from CLICOM to LOTUS to enable the current LOTUS-based summaries to be continued.

Development requirements: The whole system, including equipment, software, data management and control, training, etc, needs to be carefully reviewed, and procedures put in place to ensure its effective operation.

The Vanuatu Meteorological Service has plans to obtain some new PC's shortly, for use in their communications system and this will enable the release of two 486 PC's to the Climate section to replace the Model-60 and the Model-30's. This will then provide three 486's plus the Model-60 (which is still a useful machine and could be used for data entry.)

There is no real need to network the PCs for CLICOM V3.0, as there is not a great volume of data and diskette transfer of entered data is more trouble free. The latest WMO recommendations specify LANtastic for the network system instead of the now out-of-date PC-LAN system. Although we have no experience with LANtastic, we believe that networking is not necessary for the small CLICOM operations of the Pacific Islands.

There is a need to get the IBM3363 optical disk interfaced to one of the 486 PC's, or failing this to obtain a new optical disk drive. An optical disk drive, re-writable type, 127MB, with COREL-SCSI software, and compatible with SCSI devices, would be

suitable as an archive device. This is the drive now recommended in the latest CLICOM technical specifications.

Provision of a new copy of DataEase, version 4.5.3 complete with manuals is needed. MS-FORTRAN V5.1 and manuals will be needed if a staff member is trained to become proficient in FORTRAN programming.

There are strong needs for training for all staff involved with the CLICOM system. Most could benefit from a CLICOM course, even the basic three-week one in Melbourne would be useful. One or two selected staff should attend a more advanced course such as the CLICOM and statistics course at the University of Reading, UK. Training in programming and DataEase would be desirable.

Regular on-site support and training visits will be essential. As with other countries, the development of software for the routine production of a monthly climate bulletin would be desirable.

There is a need to obtain copies of historical data archived in Australia, along with the software to import these data sets into CLICOM. Some of this back data is already in Vanuatu, but it is not clear what this consists of. Software developed by Mr Ereckson for Solomon Islands data import may be applicable here.

2.4 Fiji

Mission details: Discussions were held at Nadi Airport, 26 August and 5 September 1994, with Mr Rajendra Prasad (Director, Fiji Meteorological Service), Mrs Sudha Paduram (Deputy Director), Mr Kafoa Mani (Chief Tech. Officer, Climatology), and Ms Janita Pahalad (Sen. Scientific Officer, Climatology). A flight cancellation meant that a considerable part of the time in Nadi had to be spent arranging a new itinerary.

Supply and installation: The CLICOM system was supplied through the WMO under the VCP, and installation and on-site training was done over a two week period in September 1988 by WMO CLICOM expert, Mr Ian Dale, University of Reading, UK.

Hardware: A full 3-PC CLICOM system was supplied, comprising an IBM PS/2-60/60MB HD as the server; and two IBM PS/2-30 (no HD) as the data entry PC's. These were networked using the Token Ring PC-LAN. An IBM 3363 Optical disk drive, WORM type, 200MB cartridge, was supplied as the archive device, along with diskette drives, printer, and UPS. An EXEL/ETC 486-33/280MB HD was obtained in 1994 under local purchase and funding.

Software: DOS V5 is used, but with DOS V3.3 on the data-entry PC's. CLICOM V3.0 and associated software, using DataEase 4.2 (no manuals) are available. The DataEase V2.53 from the original CLICOM supply is present. COSORT V4.2 is present but without a manual, plus INSTAT (version unknown) and manual. An early version of LOTUS 123 (V2.2) is present but without a proper manual. The supply of some new software (DataEase 4.+; MSDOS 6.2; WP5.1; Quattro-Pro) is believed to be under action with the support of the AIDAB PMS project.

A custom-designed BASIC program is routinely used to produce a timely monthly climate summary with water balance calculations. This stand-alone application requires separate data entry at least weekly, and is not integrated with the CLICOM system.

Technical Faults/Problems: There have been few faults with hardware. The Model-60 3.5" diskette drive had to be replaced, and there were some faults in the screen display on one Model-30 (fixed locally.) The IBM Proprinter II has given some minor faults. The PC-LAN V1.2 network never worked after the implementation of DOS V5 in 1992.

Operations: For almost all of its six-year life, the system has not been in a proper state of operation, despite considerable efforts by various staff. However, the system is now being re-established and brought into operation by Ms Pahalad as part of her duties in the Climatology Division. There is also a part-time data-entry operator who has had some CLICOM training, and another 1 or 2 staff can do data-entry. The equipment is in an air conditioned room, but dust from the nearby main road can be a problem. Security is satisfactory. The office is locked at nights, a password system is in operation, and strict controls are in place for the use of diskettes to combat virus problems. Ms Pahalad has produced a very useful CLICOM Simplified User Manual. This is a commendable initiative to simplify and clarify instructions of the official CLICOM Manual.

There have been delays in the re-development of the CLICOM system, and there were virus problems on the new 486-33 PC. The 486-33 PC now supports the main CLICOM system, V3.0, as a standalone system. The use of the original system, IBM-60 networked to two IBM-30's has been discontinued, but the IBM-60 is still available and the Model-30's are being used for production of the routine monthly summary system and for Met. Observer training elsewhere in the Service.

There is no archive device for the 486-33, apart from the use of the diskette drive. Unfortunately it was necessary to declare the six-year old IBM-60, which contains the IBM3363 optical disk archive device, as surplus in order to obtain the new 486 machine. This optical disk drive has had very little use. Efforts are being made by local technical people to see if it can be removed and interfaced to the 486, but this does not look promising. This problem illustrates the practical difficulties that can be encountered when trying to simultaneously satisfy computer system technical needs and local financial constraints and administrative procedures.

Very little new data has been entered over the six years life of the system. There has been no data-entry to CLICOM for some months now, but this is expected to start again soon. No archiving has been done for years. The DOS backup is used to make copies on diskettes. However, two large data sets have been created by importing monthly and daily values from the original climate data processing system in the Fiji Government Computer Centre. They consist of (i) 9200 records of monthly values for various elements/stations, from the start of records to 1989 with most stations now updated through CLICOM data entry to 1993; and (ii) 17,000 monthly records of daily values for various elements/stations for various periods and with a few stations updated to 1993.

This latter data-set was earlier cleared from online and a restore attempted from the backup diskettes. Unfortunately one of the diskettes was corrupted and the restore failed. There was no other backup. This underlines the importance of establishing proper back-up procedures, and the need for at least two copies of backups and also an archived set. Mr Ereckson is currently voluntarily assisting Fiji in the repair of this data-set. All original supply diskettes for CLICOM and commercial software are retained. Copies of some software and data files are kept in another office.

No summaries are produced through CLICOM itself. Fiji's operational monthly climate summary ("Quick Climate System"), which is produced within a few days of the end of the month, does not use CLICOM data. In fact the daily data from the 22 stations used in this summary do not get entered into CLICOM. The summary contains water balance calculations and is a valuable product that has potential for application in the other Pacific islands. It would be very desirable to re-design this software to make it work as a CLICOM product.

Data volumes and observation network: About 4.4MB of data has been entered (mainly by importation from the previous archive at Suva), compared to the available back data of over 570MB, and an annual increase of 18.4MB. The monitoring network comprises:

Daily climate observations at 52 stations.
Daily rain only at 81 stations (plus further 180 in separate Public Works Department hydrological network.)

Three-hourly synoptic weather reports at 17 stations.
Hourly reports at 2 stations.
Upper air radiosonde and wind at 1 station.

Training: Ms Janita Pahalad, (Sen. Scientific Officer, Climatology): Some programming in PASCAL, COBOL, and a little FORTRAN while attending Macquarie University, Sydney, 1987-1990. Training courses in Word Processing and Lotus 123 in Fiji. Basic CLICOM training, Melbourne, 3-weeks, July 1993. CLICOM V3.0 training seminar, Manila, 1-week, Aug. 1993.
Ms Varanisese, (Tech. Officer, Climatology): Training courses in Word Processing and Lotus 123 in Fiji. Basic CLICOM training, Melbourne, 3-weeks, June 1994.
Mr Kafoa Mani (Chief Tech. Officer, Climatology): Some CLICOM training on-site during installation, 10/1988.

There have not been any on-site support and training visits since the installation 1988; except for Mr Ereckson's brief visits in December 1991, May 1992, and now August/September 1994 (none of which were for training purposes.) Fiji staff expressed a wish to have more extensive training that the simple levels received to date. Training is desired on data management and archiving (including practical work on forms design, import/export, archive, transfer of data to DataEase), use of DataEase for reports, and programming for products and applications.

General summary: Fiji suffered the same problems with poor supply of instructions and manuals as reported above for Vanuatu. There were various problems with both hardware and software. The system operated in a small way over the first two years, but without making a real contribution to improving the Service's climate data services. There were no support visits and the only support was by fax or letter to the CLICOM expert at Reading, UK. Staff had great difficulty developing and managing the system on top of their other duties, and the system virtually died in early 1991 with the loss of key staff.

The system was reactivated again in late 1991, but owing to lack of CLICOM expertise and to changes made to core features of the software by the then system administrator, proper operations could not be sustained. However, since late 1993 Ms Pahalad has taken over control and although the CLICOM cannot yet be classed as fully operational, it is progressing well and can be expected to improve further and reach proper operation in due course.

Development requirements: Fiji has the staff skills and local technical computer support to successfully develop the CLICOM system. However, the present position is rather insecure and continuing support will be needed to bring the current recovery effort to satisfactory fruition.

A number of hardware improvements are needed. Fiji has one of the largest observation network in the South Pacific and this warrants more than just a single PC to support the CLICOM operation. We recommend an IBM compatible PC 486-33 based processor, 4MB Ram, 200MB HD, 1.44MB 3.5" diskette drive and 1.2MB 5.25" diskette drive, serial & parallel ports, SVGA colour monitor. The problem of the IBM3363 optical drive has been detailed under *Operations* above. If the optical disk drive cannot be interfaced to the 486-33 PC then it should be replaced with a new

drive such as the re-writable type, 128MB, with COREL-SCSI software, and compatible with SCSI device now recommended in the latest CLICOM technical specifications.

Additional software complete with manuals is needed, i.e. DataEase, COSORT 4.4, MS-FORTRAN V5.1.

Training and support are the most important requirements for Fiji's CLICOM operations. There are only two officers with training in CLICOM, and this has been of a very limited nature. At least one staff member should undertake an in-depth training course such as the University of Reading course, and another officer should be given basic training in CLICOM. The supervisor of the climatological data operations, Mr Mani, needs training in CLICOM to enable him to make use of the system and to better integrate existing manual operations and services with the now re-developing CLICOM operations. A programme of regular on-site support and training visits is required. Training in the use of DataEase and in FORTRAN is needed.

Consideration needs to be given to obtaining Fiji data archived in the NIWA computer database in Wellington, and to the provision of software to facilitate its import to CLICOM.

As noted earlier, we believe that it would be highly desirable for the production of the Fiji monthly climate summary be reviewed and re-programmed to run under CLICOM, and that this be done as a generalised program so that other Pacific CLICOM sites could also make use of it. This project should be done on-site in Fiji and should involve the participation of local CLICOM officers in the whole job from review, through to the programming, as an on the job CLICOM training experience. Mr Ereckson would be pleased to contribute to this project.

2.5 Kiribati

Mission details: Discussions were held in Betio, Tarawa, on 27-29 August 1994, with Mr Uarai Koneteti (Head of Kiribati Meteorological Service), Mr Tekena Teitiba (Aerology Officer). Brief meetings were had with Mr Kirion Kabunateiti (Sen. Met. Tech.) and Mr Morriti Tibiriano (Sen. Met. Tech.)

Discussions were also held with Miss Nikki Hill, Computer Information Office Manager, Ministry of Education/Science & Technology. She is doing a two year volunteer service assignment, with a year and a half left, and provides a first level of support to call on for any computing problems in Kiribati Government departments. She has been giving some help to the Meteorological Service and is interested to support the CLICOM operations. Mr Ereckson briefed Miss Hill on CLICOM and the Inventory and Review Project.

Supply and installation: A single PC and standalone CLICOM was supplied by Australia when Mr Kabunateiti attended a CLICOM training course at the Bureau of Meteorology, Melbourne in June 1994.

Hardware: This comprises a NEC APC IV-286 PC (640kb RAM, 40MB HD, 360Kb and 1.44MB diskette drives, NEC 14" EGA APC-4311 monitor), and an AMUST DT130, 9-pin dot matrix printer. There is also available a COMPAQ LTE 386/20, with a UPS AVR type, supplied under the COMCIAM project in 1991.

Software: DOS V5.0, CLICOM V3.0, and associated software (without network software) are present. No CLICOM tutorials were provided. There are manuals for COSORT V4.4 and DataEase V4.5 (version unknown). This software was thought to have been supplied under the COMCIAM project. Other software includes Lotus 123 and Virus Buster.

Technical Faults/Problems: During the mission visit on 29 August the computer's 1.44MB A: drive was found to be unserviceable, with seek error messages. If the NEC PC HD goes down they will not be able to re-start the machine. There is no computer maintenance and repair facility in Kiribati. The supply of consumables can be a problem. Apparently the diskettes supplied locally are not very reliable, and there was no fanfold paper available for the printer.

Operations: The system is run part time by Mr Teitiba (Aerology officer). He is assisted by Mr Kabunateiti, also part-time. The PC is set up in an air-conditioned room within the main office. The room is very small and also contains the COMPAQ PC. Security is considered to be acceptable, and the PCs are regularly checked for viruses.

The CLICOM could run on the COMPAQ if necessary. The purposes for which the COMPAQ was supplied are not clear. A considerable amount of software was supplied with it. It seems now to be used only by Mr Teitiba for other tasks.

The system was started in July 1994, with some attempts at data-entry. Some daily data had been entered, for only the one station at present, using a Data Entry Form for 11 Elements supplied with the system. The station information system details are not completed. Mr Teitiba had tried out the graphics facility and had produced a time

series plot of daily data. Data management procedures are limited. There is a lack of knowledge about how to do backups, and most software is only on the original supply diskettes.

Data volumes and observation network: Less than 0.1MB of data has been entered, compared to the available back data of 300MB, and an annual increase of 8.0MB. The monitoring network comprises:

Daily climate observations at 8 stations.
Daily rain only, at 21 stations.
Three-hourly (or six-hourly) synoptic weather reports at 8 stations.
Hourly reports at 1 station.
Upper air radiosonde and wind at 1 station.

Training: Mr Tekana Teitiba (Aerology Officer): Computer familiarisation course, Tarawa, part-time over 3-months 1992. Basic CLICOM training. Bureau of Met. Melbourne, 3-weeks, July 1993.
Mr Kirion Kabunateiti (Sn. Met. Officer): Basic CLICOM training, Bureau of Met. Melbourne, 3-weeks, June 1994.

Staff expressed the desire for longer courses of intensive training, and also for on the job training practical work with CLICOM.

General summary: Naturally progress has been very limited given the short period the CLICOM has been available and the very basic levels of training. Staff are very keen to get CLICOM fully operational and to become proficient with its use.

Part of the mission visit was spent with Mr Teitiba, answering queries, fixing some problems on the system, and giving him some brief training on Forms design, creating ASCII format records, use of the Norton editor, backup and archiving.

Development requirements: On-site support and training visits are the most immediately needed requirement. Another officer should be selected for the basic CLICOM training, and consideration should be given to placing one staff member on a more advanced course such as the CLICOM and statistics course at the University of Reading, UK. Training in the use of DataEase would be useful, and the supply of FORTRAN and training in FORTRAN programming, at a later stage, would be worthwhile.

A standalone CLICOM will be sufficient for Kiribati. There is no need for a networked system. The donated second-hand NEC 286 PC is probably adequate to start with, but it is old and already has an unserviceable A: drive. It may well break down further at any time, and it is too slow for the new CLICOM V3.0. We therefore recommend the provision of the following equipment (follows WMO technical recommendations).

- New IBM compatible PC 486 (DX-33 at least), 8MB RAM, 200MB hard disk, minimum, 1.44MB 3.5" diskette drive, 1.2MB 5.25" diskette drive. Serial & parallel ports, SVGA colour monitor.

- Optical disk drive (as the archive storage device), re-writable, (with COREL SCSI software and compatible with SCSI devices), 128MB capacity, (similar to IBM3510).

- Laser Jet Printer. (HP laser jet series III class).

- 50 diskettes, 1.44MB, 5 optical disk cartridges, and 2 toner cartridges for Laser Jet printer III.

Consideration needs to be given to obtaining Kiribati data archived in the NIWA computer database in Wellington, and to the provision of software to facilitate its import to CLICOM.

2.6 Tuvalu

Mission details: Discussions were held in Funafuti, 30 August - 3 September 1994, with Ms Mapusaga Fuamatagi (Acting Director, Tuvalu Meteorological Service), and in brief meetings with Mr Poni Faavae (Met. Tech), and Mr Melton Tauetia (Sn. Met. Tech).

Supply and installation: A single PC stand-alone CLICOM was supplied by the Australia upon request of Ms Mapusaga Fuamatagi when she attended a basic CLICOM training course at the Bureau of Meteorology, Melbourne in June 1994 (this initiative also resulted in the supply of CLICOM to Kiribati.)

Hardware: Equipment comprises an NEC Powermate 286 PC (1MB RAM, 40MB HD, 360Kb and 1.44MB diskette drives, and ELETE 14" VGA monitor), and a CPB 80EX 10" 9-pin dot matrix printer. There is another PC (a COMPAQ LTE 386/20, with a UPS), which was supplied under the COMCIAM project in 1991 and is used for administration work.

Software: DOS V5.0, CLICOM V3.0, and associated software (without network software) are present. There are manuals for COSORT V4.4 and DataEase V4.5 (version unknown). This software was thought to have been supplied under the COMCIAM project. Other software includes Lotus 123, Virus Buster, and Windows 3.0. The CLICOM tutorials and manual are available.

Technical Faults/Problems: During the mission visit, on 31 August, the NEC PC would not boot up. On checking, it was found that changes and deletions had been made to the system files. Mr Ereckson corrected the files and fixed the problem. Later, on 2 September, the NEC PC's 1.44MB diskette drive (A:) was found to be unserviceable, and investigation showed that the fault had occurred the previous night, possibly through the use of suspect disks. This highlights the inadequacy of security of the facility, where the PC is accessible to all workers at the site. If the NEC's hard disk goes down the machine will not be able to be re-started.

Operations: Ms Fuamatagi is the only officer with some CLICOM training, and the CLICOM is really only operated on a trial basis by her, as and when her other duties permit. A small amount of station information has been entered. The NEC PC is installed in a large air conditioned room in the main Met. Office. The environment is not ideal, as a lot of dust gets into the Office from the adjacent runway and roads, and it is very close to the ocean on the other side.

As noted above, security is not very good. Combination locks are soon to be fitted to the building. There are no virus checks, and no password system. Staff on shift duties have access to the computer and use it for some of their duties, typing of forecasts, and entry of some daily data into a spreadsheet for computation of end-of-month summary values (a recent innovation). Copies of the CLICOM software are on diskette, as the only back-up.

There are no computer repair facilities on Funafuti. The Bureau of Meteorology in Melbourne is called on any CLICOM operation problem. There is a computer programmer (Mr Tiputa Samasoni) attached to the Office of the Prime Minister, but

there has been little contact with him to date. A CLICOM V3.0 is also installed on the COMPAQ PC in Ms Fuamatagi's Office, just as a trial.

Data volumes and observation network: No data has been entered, the available back data of 155MB, and an annual increase of 4.4MB. The monitoring network comprises:

Daily climate observations at 4 stations.
Daily rain only, at 5 stations.
Three-hourly (or six-hourly) synoptic weather reports at 4 stations.
Hourly reports at 1 station.
Upper air radiosonde and wind at 1 station.

Training: Ms Mapusaga Fuamatagi, (Acting Director): LOTUS 123 training course, Funafuti, 1-week, 1992. Basic CLICOM Training, Melbourne, 3-weeks, June 1994.
Two other officers have PC experience:
Mr Poni Faavae. Did a training course on hydrology, Colorado USA, 1993 (at which he was given MS-Works software registered to him—he uses this for entering daily climate data.
Mr Melton Tauetia. Can use a PC, e.g. uses MS-Works to type out forecasts for display.

Ms Fuamatagi noted that her training has been insufficient, and that it is difficult to use CLICOM without the basic training and knowledge of PC use. More training is needed for other staff also. I appears that there is a unit of the University of the South Pacific on Funafuti which may be able to provide computer courses from time to time.

General summary: Naturally progress has been very limited given the short period the CLICOM has been available (since July 1994) and the very limited training and staff resources available. Staff are keen to get CLICOM operational and to become proficient with its use.

Development requirements: Another two officers should be selected for the basic CLICOM training, and consideration should be given to placing one staff member on a more advanced course such as the CLICOM and statistics course at the University of Reading, UK. Training in the use of DataEase would be useful, and the supply of FORTRAN and training in FORTRAN programming, at a later stage, would be worthwhile. On-site support and training visits are the most immediately needed requirement.

A standalone CLICOM will be sufficient for Tuvalu, as there is no need for a networked system. The donated NEC 286 PC is probably adequate to start off with CLICOM. However, it is old, the A: drive is already unserviceable, and it is too slow for the new CLICOM V3.0. We therefore recommend the provision of the following equipment (the same as described above for Kiribati.)

- New IBM compatible PC 486 (DX-33 at least), 8MB RAM, 200MB hard disk, minimum, 1.44MB 3.5" diskette drive, 1.2MB 5.25" diskette drive. Serial & parallel ports, SVGA colour monitor.

- Optical disk drive (as the archive storage device), re-writable, (with COREL SCSI software and compatible with SCSI devices), 128MB capacity, (similar to IBM3510).

- Laser Jet Printer. (HP laser jet series III class).

- 50 diskettes, 1.44MB, 5 optical disk cartridges, and 2 toner cartridges for Laser Jet printer III.

Consideration needs to be given to obtaining Tuvalu data archived in the NIWA computer database in Wellington, and to the provision of software to facilitate its import to CLICOM.

2.7 Tonga

Mission details: Discussions were held in Nuku'alofa, 6 - 8 September 1994, with Mr Paea Havea, (Director, Tonga Meteorological Service), and Ms Selu 'Ilolahia, (Office Assistant.)

Supply and installation: CLICOM software was supplied by Australia to Ms Selu 'Ilolahia when she attended the basic CLICOM course in June 1994 at the Bureau of Meteorology, Melbourne. There was an earlier supply of CLICOM on diskettes to Mr Paul Cheesman (Sen. Met. Officer) when he attended an earlier course in Australia in 1993.

Hardware: No hardware has been supplied as part of CLICOM, but the software has been installed on a COMPAQ LTE 386/20 (3MB RAM, 105MB HD, 5.25" 1.2MB and 3.5" 1.44MB diskette drives, COMPAQ VGA monitor which had been supplied by the COMCIAM project about 1991. An HP Deskjet 500 is available. There are no other PCs.

Software: DOS4.0 and DataEase V4.53 (with manual) was originally supplied with the COMPAQ. Now DOS6 is in use without a manual. CLICOM V3.0 is in hand, as is DataEase V4.5.2, a copy from the supply of CLICOM, but no manual is available. There is also COSORT 4.4, Norton Editor, Windows 3.1, Quattro-Pro V4.0, and OPTDATA (a hydrological program for CLICOM).

Technical Faults/Problems: There have been no faults on the COMPAQ. An intermittent fault on the printer disappeared after the cable was changed.

Operations: The system is run by Ms Selu 'Ilolahia, full time. The only other officer at the Tonga HQ is the Director, Mr Havea. The equipment is sited in a small air conditioned room within the main office, which is exposed to some dust but is kept very clean and tidy. Basic security is in place, e.g. the office is locked up. An officer from the parent Civil Aviation Department next door uses this PC occasionally.

Some repair to PC's can be done locally. For problem support Ms 'Ilolahia calls Ms V ranisese at the Fiji Meteorological Service (who was on the same 1994 CLICOM course with her), and she can also contact Tan Lee Seng in Malaysia and Mr Ereckson in New Zealand.

CLICOM operations have just commenced. Some daily data is being entered. Some monthly data have been entered into Quattro Pro spreadsheets. Backup is not yet organised, and some original diskettes are not backed up. Some of the Quattro Pro spreadsheets are backed up.

Data volumes and observation network: Less than 0.1MB has been entered, the available back data is 180MB, and the annual increase is 6.4MB. The monitoring network comprises:

Daily climate observations at 8 stations.
Daily rain only at 3 stations.
Three-hourly synoptic weather reports at 7 stations.
Hourly reports at 1 station.
Upper wind at 1 station.

Training: Ms Selu 'Ilolahia, (Office Assistant and Computer Operator): Basic computer skills training 1-day per week, while at Victoria University, Wellington, 1989. Plans to complete degree later (BSc Chem), needs 1 1/2 more years. Employed as computer operator from August 1993. Basic CLICOM training, Bureau of Met. Melbourne, 3-weeks, June 1994.
Mr Paul Cheesman, (Sen. Met. Officer): Basic CLICOM training, Bureau of Met. Melbourne, 3-weeks, July 1993. On return from this course he installed a CLICOM, and entered some data, which is now stored in a Quattro Pro spreadsheet. This CLICOM was later lost. He is now based at the airport office and not at the headquarters office where the CLICOM system is located.

General summary: A good start has been made, but progress necessarily has been limited by the very small amount of training and available staff resources. During the mission a number of faults were found in the CLICOM and incorrect procedures noted. Mr Ereckson was able to provide some assistance and guidance with a number of matters. He repaired various faults, including the fix for CLICOM to run under DOS 6.0, and many others too detailed to mention here.

The CLICOM is now working without faults and also Ms 'Ilolahia has more confidence to proceed. However, we doubt that the operations can be sustained without regular on-going support visits.

Mr Ereckson checked out what data was on hand that could be entered to CLICOM. Copies of the reporting Forms for the daily climate (F301) and daily rainfall (F20) are kept. All synoptic report data Forms are sent to Wellington (to NIWA). It was suggested that they concentrate on daily climate data entry and leave the synoptic data until later.

Development requirements: There should be another officer trained in CLICOM who is at least reasonably familiar with the current operations. There are no other staff at the HQ Office at present, but Mr Cheesman (currently at the Airport Office (?) might be able to fill this 'backup' role. Further training for Ms 'Ilolahia, such as the CLICOM and Statistics course at the University of Reading, UK would be very desirable, as would training on the use of DataEase. On-site support and training visits will be essential.

A standalone CLICOM will be sufficient for Tonga, as there is no need for a networked system. The COMPAQ 386/20 PC is probably adequate to start off with CLICOM. However, it is three years old now, and it is too slow for the new CLICOM V3.0. We therefore recommend the provision of the following equipment (the same as described above for Kiribati and Tuvalu.)

- New IBM compatible PC 486 (DX-33 at least), 8MB RAM, 200MB hard disk, minimum, 1.44MB 3.5" diskette drive, 1.2MB 5.25" diskette drive. Serial & parallel ports, SVGA colour monitor.

- Optical disk drive (as the archive storage device), re-writable, (with COREL SCSI software and compatible with SCSI devices), 128MB capacity, (similar to IBM3510).

- Laser Jet Printer. (HP laser jet series III -class).

- 50 diskettes, 1.44MB, 5 optical disk cartridges, and 2 toner cartridges for Laser Jet printer III.

Consideration needs to be given to obtaining Tonga data archived in the NIWA computer database in Wellington, and to the provision of software to facilitate its import to CLICOM.

2.8 Western Samoa

Mission details: Discussions were held in Apia, 8-15 September, with Mr Ausetalia Titimaea (Superintendent Meteorological Division, Apia Observatory) and Mr Niko Tualevao (STO Met), and brief meetings with Mr Frank Malele (Asst. Sup. Dept. Agriculture, Forest, Fisheries, and Meteorology), Mr Lameko Talia (PTO Geophysics), and Mr Taala Tuilagi (PSO Met).

Supply and installation: The CLICOM V2.1 was provide by Australia under the COMCIAM programme in about 1991, and introduced by Mr Titimaea following a training course at the Bureau of Meteorology, Melbourne. CLICOM V3.0 software was obtained later, in 1993, and brought in by Mr Tualevao who was attending a 'Climate Variability' course in Melbourne. Mr Ereckson was unable to determine how the installation was achieved or by whom.

Hardware: No hardware has been supplied as part of CLICOM, but the software is installed on a COMPAQ 386SX PC (2MB RAM, 90MB HD, 5.25" 360Kb and 3.5" 1.44 diskette drives, COMPAQ 14" VGA colour monitor.) This PC was supplied by the COMCIAM project about 1991. There is an HP Deskjet 500 printer, a UPS, and two other PC's at the Observatory. A SWAN 486 PC is assigned to geomagnetic and earthquake work and is also used by an hydrologist at the Observatory. This is provided by the US Geological Survey, who maintain it. A 386 PC provided through the EEC is used for administrative and general use in the Superintendent's office. All of the PC's get regular maintenance attention from SOPAC staff based in Fiji.

Software: DOS6.2 was recently installed by a SOPAC officer and a DOS 6 manual is available. Prior to this DOS 5 was used. CLICOM 3.0 is present but there is no V3.0 manual or tutorial. The CLICOM V2 manual is present but has parts missing. DataEase V2.53 with a manual is available, having been supplied with the COMPAQ, PC in 1991. COSORT 4.4 is present, but without a manual. Other software includes: an early version of Norton Editor, V1.3C, Windows 3.1, Excel for Windows, WP51, Virus Buster, Fastlynx, and a GIS program IDRISI.

Technical Faults/Problems: There have been no faults on the COMPAQ PC. A problem for several months with the printer was fixed by the visiting SOPAC officer from Fiji. The COMPAQ PC on which CLICOM is now installed has a great deal of software that is used by other Observatory officers, as well as the Meteorological staff. It is very heavily loaded, with only some 8MB free space remained at time of the mission. This is barely sufficient space to run a basic CLICOM. This is not a satisfactory platform for a CLICOM, which should reside on a PC used only by CLICOM staff.

Operations: The CLICOM facility is under the care of Mr Ausetalia Titimaea, and he has assigned Mr Niko Tualevao, to operate the system. CLICOM V2.1 was installed on a trial basis by Mr Titimaea in 1992. It contained 5-years of daily data for Apia. There is no record of this data in the current CLICOM V3.0 which was installed about July 1993 but never became operational. A diskette containing this data set is available, so it could be put into CLICOM 3. The CLICOM was not operational when Mr Ereckson arrived on 8 August.

The CLICOM PC is sited in a small room in the Observatory building which houses the geomagnetic recording equipment. This is the only room with air-conditioning,

but it has no windows, is very dusty, and is crowded with many papers, boxes, etc, stacked about the walls and across the floor. It is at present a very difficult and unsatisfactory working environment for both equipment and staff.

Security of the system is inadequate. The CLICOM PC is used by other staff, and as noted above, is very heavily loaded with various other software and data. There is no password system and no virus checking is done. There are no backups of the original software supply diskettes including those for CLICOM 2.1 and 3.0.

Upon commencing the system inventory and review work on 8th September, Mr Ereckson found that there were a number of faults and problems and that the CLICOM would not operate properly (see further notes below). However, with his assistance, by the day of his departure, on 15 September, it was operating correctly and daily data was being entered, verified, and loaded to the database. A backup of the system had been done.

Data volumes and observation network: Less than 0.1MB has been entered, the available back data is 85MB, and the annual increase is 2.6MB. The monitoring network comprises:

Daily climate observations at 6 stations.
Daily rain only, at 11 stations.
Three-hourly synoptic weather reports at 2 stations.
Hourly reports at 1 station.
Upper wind at 1 station.

Training: Mr Ausetalia Titimaea, (Sup. Met. Div.): Climate Data Management and Monitoring using CLICOM, course under AIDAB, Bureau of Meteorology, Melbourne, 4-months in 1991. On his return from this training, Mr Titimaea wrote a report "The use of the CLICOM system in Climate Data Management and Monitoring, Case Study: Western Samoa", which makes some observations on various CLICOM features and some recommendations for improvements. His conclusion was that the CLICOM system with its current capability will mostly suit Western Samoa.
Mr Lameko Talia, (PSO Geophysics Div): Has degree in geophysics, University of Canterbury. Some three weeks training on Windows, MS-Word, MS-Exel, Apia, Sept. 1993. No CLICOM training. He was assigned by the Observatory Superintendent to be a stand-by and help to Mr Tualevao while Mr Ereckson was bringing the CLICOM up to data-entry stage and giving some training.
Mr Niko Tualevao, (STO Met): Has 20 years service and has meteorological technical training in the NZ Met. Service, but has not had any computer or CLICOM training.

General summary: The CLICOM system is not operational and the background of training, experience and environment at the site mean that it cannot be made operational without substantial further support. However, during the mission, at the request of Mr Titimaea and Mr Malele, Mr Ereckson agreed to investigate whether he could get the system running and Mr Tualevao trained up to the stage of entering data. Fortunately, time to do so became available as a result of changed airline schedules and to an aircraft incident that blocked the Faleolo Airport runway for some days.

During the period 8th to 15th Mr Ereckson repaired the faults, including the adjustments necessary for CLICOM V3 to run on DOS 6, and many others too detailed to mention here. He got the system running, and was able to give training to Mr Tualevao to the stage where he could enter, verify, and load data. On the 15th, the day of departure, some eight months of daily data for one station had been entered by Mr Tualevao, and he was continuing with data-entry. Among other operations learned was the production of a standard CLICOM report of a month's daily data, and the production of a time-series graph. Mr Tualevao's commitment and enthusiasm was exemplary, and included many hours of off-duty time to undergo the training.

Despite this success, Mr Ereckson advised Mr Titimaea that without further help and training, it was unlikely that operations will be sustained for very long.

Development requirements: For CLICOM to have chance of operating successfully and being sustained in Western Samoa, formal training in CLICOM must be given to Mr Tualevao (assuming he is to carry on with the CLICOM duties), and to another officer. In due course, once the basic CLICOM operations and management skills are achieved and more experience is gained, higher levels of training will be desirable, e.g. training in the use of DataEase, and the supply of FORTRAN and training in FORTRAN programming.

A standalone CLICOM will be sufficient for Western Samoa, as there is no need for a networked system. The COMPAQ 386SX PC is probably adequate to start off with CLICOM. However, it is three years old now, it is too slow for the new CLICOM V3.0, and it is heavily loaded with other applications and users. We therefore recommend the provision of the following equipment (the same as described above for Kiribati, Tuvalu and Tonga), with the proviso that it should be provided only if suitable accommodation can be made available. One possibility is to re-furbish the room that Mr Tualevao uses as his office, with air-conditioning and with other alterations necessary to house the new hardware.

- New IBM compatible PC 486 (DX-33 at least), 8MB RAM, 200MB hard disk, minimum, 1.44MB 3.5" diskette drive, 1.2MB 5.25" diskette drive. Serial & parallel ports, SVGA colour monitor.

- Optical disk drive (as archive storage device), re-writable, (with COREL SCSI software, compatible with SCSI devices), 128MB, (similar to IBM3510).

- Laser Jet Printer. (HP laser jet series III class).

- 50 diskettes, 1.44MB, 5 optical disk cartridges, and 2 toner cartridges for Laser Jet printer III.

Obtain a CLICOM V3 manual, CLICOM Tutorial manuals and software. Obtain a copy of DataEase V4.5.3 and manuals.

Consideration needs to be given to obtaining Western Samoa data archived in the NIWA computer database in Wellington, and to the provision of software to facilitate its import to CLICOM.

2.9 Cook Islands

Mission details: Discussions were held in Rarotonga, 19-23 September, with Mr Arona Ngari, (Manager Cook Islands Meteorological Service), Mr Raui Nicholls, (TO Met), and Mr Numa Ukarangi (TO Met.)

Supply and installation: The CLICOM software was supplied by Australia to Mr Numa Ukarangi, when he attended a basic CLICOM course at the Bureau of Meteorology, Melbourne, June 1994. The software was installed by Numa when he returned from the course.

Hardware: No hardware has been supplied as part of CLICOM, but the software is installed on a MITAC 386 PC (1MB Ram, 200MB HD, 5.25" 1.2MB and 3.5" 1.44MB diskette drives, MITAC 14" VGA monitor) which was supplied under the VCP by New Zealand in late 1990. There are two other PC's in the Service; one in Administration, and one for the Manager.

Software: Available software at the site includes DOS 4.1 with manual, CLICOM V3.0, DataEase V4.5.2 (no manual; there is also an earlier version, 2.53, with no manual), COSORT 4.4 (no manual), Norton Editor, V2 (not registered), GWBASIC V3.23, PFS First Choice V3, WP51, EXCEL V4, VSCAN/Mcaffee. CLICOM tutorial Manuals 1 & 2 and tutorial software are available.

Technical Faults/Problems: There have been few faults. A fault in the display screen was fixed locally, and a fault in the printer was fixed by the Met. Technician. There is a need for a separate UPS for the CLICOM PC.

Operations: Mr Raui Nicholls and Mr Numa Ukarangi have been assigned to operate CLICOM part-time amongst their other duties. The system is sited in the Administration office, in a clean, tidy, air-conditioned room. Security is good, the room locked outside 8am-4pm, and password protection is in use. The PC in the Manager's office could run CLICOM if necessary. The originally supplied diskettes were not backed up.

Hardware support is available from the Met. Technician, and also from private sector business in Avarua. For software problems and support needs, access is available to the Bureau of Meteorology in Melbourne and to Mr Ereckson in Wellington.

The system was not operational when Mr Ereckson arrived on 19 September. There had been some efforts to enter station information, but the system was not working properly and they had been waiting upon Mr Ereckson's visit in the hope that it might be fixed then. However, with the help of Mr Ereckson, by the time of his departure on 24 September, the CLICOM was operating correctly, daily data was being entered, verified, and loaded to the database, and a backup of the system had been done.

Data volumes and observation network: No data has been entered, the available back data is 290MB, and the annual increase is 9.7MB. The monitoring network comprises:

Daily climate observations at 13 stations.
Daily rain only, at 20 stations.

Three-hourly synoptic weather reports at 8 stations.
Hourly reports at 2 station.
Upper wind at 1 station.

Training: Mr Raui Nicholls, (TO Met.): basic CLICOM training, Bureau of Met., Melbourne, 3-weeks, 7/1993. (12 years service in Met. Service.)
Mr Numa Ukarangi, (TO Met.): basic CLICOM training, Bureau of Met. Melbourne, 3-weeks, 6/1994, (4 years service in Met. Service.)
Comments on adequacy of training were that it was not enough, and too short.

General summary: The system was not operational, owing to the lack of training and support. While doing the work required for the Project's inventory and review of the system Mr Ereckson found there were many faults and problems in the system, which were probably due to lack of experience with the system and especially with software installation procedures.

The Manager, Mr Arona Ngari, asked Mr Ereckson if he could get the CLICOM operating properly and give some help and training to Mr Nicholls and Mr Ukarangi. The schedule of three days at Rarotonga was ample for the project work, but insufficient to achieve the requested extra work. Thus an extra two days were approved to deal with the problems present, provide some training, and complete the re-establishment of CLICOM.

Mr Nicholls and Mr Ukarangi are very keen to work on CLICOM and to make a success of it. They put in extra hours during the mission visit and were always very cooperative and helpful. All the training given was of a practical nature; they did the hands-on work, and will now be able to proceed with more confidence.

Development requirements: Consideration should be given to placing one staff member on a more advanced course such as the CLICOM and statistics course at the University of Reading, UK. Training in the use of DataEase would be useful, and the supply of FORTRAN and training in FORTRAN programming, at a later stage, would be worthwhile. On-site support and training visits are the most immediately needed requirement.

A standalone CLICOM will be sufficient for Cook Islands, as there is no need for a networked system. The MITAC 386 PC is probably adequate to start off with CLICOM. However, it is some four years old now, it is too slow for the new CLICOM V3.0. If it goes down there is nothing to fall back on, as the other available PCs are not valid options for this. The MITAC 386 could provide service in training as well as a backup to the proposed new machine. We therefore recommend the provision of the following equipment (the same as described above for Kiribati, Tuvalu, Tonga and Western Samoa):

- New IBM compatible PC 486 (DX-33 at least), 8MB RAM, 200MB hard disk, minimum, 1.44MB 3.5" diskette drive, 1.2MB 5.25" diskette drive. Serial & parallel ports, SVGA colour monitor.

- Optical disk drive (as the archive storage device), re-writable, (with COREL SCSI software and compatible with SCSI devices), 128MB capacity, (similar to IBM3510).

- Laser Jet Printer. (HP laser jet series III class).
- A UPS 1200VA.
- 50 diskettes, 1.44MB, 5 optical disk cartridges, and 2 toner cartridges for Laser Jet printer III.
- Registered copies of DataEase V4.5.3, COSORT V4.4, and FORTRAN V5.1, with manuals.

Consideration needs to be given to obtaining Cook Islands data archived in the NIWA computer database in Wellington, and to the provision of software to facilitate its import to CLICOM.

2.10 Niue

Mission details: It was not possible to visit Alofi, Niue, but a number of discussions were held as follows: by telephone conference call between Mr Richard Hipa (Director, Department of Posts and Telecommunications), Mr Sionetasi Pulehetoa (Sen. Met. Officer), and Dr Reid Basher, 16 August 1994; and by telephone and fax from Wellington, and by personal meeting at the SPREP meeting of Directors, Fiji 3-5 Oct. 1994, between Mr Pulehetoa and Mr Ereckson.

Supply and installation: A PC with CLICOM V3 already installed was supplied by Australia and delivered to Niue in September 1994. This donation was in response to an inquiry made by Mr Pulehetoa in May 1993. At the time of preparation of this report, the PC had not been started up at Niue.

Hardware: The details of the PC are not known at this point, but we understand that it is a second-hand 286 machine, and that no printer was supplied. The Niue Met. Office has no other computer facilities, but it has access to PCs in the parent department of Posts and Telecommunications.

Software: Unknown, but CLICOM and other necessary software understood to be installed, along with station information files.

Technical Faults/Problems: Nil at this stage.

Operations: Not established. It is understood that Mr Pulehetoa will endeavour to operate the system as part of his existing duties. Technical support from among Telecommunications Department staff may be available.

Data volumes and observation network: No data has been entered, the available back data is 48MB, and the annual increase is 0.8MB. The monitoring network comprises:

Daily climate observations at 2 stations.
Daily rain only, at 2 stations.
Three-hourly synoptic weather reports at 1 stations.
Hourly reports at 1 station.

Training: Mr Sionetasi Pulehetoa has not had any training in basic PC use, and no training in CLICOM. Formal training and CLICOM technical support will be essential.

General summary: It is too early to comment on the Niue CLICOM operation, except to note the great challenge that the project poses for such a tiny and remote country (population less than 3000 people).

Development requirements: A standalone CLICOM will be readily sufficient for Niue. An installation and training visit will be required to get CLICOM started and running smoothly, and regular on-site support visits will be necessary.

It is not certain at this point what model of computer was supplied. If it is a second-hand 286 machine, it may be a little old and will be too slow for CLICOM 3.0. To improve on this will require the same single PC suite of equipment as we have recommended above for the other small countries.

Consideration needs to be given to obtaining Niue data archived in the NIWA computer database in Wellington, and to the provision of software to facilitate its import to CLICOM.

3. REGIONAL SUMMARY AND PERSPECTIVE

In this Section, we attempt to collate the detailed country information into a single regional picture and draw conclusions about what needs to be done on the regional scale.

3.1 Overview of CLICOM in the Region

The overall picture is rather disappointing, in that only one of the ten countries was close to having CLICOM operating completely effectively. Papua New Guinea, Solomon Islands, Vanuatu and Fiji are more advanced, having started earlier with WMO assistance, and having had the benefit of some on-site training and support. They can certainly claim some success for their efforts. The most advanced site is that of the Solomon Islands, whose success we believe is due to the higher level of training and support received, and to a very strong managerial commitment to CLICOM.

The remaining smaller countries have come to CLICOM at a later stage, and have not had the benefit of a systematic project to implement the system. Given that the provision of equipment, software and training has been on an opportunistic, piecemeal basis, and that the resources to properly implement the system have not been made available to the Met services, it is hardly surprising that little real progress has been made with CLICOM in these countries.

The question might be asked as to whether CLICOM is suitable for the Pacific islands. The answer is yes. It is designed for small countries and can do the job required. The CLICOM concept is good. CLICOM has been implemented satisfactorily in other countries such as Sri Lanka, Mauritius, Malaysia (although not without difficulties it might be said.) There are aspects that need improvement, for example in the range and quality of climate information products and applications, but overall it is the best available system. The alternatives, are basically (i) designing your own climate data system using spreadsheets or databases, or (ii) making use of a central database in another country, such as Australia or New Zealand. Neither of these options would serve the Pacific island countries very well.

One qualification can be made on the above recommendation, however. To maintain a CLICOM system requires sufficient skilled staff resources. The larger Pacific Island countries can meet this requirement, but for the very tiny countries, such as Niue, it is likely to be very difficult to consistently meet, especially when pitted against the numerous other development needs a country has. We believe that if the smallest countries are to sustain CLICOM, then they will need a good deal of help from other Pacific island CLICOM sites as well as from the more distant sources of CLICOM expertise.

One problem with the CLICOM idea is that it has been promoted as a simple, easily operated system, but this is not true if the staff involved have little computer knowledge and experience. Because it is not a commercial product, the user cannot turn to suppliers for help. Training and on-going technical support are needed to run

the system. Also, there have been software faults (now largely fixed in version 3.0) which have caused difficulties in the past.

An obvious factor in the relatively poor performance of CLICOM in the South Pacific systems is that most have been set up without adequate planning, funding, and ongoing technical support. This is the classic tale of badly designed aid, resulting in wasted resources, unsuccessful implementation, few real end-results and benefits, and disappointed local aspirations. Although it is understandable why donors and recipients engage in this sort of piecemeal approach, it has to be recognised that it is not the way to produce effective, lasting results.

A particularly unsatisfactory aspect is that in many cases, the software appears to have been supplied as pirated copies, occasionally as an out-of-date version and often without the necessary manuals. In two instances, equipment manuals were supplied in a foreign language not understood by the recipient agency. In some cases the hardware supplied is not adequate to operate the current version 3.0 CLICOM software.

Training opportunities have not been sufficient to meet the needs. Short courses have been developed, e.g. the basic CLICOM course at the Bureau of Meteorology in Melbourne, but these are not enough to develop an adequate understanding of the system and its management, nor to develop practical experience in all the various operating procedures of the system. The dominant reaction of Pacific Islands staff who have been on the short courses provided in the region was that they were too short, and did not provide enough opportunity to develop practical competence.

Another important point is that there is a body of knowledge and practice in running a computer system that is well-known and carefully pursued in the management of large computer centres, but which unfortunately is usually not well known or applied in the operation of personal computers. This includes physical security (passwords, locked doors, etc), software security (back-up copying and off-site storage of software and data, etc), system management (authorisation of database administrator, personnel access, manuals management, log books, etc).

By way of example, the Caribbean country Jamaica recently lost virtually all of its historical climate data resources through a devastating office fire. With computer systems, it is possible to very quickly resurrect a complete data system—provided a systematic backing-up process has been followed. This is a critical requirement for PC-based climate services, and it must be a key area for training.

An associated problem was the absence of good record keeping systems. In most of the countries visited, there were great difficulties in obtaining basic information for the inventory, such as on the observing network, measurement types, station histories, available data resources, what data had been entered to the computer archives, and the hardware and software being used. Generally there were no logs of computer use that could provide information on the installation of software, entry of data, archive status, and faults encountered.

The absence of systematic ongoing advice and support and on-site visits has been a major handicap in solving the inevitable computer and software problems that occur, and in building the experience and confidence of local staff. We believe that this is

one of the main reasons why most Pacific sites have not been successful. On-site support visits should be provided at six-month intervals for the first one to two years of operations. The 7-10 days training given at installation time is quite insufficient.

WMO has strongly supported the development and implementation of CLICOM, and has acted as a coordinator and broker for donors and recipients. However, its funds are limited and must be shared among the extensive meteorological needs of its more than 160 members. While it can provide some help and support, responsibility for problem-solving and ongoing operations once the initial installation has been completed mainly rests with the individual country and, as appropriate, its donors. WMO has neither the funds nor staff to undertake this level of operational support.

Finally, it must be added that, in some cases, the support that has been given by donors has been largely wasted through lack of strong local commitment and support, and lack of resolute action and control on the resources available at the site. It is to be hoped that the detailed descriptions provided for the individual countries will provide valuable guidance for all countries on what contributes to a site's success, and what detracts from it, and on what should be done and what should not, in managing and developing CLICOM climate data systems.

3.2 Summary of Individual Country Needs

The situations of the individual countries are summarised in the two following tables. Table 3 provides a summary of the observing networks, data availability and data growth. The purpose of computing the sizes of the data sets is to get an estimate of the amount of data to be dealt with by each country and therefore what computer storage capacity required. The numbers are approximate only.

The data size is very much affected by the number of climate elements chosen to be entered for each data type. It is possible that the maximum number of elements reported by each station may not be entered, for instance the occurrence of some of the phenomena types, types of cloud, directions cloud movement, etc may not be worth archiving digitally. Most countries have for the present limited their data-entry to a few selected elements. The number of climate elements recorded will vary between stations. We have chosen to base the computations on the maximum number of elements possible, in order to estimate the maximum sizes for database purposes. No account has been taken of data from automatic weather stations or upper winds observations.

Table 4 provides a summary listing of the main development requirements that the project has identified, under headings of hardware, software, training and other. We have estimated the cost of the listed hardware and software recommendations as about US$55,000.

Table 3: Observing Network and CLICOM Data Base Size

	Types of observation							Size in MB as at 1994				
Country	Daily Clim.	Rain-fall only	3-hrly	6-hrly	Hrly Metar	Upper air sonde	Upper air wind	Data enter-ed	To be entered	Data digi-tised	Annual increases	Total size
PNG	12	150	33	-	12	1	1	0.8	720	?	32.5	720
Solomon Is	8	40	7	-	1	1	1	21.3	74	55?	7.2	100
Vanuatu	7	48	6	-	1	1	1	21.0	172	?	7.2	200
Fiji	52	81*	17	1	2	1	1	4.4	574	224	18.4	580
Kiribati	8	21	1	7	1	1	1	0	300	109	8.0	300
Tuvalu	4	5	3	1	1	1	1	0	152	80	4.4	155
Tonga	8	3	**7	**	1	-	-	0.05	180	116	6.4	180
W. Samoa	6	11	2	-	1	-	-	0.03	83	30	2.6	85
Cook Is.	13	20	8	-	2	-	-	0	288	151	9.7	290
Niue	2	2	1	-	1	-	-	0	48	32	0.8	48

Notes: (*) Fiji has another 180 rainfall stations in the Public Works Department network, which are not included in this table. (**) Tonga synoptic observations are a mixture of 3-hourly and 6 hourly observations.

Table 4: Summary of Specific Recommendations in Country Reports

Country	Hardware	Software	Training	Other Notes
Papua New Guinea	Nil.	Nil.	On-site support and training visits. Training in FORTRAN and DataEase	Support visit of Tan Lee Seng planned. Back-data from Multiplan files, and from Australia.
Solomon Islands	Additional optical drive.	Nil.	On-site support visit. Training on FORTRAN and DataEase	Develop monthly climate summary (like Fiji summary).
Vanuatu	Interface IBM 3363 optical drive to 486PC or obtain new drive (IBM 3511).	DataEase V4.53 and manuals. MS FORTRAN V5	On-site support and training visits. CLICOM and statistics training for 2-3 staff. Training in programming, FORTRAN and DataEase	Review of system and data management procedures. Develop monthly climate summary (like Fiji summary). Back-data from Australia.
Fiji	Additional 486DX PC. Interface IBM 3363 optical drive to 486PC or obtain new drive (IBM 3511).	DataEase V4.53, COSORT 4.4 and manuals. MS FORTRAN V5	On-site support and training visits. Training in programming, FORTRAN and DataEase. CLICOM and statistics training for 1 staff.	Revise and re-program existing monthly climate summary to work from CLICOM. Back data from New Zealand.

Country	Hardware	Software	Training	Other Notes
Kiribati	New 486DX. Optical drive IBM 3511 Laserjet printer. Disk & printer supplies.	MS FORTRAN V5.	On-site support and training visits. CLICOM and statistics training Training in programming, FORTRAN and DataEase.	Develop monthly climate summary (like Fiji summary). Back data from New Zealand.
Tuvalu	New 486DX. Optical drive IBM 3511 Laserjet printer. Disk & printer supplies.	MS FORTRAN V5.	On-site support and training visits. CLICOM and statistics training Training in programming, FORTRAN and DataEase.	Develop monthly climate summary (like Fiji summary). Back data from New Zealand.
Tonga	New 486DX. Optical drive IBM 3511 Laserjet printer. Disk & printer supplies.	MS FORTRAN V5.	On-site support and training visits. CLICOM and statistics training Training in programming, FORTRAN and DataEase.	Develop monthly climate summary (like Fiji summary). Back data from New Zealand.
Western Samoa	New 486DX. Optical drive IBM 3511 Laserjet printer. Needs more suitable physical accommodation. Disk & printer supplies.	DataEase V4.53, CLICOM manual and tutorials, MS FORTRAN V5.	On-site support and training visits. DOS training. CLICOM and statistics training Training in programming, FORTRAN and DataEase.	Develop monthly climate summary (like Fiji summary). Back data from New Zealand.

Country	Hardware	Software	Training	Other Notes
Cook Islands	New 486DX. Optical drive IBM 3511 Laserjet printer. Disk & printer supplies. 1200VA UPS	DataEase V4.53, COSORT 4.4, MS FORTRAN V5.	On-site support and training visits. CLICOM and statistics training Training in programming, FORTRAN and DataEase.	Develop monthly climate summary (like Fiji summary). Back data from New Zealand.
Niue	Not certain, but likely to similar to Kiribati needs.	May need new versions of all software.	Training in DOS, and CLICOM. On-site support and training visits.	Not certain, but likely to be similar to Kiribati needs.

3.3 Potential for Regional Cooperation

There is obvious potential for regional cooperation in developing CLICOM, since the climate data needs and the recommended CLICOM software systems are very similar for all sites. The Heads of Meteorological Services were all agreed that cooperation should be a feature of future development and expressed their willingness to collaborate and contribute cooperatively. There would be significant advantages to donors and recipients in sharing the overheads involved in such things as purchasing, training, and on-going support services.

There are three keys to effective regional cooperation in our view.

- A regional programme must recognise the individual circumstances and needs of the participating countries, and build its components on these needs, rather than applying some standard approach to all countries.

- The programme should be overseen in some way by a committee of those in the Meteorological Services who are involved with CLICOM, either the Director or head of the climate division, in order to ensure that it meets their needs and they feel a sense of ownership and responsibility for the programme.

- The programme must have a full-time, CLICOM-literate officer who is responsible for leading and coordinating the programme, liaising between donors and recipients, and who is available to participating countries to sort out technical difficulties when they arise.

We are convinced that the countries of the region could radically improve their climate service capabilities through closer involvement with each other, mutual assistance, and possibly even a little rivalry! The more experienced Pacific island CLICOM sites could provide invaluable help to the smaller sites, by providing trouble-shooting advice by telephone, on-site support visits, software exchange, and training courses at a CLICOM site within the region. As an example of software exchange, we believe that Fiji's monthly "quick climate summary" should be generalised to operate from CLICOM and then implemented in those other countries which need such a summary.

One option that needed to be considered under this Project was the possibility of a single CLICOM site carrying out the climate data operations for more than just one country. Apparently it has been demonstrated in the Carribean region that CLICOM units can be shared among very small states, with the aim of reducing costs and improving services through focussed expertise and experience. We do not have information of any shared operations and cannot comment on their relative success.

Furthermore, our experience is that the island countries of the Pacific are as independently minded as most countries and want to process their own data. None show any wish to have their data processed by some other country, no matter how close geographically, and especially so now that all have a CLICOM system. There are some significant differences between the Caribbean and the South Pacific, among which are the greater distances between the countries, and the absence of a regional meteorological organisation such as the Caribbean Meteorological Organisation that has for many years undertaken shared services on behalf of members. Ultimately, a shared CLICOM operation would only work in the context of a strong organisational relationship, in which all parties were able to benefit and to influence the results.

The major savings arising from sharing would be on labour, training and external support. The savings on hardware, software and consumables would not be great. There would be extra costs of liaison, communication and travel. The most likely candidates for a shared operation would be the very small countries or territories, for whom maintaining a CLICOM system might be too difficult to sustain.

3.4 Proposal for Regional CLICOM Development Programme

To get CLICOM operating in the region, we recommend as follows:

- *Long-term regional development plan for CLICOM.* Design and implement a well thought out, three-year development programme to establish CLICOM operationally in the region. All parties (Met. Services, Governments, SPREP, and donors) will need recognise that this requires a much bigger and more integrated effort than we have seen in the past.

- *Focus on end-result:* There must be a very strong focus on the desired final result, which is the ability to easily achieve climate data and provide users with useful climate information. The goal is not CLICOM, but the provision of useful climate information.

- *Flexibility and involvement:* The programme should be flexible to allow its efforts to be progressively and closely tailored to the individual needs of countries, as these evolve. This will require that there be considerable freedom on the part of the programme managers to tailor the programme tasks to evolving needs, and a commensurate close involvement of participating organisations in the overall direction of the programme.

- *Capacity building:* The programme should strongly emphasise local capacity building, self-help within the region, and mutual collaboration and support.

- *On-going training and support:* This is a critical need. Periodic visits by a knowledgeable CLICOM support person are needed, preferably the one person for all countries and someone from the region who is specially committed to developing CLICOM in the Pacific islands. This will overcome many of the current problems.

- *Long-term development of local experts.* Provide extra training and experience in computer studies, CLICOM, and climate statistics for a selection of two or three officers, in order to develop a strong local support capability within the region, to assist all South Pacific countries operating CLICOM.

- *CLICOM improvements.* Identify shortcomings in CLICOM, especially those things that do not suit the Pacific islands and seek changes from CLICOM designers or WMO, e.g. to produce normals from monthly summary data. Seek development of useful data analyses, applications and graphics needed for the tropical Pacific, e.g. software to enable each country to produce a monthly climate summary like Fiji's existing PC-based summary.

- *Hardware and software upgrades.* Provide various needed items of hardware and registered copies of the commercial packages associated with the CLICOM system, as per the individual country summaries (Section 2) and the summary list in Table 4.

- *Regional coordination and liaison.* Develop cooperation and agreements about standard CLICOM practices in the region; develop newsletters and exchange of experiences; cooperate on aid projects; help each other on trouble shooting; joint training courses; seek coordination of donors; etc.

A detailed design and costing of the envisaged programme is not part of the present study. However, for general guidance we have provided the following approximate estimate of costs, in US dollars, for 10 countries over a three year programme. The rate of US$4,000 per week used for consultant services and associated living expenses, is relatively low by international standards, but is not unrealistic. It can be noted that most of the total sum of $900,000 would be spent on training and support. The average annual cost per country is only $30,000.

Table 5: Approximate Costs of CLICOM Development Programme

Programme item	Calculation basis	Three-year cost US$
Hardware and supplies	Average of $2,000 per country per annum.	$60,000
Software	Average of $1,000 per country per annum.	$30,000
Initial establishment or support visits by expert	Four-week establishment visits to six countries; two-week initial support visits to four countries. $4,000 per week plus $5000 air fares per circuit.	$133,000
Support visits by expert or regional support officer.	Four one-week support visits per country. $4,000 per week plus $5000 air fares per circuit.	$180,000
Regional support officer	Locally-based salary and expenses, including newsletter costs, etc, $20,000 per annum.	$60,000
Within-region training workshops	Three one-week training and liaison workshops for one person per country, held in Pacific, Australia or New Zealand. US$2000 per person per meeting.	$60,000
Long-term training	Twelve-week CLICOM and statistics training course in UK for 10 people, at $20,000 per person (estimated $2K travel, $8K expenses, and $10K course fees.)	$200,000
Software development (for data import, products tailored to Pacific needs, other problem solving)	Estimate of 10 weeks at $2,000 per week, plus $2,000 travel.	$22,000
Project design, management and appraisal	Estimate of 20 weeks at $2,500 per week, plus $5,000 travel.	$55,000
	Total	$800,000
	Plus 12.5% Contingency	$100,000
	Grand Total	$900,000

4 CONCLUSION

The project has successfully achieved its objectives. It has obtained, documented and summarised an extensive set of information on CLICOM and climate data services in the ten countries studied, and it has detailed what needs to be done to properly establish climate data services in these countries with CLICOM. A valuable side benefit of the project has been the assistance Mr Ereckson achieved en-route, in trouble-shooting work, staff training, and CLICOM re-establishment.

This project may be the first comprehensive regional appraisal of CLICOM anywhere in the world, and we expect it will be of considerable interest to WMO and other CLICOM users outside the region. The difficulties we have documented will serve as warning to any organisations expecting to meet their climate data management needs with the simple purchase of a PC.

The information gathered on each of the ten countries studied will form an essential foundation for the further development of CLICOM in the region. We hope that the ideas and recommendations presented will provide a good starting point for affected organisations to develop an active response to the needs identified, and that a programme along the lines we recommend can be designed and implemented as soon as possible. We believe that the time is right for action, and that a relatively small but well designed multi-year development project would be very cost-effective and will quickly lead to the effective establishment of CLICOM in most of the countries affected.

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Glossary

AIDAB	Australian International Development Assistance Bureau
BoM	Bureau of Meteorology
CLICOM	Climate computing software system
COMCIAM	Commonwealth Climate Impact Assessment and Management Programme
DOS	Disk operating system (also MS-DOS, DOS4, DOS6, etc)
GIS	Geographical information system (software)
HD	Hard disk
LAN	Local area (computer) network
MB	Megabyte
MFAT	Ministry of Foreign Affairs and Trade (New Zealand)
NIWA	National Institute of Water and Atmospheric Research Ltd
NWP	Numerical weather prediction
OS 2	Disk operating system
PC	Personal computer
PMS	Pacific Meteorological Services project
RA II, RA V	Regional Associations II and V of WMO
SOPAC	South Pacific Applied Geoscience Commission
SPREP	South Pacific Regional Environment Programme
UNDP	United Nations Development Programme
UPS	Uninterruptible power supply
VCP	Voluntary Cooperation Programme (of WMO)
WCDP	World Climate and Data Programme
WMO	World Meteorological Organization
WORM	Write once, read many times (type of optical disk)

Annex 1: Summary of Country Missions Conducted by Mr B C Ereckson

Day and Date	Activity and Place
Thurs, 18 Aug	Travel Wellington-Auckland-Port Moresby.
Fri, 19 Aug	Work PNG Met. Service.
Sat, 20 Aug	Work PNG Met. Service.
Sun, 21 Aug	Work PNG Met. Service. Travel PNG-Honiara.
Mon, 22 Aug	Work S. I. Met. Service.
Tues, 23 Aug	Travel Honiara-Port Vila. Work Vanuatu Met. Service.
Wed, 24 Aug	Work Vanuatu Met. Service.
Thurs, 25 Aug	Work Vanuatu Met. Service. Travel Port Vila-Nadi.
Fri, 26 Aug	Work Fiji Met. Service.
Sat, 27 Aug	Travel Nadi-Tarawa.
Sun, 28 Aug	Work Kiribati Met. Service.
Mon, 29 Aug	Work Kiribati Met. Service.
Tues, 30 Aug	Travel Tarawa-Funafuti. Work Tuvalu Met. Service.
Wed, 31 Aug	Work Tuvalu Met. Service.
Thurs, 1 Sept	Work Tuvalu Met. Service.
Fri, 2 Sept	(Flight cancelled.) Work Tuvalu Met. Service.
Sat, 3 Sept	Travel Funafuti-Nadi.
Sun, 4 Sept	Rest day.
Mon, 5 Sept	Work Fiji Met. Service. Re-arrange travel. Travel Nadi-Nuku'alofa.
Tues, 6 Sept	Work Tonga Met. Service.
Wed, 7 Sept	Work Tonga Met. Service.
Thurs, 8 Sept	Work Tonga Met. Service.
Fri, 9 Sept	Travel Nuku'alofa-Apia (cross dateline).
Thurs, 8 Sept	Work W. S. Met. Service.
Fri, 9 Sept	Work W. S. Met. Service.
Sat, 10 Sept	Work W. S. Met. Service.
Sun, 11 Sept	Rest day.
Mon, 12 Sept	Work W. S. Met. Service. Visit SPREP.
Tue, 13 Sept	Work W. S. Met. Service.
Wed, 14 Sept	Work W. S. Met. Service. Visit SPREP.
Thurs, 15 Sept	Work W. S. Met. Service. Re-arrange travel.
Fri, 16 Sept	Travel Apia-Auckland (cross dateline.)
Sun, 18 Sept	Travel Auckland - Rarotonga (cross dateline.)
Sun, 18 Sept	Rest day, Rarotonga.
Mon, 19 Sept	Work Cook Is. Met. Service.
Tue, 20 Sept	Work Cook Is. Met. Service.
Wed, 21 Sept	Work Cook Is. Met. Service., CLICOM support work.
Thurs, 22 Sept	Work Cook Is. Met. Service., CLICOM support work.
Fri, 23 Sept	Work Cook Is. Met. Service., CLICOM support work.
Sat, 25 Sept	Return to Auckland-Wellington (cross dateline.)

Annex 2: CLICOM Recommended Technical Specifications

(8 July 1994)

Quantity	*Items / Specification*
1	**Central processor / File server machine:** IBM compatible computer (486-based processor) with: Minimum 8 MB RAM, Minimum 300 MB hard disk, One 1.44 MB 3.5" diskette drive, One 1.2 MB 5.25" diskette drive, One CD-ROM drive, One 128 MB optical disk drive (with CORELSCSI software, rewritable optical disk drive and compatible with SCSI devices) Super VGA colour monitor, Laser Jet printer (HP Laser Jet Series III - class), Serial and parallel ports, LANtastic Network board, Uninterruptable Power Suply UPS 1250 VA.
2	**Working stations for data entry and quality control, each as follows:** One IBM compatible computer (Minimum 486SX-based processor) with: Minimum 4 MB RAM, Minimum 170 MB hard disk, One 1.44 MB 3.5" diskette drive, One 1.2 MB 5.25" diskette drive, Color VGA monitor, LANtastic Network board.
10	Optical disk cartridges for the above mentioned optical disk drive
2	Toner cartridges for Laser Jet Printer, Series III
50	Diskettes, 3.5", high density (1.44 MB)
50	Diskettes, 5.25", high density (1.2 MB)
1	MS DOS 5.0 - Operating system
1	DataEase 4.53 or DataEase 5.0
1	COSORT 4 .3 or COSORT 4.4 - Sort Utility
1	FORTRAN 5.0 - Fortran Compiler
1	NORTON Editor
1	NORTON Utilities for Disk Management
1	LANtastic 5.0 - Network software (starter + additional kit)

Special notes: (1) Documentation and software in English
(2) Power supply: 220 v, 50 Hz

CLICOM INVENTORY AND REVIEW PROJECT

Draft questions for Directors or senior person interviewed.

Country _____ Officer _____ Date _____

Is there a growing demand for climate information? Who are the users? What do they do with it?

Do you see this area growing faster than forecasting services?

Are you under any pressure from government departments and other users to improve climate services?

Do you have good support on climate services development from the Govt? Are othe Departments supportive? Donors? And the community in general?

Do you think it would be useful if CLICOM could also be used for other types of environmental data (e.g. tides, pollution levels, etc)

What do you think are the main gaps or shortcomings in your climate data services at present?

What plans do you have to deal with these? Do you have any proposals with Govt or donors?

Do you think CLICOM will generally solve the shortcomings? If not, what are the remaining problems?

Is CLICOM doing what you thought it would? Is progress with it generally satisfactory?

What things do you need help with for your CLICOM/climate services right now?

What things do you need help with in the long term?

Hardware

Software

Training

Maintenance

Problem support

Applications progr

Do you think that regional cooperation among PICs on CLICOM would be a good idea? What ways do you think your country might benefit from such cooperation?

Newsletter

Software

Hints and advice

Staff exchanges

Troubleshooting

Networking

Do you think a major cooperative programme to develop CLICOM throughout the Pacific (e.g coordinated by SPREP) would be useful? Would you be interested in participating?

What are your views on the idea of a CLICOM Regional Support Centre? Malaysia and Australia okay? Or would you prefer a support centre in the Pacific islands?

Do you see ways that your agency might be able to help other CLICOM operators, (e.g. with on-site training with your CLICOM staff and facility)?

Would you like support visits from other PIC experienced CLICOM staff?

Do you think it is necessary to have a back-up of all your climate data in a secure archive in a developed country, e.g. New Zealand or Australia?

Annex 4: Table for Summary of Data Available

CLICOM INVENTORY & REVIEW PROJECT

SUMMARY OF DATA AVAILABLE:

COUNTRY: _____ DATE: _____

DATA ALREADY ENTERED IN CLICOM:

	Daily Climat	Daily Rain	Hourly Values	Month Values	Synop	Upper Air	Other	Other	Totals
Stations									
Years of Record									
Observations per day									
Elements Entered in CLICOM									
Elements. Maximum in Obs.									
CLICOM Data Size MB									
Annual Increase. Size MB									

DATA TO BE ENTERED TO CLICOM BY DATA ENTRY:

	Daily Climat	Daily Rain	Hourly Values	Month Values	Synop	Upper Air	Other	Other	Totals
Stations									
Years of Record									
Observations per day									
Elements (recorded)									
Elements (expected entry)									
Elements. Maximum in Obs.									
CLICOM Data Size MB									

DATA ALREADY DIGITISED AND SUITABLE FOR IMPORT TO CLICOM:

	Daily Climat	Daily Rain	Hourly Values	Month Values	Synop	Upper Air	Other	Other	Totals
Stations									
Years of Record									
Observations per Day									
Elements (recorded)									
Elements (expected entry)									
Elements. Maximum in Obs.									
CLICOM Data Size MB									

CLICOM INVENTORY and REVIEW PROJECT

COUNTRY: _____ DATE: _____

1 SYSTEM SUPPLY: How funded (VCP, National Purchase, Other) SUPPLY DATE: _____

2. CLICOM HARDWARE:

		SERVER	READER 1	READER 2
2.1	PROCESSORS: TYPE: RAM: Kb.: HARD DISK: MB: FLOPPY DISK 1: Kb: FLOPPY DISK 2: Kb:			
2.2	SCREEN: TYPE: DISPLAY:			
2.3	DATA ARCHIVE STORAGE DEVICE: TYPE: SIZE: MB:			
2.4	SYSTEM BACKUP DEVICE: TYPE: SIZE: MB			
2.5	PRINTERS: TYPE:			
2.6	PLOTTER: TYPE			
2.7	DIGITIZER: TYPE:			
2.8	OTHER:			
2.9	HARDWARE FAULTS/PROBLEMS EXPERIENCED:			

CLICOM INVENTORY and REVIEW PROJECT

COUNTRY: _____ DATE: _____

3 CLICOM SOFTWARE:

		SERVER	READER-1	READER-2
3.1	OPERATING SYSTEM: TYPE: VERSION: MANUALS AVAILABLE:			
3.2	NETWORK: TYPE: VERSION:			
3.3	CLICOM: VERSION:			
3.4	DATAEASE: VERSION:			
3.5	COSORT: VERSION:			
3.6	EDITOR USED: VERSION:			
3.7	HALO GRAPHICS: (Indicate if on-line)			
3.8	FORTRAN: COMPILER: CLI/FORT. LIBRARIES: CLI/FORT. SOURCE CODE:			
3.9	OTHER LANGUAGES:			
3.10	STATISTICAL PACKAGES: INSTAT:			
3.11	COMMERCIAL PACKAGES:			
3.12	OTHER APPLICATIONS and PRODUCT PROGRAMS:			

CLICOM INVENTORY and REVIEW PROJECT

COUNTRY: _____ DATE: _____

4. CLICOM OPERATIONS:

4.1 STAFF (Indicate if full or part time)
Supervisor/Controller.
Data Entry
User.

4.2 ENVIRONMENT

4.3 SECURITY
(Security procedures in effect.)

4.4 HARDWARE MAINTENANCE/REPAIR
(Support available.)

4.5 SOFTWARE FAULTS/PROBLEMS SUPPORT:
(Support available.) (include all Clicom & associated commercial software.)

4.6 LOG OF OPERATIONS
(Are there records of all operations, maintenance, faults, system changes, etc.?)

4.7 HARDWARE REDUNDANCY:
(any spare (standby) processor, video, printer, etc)

4.8 CONSUMABLE SUPPLIES
(availability, costs, etc)

4.9 ACCESS OF ONLINE DATABASE
(use under network ?), (is access for multiple users required?)

4.10 DOCUMENTATION ON PROCEDURES
(availability)

CLICOM INVENTORY and REVIEW PROJECT

COUNTRY: _____ DATE: _____

4. CLICOM OPERATIONS: (continued)

4.11 SYSTEM BACKUP PROCEDURES
(describe)

4.12 ROUTINE SUMMARIES, LISTINGS, GRAPHS, PRODUCED.
(Describe)

4.13 SUPPLY OF CLICOM DATA, SUMMARIES, LISTS, GRAPHS
(clients)

CLICOM INVENTORY and REVIEW PROJECT

COUNTRY: _____ DATE: _____

4. CLICOM OPERATIONS: (continued)

4.14 CLICOM DATA ARCHIVE MANAGEMENT / PROCEDURES
(Describe for each data type. (Any documentation available?).
(Comment also on CLICOM archive batch control, data to archive, from archive, update)

CLICOM INVENTORY and REVIEW PROJECT

COUNTRY: _____ DATE: _____

5. CLICOM FEATURES/FACILITIES:

Comments upon usage and problems experienced.

5.1 NETWORK:

5.2 DATABASE:
Comments on overall usage, suitability, etc

Use of Reports Facility. Creating Reports in DQL.

Data Management. Data Selection.

Data Import.

Data Export.

Data Dictionary.

Use over Network.

5.3 DATA INVENTORY
(Availability?). (How comprehensive?)

CLICOM INVENTORY and REVIEW PROJECT

COUNTRY: _____ DATE: _____

6. CLICOM PRODUCTS / APPLICATIONS.

Comments upon usage, practicality, suitability for local conditions, benefits, problems, etc

6.1 PRODUCTION OF PERMANENT DATA:

Produce monthly data from daily

Produce 10-day data from daily

Produce daily means/extremes

Produce 10-day means/extremes

Produce monthly means/extremes

Produce monthly normals

Create records of data by observation, in ASCII. (export)

Create records in CLICOM DataEase format. (export)

Create records in CLICOM ASCII format. (export).

6.2 CLICOM DATA REPORTS:

Produce a daily extremes table

Produce a bi-variate frequency distribution

Produce a monthly tabulation of daily data.

CLICOM INVENTORY and REVIEW PROJECT

COUNTRY: _____ DATE: _____

6. CLICOM PRODUCTS / APPLICATIONS: (continued)

Comments upon usage, benefits, problems experienced.

6.3 CLICOM GRAPHICS
General comments

Time series

Map / Area definition

Upper air sounding

Wind rose.

Predefined graph definition

Predefined graphics screen

6.4 DATAEASE PRODUCTS:

Select a sub-set of data for analysis

Produce a report of monthly means / extremes

Other

6.5 CLICOM STATION INFORMATION SYSTEM:

DataEase Reports on Station Information

Other

CLICOM INVENTORY and REVIEW PROJECT

COUNTRY: _____ DATE: _____

5. CLICOM FEATURES/FACILITIES: (continued)

Comments upon usage and problems experienced.

5.4 DATA ENTRY, DATA VALIDATION, FILE UPDATES:

5.5 STATION INFORMATION SYSTEM:
(Comment on usage, completness, benefits, etc.)

Station Geography Records.
(Are station histories entered?)

Station Observation Records.

Station Elements Observed Records.

Station Means / Extremes Records (Long term).

Other

CLICOM INVENTORY and REVIEW PROJECT

COUNTRY: _____ DATE: _____

5. CLICOM FEATURES/FACILITIES: (continued)

Comments upon usage and problems experienced.

5.6 SYSTEM BACKUP: (see also Section 4)
(General comments.)

5.7 GRAPHICS: (see also Section 6.)
(General comments.)

5.8 CLICOM PRODUCTS:

CLICOM INVENTORY and REVIEW PROJECT

COUNTRY: _____ **DATE:** _____

7. CLICOM TRAINING.

7.1 TRAINING COURSES ATTENDED:
(Detail for each officer)

7.2 TUTORIALS and MANUALS
(access to CLICOM and DE tutorials on-line).

7.3 ACCESS TO ALL CLICOM and WCP INFORMATION OUTPUT FROM WMO:

7.4 ON-SITE SUPPORT VISITS/TRAINING FROM CLICOM EXPERTS:

7.5 ADEQUACY OF TRAINING:

7.6 ADDITIONAL TRAINING NEEDED