Highlights

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Highlights

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Pacific Islands GIS&RS news

The Newsletter of the GIS/Remote Sensing Users in the Pacific
Issue 2 /2003
November 2003

More Applications for GIS and Remote Sensing Tools in Pacific Island Countries !

This newsletter shows the range of GIS and Remote Sensing (RS) applications in Pacific Island Countries, where the utilisation of this tool has just started. The Kiribati example demonstrates how fast applications can develop if there is an initial input through training on a technical level. So far the SOPAC EU project has only provided GIS&RS training in four of the eight Pacific ACP countries, Fiji, Vanuatu, Solomon Island and Kiribati. Nevertheless, the developments were on show for everyone who participated in this year's Pacific GIS and RS User's Conference in Suva. Of interest is that the development not only increases the number of traditional users but also reaches new applications. Ideas of the enhancement of the Fiji Pine GIS could be transferred to similar applications. The utilisation of GIS tools for monitoring and managing rubbish collection has not been covered in the Pacific before. The demonstration of a Map Server as part of the SOPAC EU project similarly highlights new directions for GIS in the Pacific, with the use of Internet technologies to distribute spatial data, and the use of open source software to build the server.

It was impossible to include all received articles into this issue of the newsletter. However, the next one will be compiled before starting the Christmas holidays and will include contributions from Vanuatu and Solomon Islands.

The newsletter team has changed again as Conway Pene from USP has joined the editorial group This is a very important change as USP activities in the field of GIS and Remote Sensing should be closely linked with SOPAC activities and the publication of the newsletters a part of it. The team now consists of:

Wolf Forstreuter overall production, **Lala Bukarau** editorial style, **Conway Pene**, **Silika Tuivanuavou** , **Litea Biukoto**, **Elizabeth Lomani** for editing articles and **Elenoa Rokodi** for the newsletter distribution.

The Pacific GIS and RS User's conference, which was guided by Conway Pene this year, will be fully reflected in the next issue of this newsletter for which most of the articles have already been received.

Transferring the Rubbish GIS to the Kiribati Department of Environment

Download your digital version from SOPAC's web site ..!

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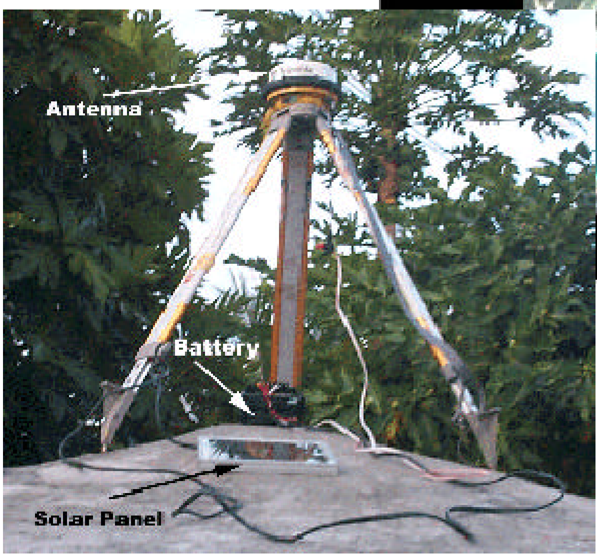
Content

Tuvalu from space

The three IKONOS images were purchased for the SOPAC EU Project. Top to bottom: Nukulaelae, Vaitupu, Nanumanga. The images display a real problem faced in the Pacific when ordering satellite imagery. The reference positions given for each of the islands were defined from World Vector Shore Lines of NIMA. More ocean than land was captured making this a truly expensive exercise. A solution is differential GPS mapping of sand-vegetation demarcation on the coast, sufficient for 1:10,000 mapping required for the Project. A reference position is set using a continuously logging GPS base station. For outer islands without electricity, this is possible with a solar panel connection (bottom left).



Reducing Vulnerabilities Via A Web Map Server

Franck Martin
SOPAC

The goal of the SOPAC EU Project is to address vulnerability reduction in the Pacific ACP States through the development of an integrated planning and management system, Island Systems Management. The Project initially focuses on eight Pacific States: Fiji, Kiribati, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu. The objective is to strengthen integrated development in Pacific ACP States by concentrating on three key focal areas in the island system: hazard mitigation and risk assessment; aggregates for construction; and water resources supply and sanitation. To deal with these three focal areas, the Project will have to address problems such as: unavailability of accurate and timely data; weak human resource base; limited resources (money and infrastructure); and lack of appropriate management plans, policies and regulatory frameworks.

Improved planning and better decision-making can be tackled by making factual and accurate data and information accessible when required. For this system to be fully efficient, it requires all decision makers to have access to the information in an uncomplicated form.

A lot of the data required by decision-makers already exists though not always available when needed. Technology development has allowed users to access data over networks and share with users all over the world. Access to geographical information improves decision-making through the visual presentation of where data belongs and how it interacts with other data in the same location and period. Geographical information often requires specialised software and skilled operators to access it however, development in Internet technology over recent years has made this argument redundant. Web-based map applications have become prominent in recent years with applications seen here in the Pacific.

Web-based GIS are available as commercial packages however, OpenSource has become increasingly competitive in providing similar advantages but without the added software costs. OpenSource is based on the same principles as the Internet, a widely published standard with no royalties or licensing terms. By using OpenSource software, the Project ensures all stakeholders have access to

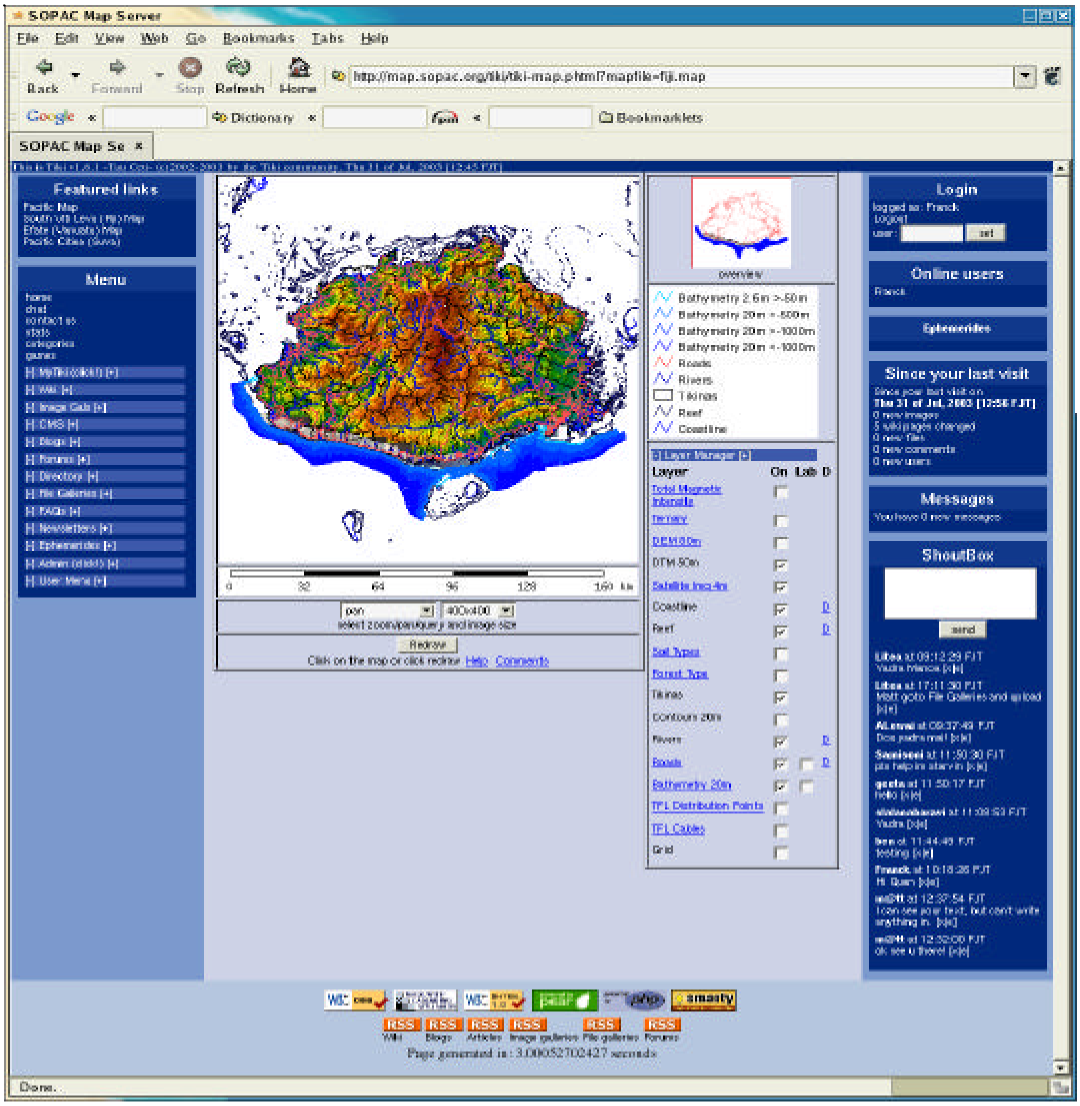


Figure 1 The maps are presented as images via a web server. An interface allows the user to query the maps and display the relevant information.

Reducing Vulnerabilities Via A Web Map Server

the information at the lowest cost. OpenSource software follows Open Standards, like the Internet it gives all access to the data. The code is not locked attracting software developers to upgrade and maintain it in a collaborative environment. Though OpenSource may not be common in developing countries, anybody can gain capacity to maintain and modify such systems.

The University of Minnesota has been developing an OpenSource environment for spatially enabled Internet applications. The MapServer is able to display dynamic maps and supports OpenGIS standards allowing the integration of data from different GIS formats. Also bundled with MapServer is tiki, a web based forum interface to facilitate the collaboration and interaction of all stakeholders. Tiki offers easy to edit pages, file and image galleries and areas to publish and log articles requiring only a web browser.

Access to the Internet has been deemed expensive in the region however, recent advances in technology has seen Internet reaching isolated communities in the Pacific. In the Solomon Islands, the People First Network, or PfNet has established a growing rural communications system based on wireless email networking via HF band. The system has been installed with full community ownership. Using this example other Pacific Island nations are considering the same idea for Internet connectivity.

The beauty of the Internet is that it has been developed when 300bauds was considered broadband. There are still many applications out there especially on the Unix/ Linux platforms that perform efficiently in very poor network conditions. Global access is also now possible via satellite over the Pacific at reasonable costs. Using DVBIP technology, sharing a satellite channel with other Internet stations, it is possible to get 64kb/s speed both ways for about USD200 a month using a less than a meter dish. The connection is not suitable for running businesses but enough for the use of an Internet Community station. If it was not due to licensing and monopolistic practises these systems would be everywhere in the Pacific. However it shows that the Internet can reach all communities and any application based on Internet Technology can reach all stakeholders at affordable costs. It makes sense now to develop applications based on Internet Technology.

Figure 2 Layers for display can be selected and viewed or saved as an image for inclusion into a report of presentation

From data to decision, a web based map server using Internet technology and OpenSource is facilitating data sharing. There is a free flow of information between all stakeholders which implies that datasets are no longer costly to share, they just need to be published on the Internet. Organisations and businesses benefit as they can work on base data, avoid duplication of resources for re-entering this base data and enhance the base data with more interesting layers.

This is how this project wants to tackle its goal of "reducing vulnerability in Pacific ACP states" through the implementation of Island System Management. Internet is an essential pillar of such development bringing a controlled anarchy suitable for the participation of all stakeholders regardless of their gender, skills, or title.

For further information contact Franck@sopac.org

The Rubbish GIS

Alice Leney, Uarai Koneteti
Foundation for the Peoples of the South Pacific, Kiribati

Introduction

Currently in South Tarawa, Kiribati, rubbish is collected with a shovel and tractor with trailer, and usually dumped on the causeways between islands. The ADB funded SAPHE project which covers Solid Waste Management (SWM), is currently constructing the nation's first proper landfill. Now is the time to start a good system to maximise the lifetime of the landfill. The Foundation for the Peoples of the South Pacific (FSP) Kiribati has developed a SWM model that incorporates a recycling system to increase the existing aluminium can recycling, and include cardboard and plastic bottles. Approx. 80% reduction is achievable from current levels due to high organic and recyclables content of the waste stream. GIS and GPS will help to organise and monitor the recycling operation, and will make the system transparent, which would enable it to be transferred to other Pacific Island Countries.

Rubbish in Kiribati

Historically, Kiribati's population did not produce rubbish as such: all waste material was biodegradable. During the last 30 years Kiribati people have begun to consume quantities of goods such as beer, soft drinks and bottled water; as well as many other inorganic materials. In addition, the population of South Tarawa is increasing at the rate of about 3000 people per year, in an area of about 30,000 people. The amount of beverage containers imported into Kiribati has increased 50% in the last three years, and much of this ends up polluting the land and sea. The shallow ground water lens that provides fresh water to many households is very vulnerable to surface pollution; and materials that pollute the reefs depress the corals, adding to the problems of climate change. Figure 1 shows a typical rubbish pile in urban South Tarawa where all rubbish components are mixed together awaiting collection. The rubbish is collected and separated otherwise the resource is not used and pollutes the environment.

Rubbish As Resource

The existing system is overloaded and a classic case of development overwhelming the infrastructure base.

Figure 1: A rubbish collecting point in Tarawa, Kiribati.

Man-made inorganic materials and biodegradable organic material is mixed. Organic materials that are taken to landfill are actually denuding the local soils of nutrient in a land of very poor soil! Some aluminium cans are recovered from bars and shops about 20%. Now, a new system is being introduced which separates organics at source, and captures recyclable materials from the waste stream, sending the remains to the landfill in biodegradable plastic ,Green Bags™. This system uses Recycling Collection Points (see Figure 1), utilising wool sacks enabling a fast collection, and separates the recyclables into aluminium cans, plastic bottles No.s 1&2 and cardboard. Wool backs are placed in special holders from where they can be easily replaced and the wool sack can be closed and transported. There is a separate wool sack for each, aluminium cans, plastic bottles and cardboard. Figure 2 shows the replaceable wool sacks at one collection point, where three rubbish components are separated.

Organic materials are directed to household "Banana Circles" shown in Figure 2, which is a 2m x 1m hemispherical hole where the bottom is covered with cardboard, keeping the moisture in, and pure organic material is placed on top. Bananas or Papayas are planted around the hole profiting from the nutrients of the composting organic material.

Rubbish collection here has usually had a single goal, which is to prevent the plastic, aluminium, etc. from polluting the islands and waters of Tarawa. As such, rubbish collection is usually viewed as a problem that must somehow be dealt with. However, there can be other benefits: Rubbish As Resource is a source of employment and income! Aluminium cans recovered are worth A$1000/t, PET plastic bottles A$300/t and cardboard A$100 per tonne, landed in Australia. The problem is that there are costs in collection and transport to Australia, and this operation has to be

Figure 2: The "banana cycle": surrounding a hole filled with organic waste, bananas are planted which use the nutrients and moisture of the composting organic material and grow well as opposed to bananas planted directly on Tarawa's coral soil.

financially sustainable and efficient if it is to pay. The FSP system proposes to use an economic instrument termed Product Stewardship, a Container Deposit, and this involves each can and bottle paying a 5cent deposit at import, with 4cents paid back when it is turned in for recycling. One cent per bottle and can will go to pay for the operation. This is Phase III of the system, which is currently at Phase 1.

Employment of GPS and GIS

GIS and GPS will help to design the system. As a first step all collection points will be placed as graphical element in a GIS layer, see Figure 3. A tabular database which is linked to the GIS will be regularly updated. The truck driver ticks a box on his list whenever he empties and replaces one of the wool sacks. The GIS provides a synoptic overview of wool sack replacement, and thus recyclables production, per collection point separated by rubbish type. An overlay with population data will allow planning an optimal rubbish collection distribution, where all wool sacks will be filled within the same time, which will minimise the running time of the collection truck and will help avoid the worse case of the truck getting home to the final destination only half filled! The population data will provide information about number of people per area and type of consumer or rubbish producers per area. Data on commercial activities in an area will also be very useful in deciding on Collection Point placement. In regular intervals the collection truck will be equipped with a GPS. This is not to record the rubbish collection point location, but to document the time required at each point and the time required to go from collection point to collection point. Currently there is only one small can crushing press on Tarawa, which crushes aluminium cans before they are placed in a container for transport to Australia. Phase II will involve purchase of a larger press that will crush plastic bottles and cardboard too. Once Phase II shows that the operation works efficiently, Phase III and the deposit system come into force. The GIS and attached relational database will provide planning figures for when shipping containers are likely to be full for shipping to Australia. By comparing the import figures of plastic bottles and aluminium cans with the tonnes crushed and returned the amount of resource recovery can be easily calculated.

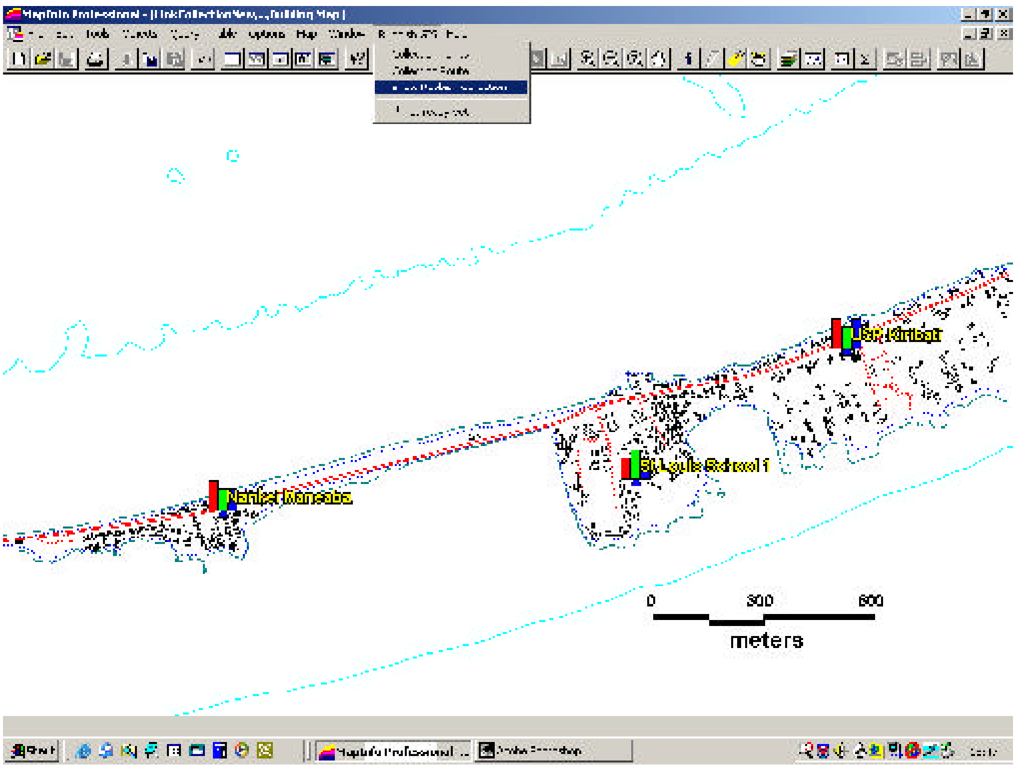


Figure 3: A rubbish collecting point displayed in spatial data environment. At a later stage, thematic maps will be created showing the amount and type of rubbish collected within a given time period. This will optimise rubbish collection saving money which then can be added towards the refund for empty bottles and cans.

Summary and Recommendations

When the collection system is working at Phase III, Kiribati will be the first Pacific Island Country which uses its rubbish as a resource for employment and income, and will avoid pollution of its environment at the same time. The GIS will make the collection system transparent which makes it scalable and transferable to other Pacific island Countries. Indeed, one of the aims of the project is to produce a model for use in other PICs who might wish to look at Rubbish As Resource. Other countries, especially atoll nations with acute waste problems, can access the lessons learned by contacting FSPK Kaoki Mange! SWM Project. Kaoki Mange means: “Send Back the Rubbish!” contact Uarai Koneteti, or Alice Leney on fsp@tskl.net.ki or aliceleney@yahoo.com.au

GIS Units in Kiribati

Tebutonga Ereata
Department of Lands, Kiribati

Introduction

In September, a 3-week training session was carried out by the SOPAC EU Project for the GIS&RS User Group in Kiribati. Since then six new GIS units have been established within the last two months and existing GIS units have been updated. The Department of Lands GIS was established in 1998. Aerial photography over Tarawa provided digital vector and raster data on a geocentric datum. The layers are available from the Department and have formed the important baseline data required by other users.

The SOPAC EU Project will be installing a MapServer in Kiribati before the end of the year. It will host most datasets and allow data to become readily available to users. The responsibility of updating and maintaining the data will be discussed by the Kiribati GIS&RS User Group and it is anticipated that the group will now meet more frequently.

Ministry of Fisheries and Marine Resources Development (MFMRD) GIS

MFMRD is responsible for non-living marine resources such as minerals and aggregates, with particular emphasis placed on the latter. Beach profile positions were the first recorded layer added to the MFMRD GIS. This will help record the beach profiles in regular time intervals and display change too. Further layers to be established are:

- **o** Aggregates (map of gravel and sand for lagoons)
- **o** Bathymetry, contour lines
- **o** High water mark
- **o** Seamounts
- **o** Nearshore Current

Department of Fisheries

The Department of Fisheries is responsible for monitoring the offshore fish resources requiring remote sensing techniques to see ocean colour, which reflects amount of phytoplankton in the water and therefore fish, temperature, etc. Aside from the offshore resource the department will also monitor and manage nearshore resources. The current status of the GIS is tabular survey data linked to GIS villages layer to create in regular time intervals thematic maps about fishing equipment and catch (Figure 1). Other layers to be established are:

- **o** coral cover
- **o** marine parks or protected areas
- **o** pearl farms
- **o** clam farms
- **o** sea cucumber locations
- **o** aquarium fish production
- **o** coral harvesting areas
- **o** areas with fish poisoning

Seaweed Project

The Project is an EU financed initiative. The GIS is currently a part of the Fisheries GIS but will be developed within the Project at a later stage. Available are tabular survey data on environmental indicators which can be linked to the village layer to create thematic maps.

Areas of interest to the Project are:

- **o** Seaweed production (amount and location of seaweed sold)
- **o** Land tenureship (seaweed needs to be dried on land and there have been conflicts with land owners)
- **o** Seaweed growth and health (survey data)

Department of Environment

The GIS unit of the environment has three different components:

- **o** Display of spatial component of environmental indicators. The environmental indicators and their

GIS Units in Kiribati

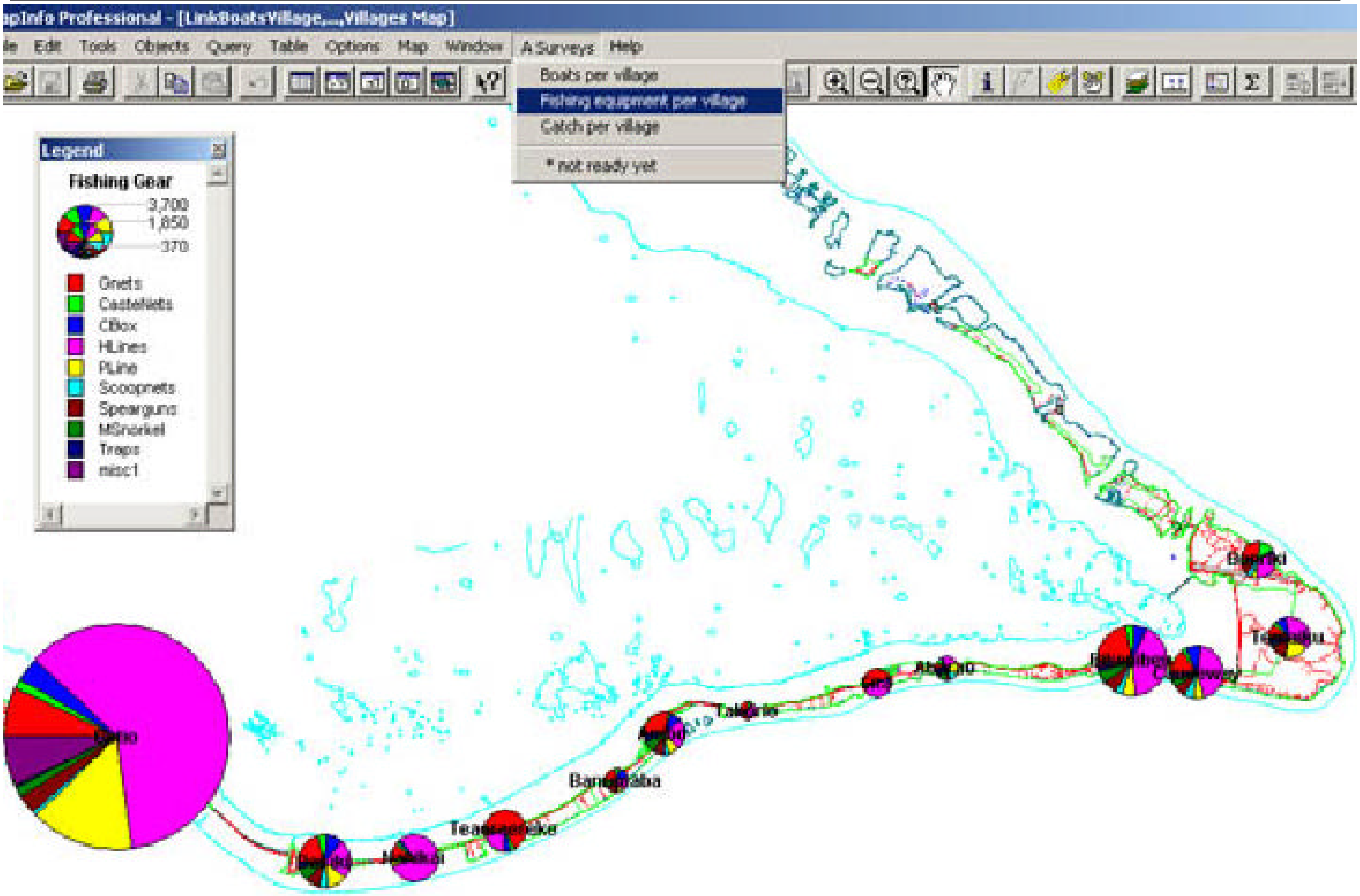


Figure 1 Customised GIS for Department of Fisheries displaying thematic map of fishing gear per village.

change over time are important to visualise climate change. One important factor will be water quality.

- **o** The department has to carry out Environmental Impact Assessment (EIA) for all projects, which touch environmental parameters such as construction, fish farming, etc. The GIS provides a synoptic overview for ongoing projects.
- **o** The rubbish GIS, which has the purpose to optimise the rubbish collection.

A fourth component, up-to-date water quality information in spatial environment is missing.

The Rubbish GIS

The Foundation for Peoples of the South Pacific Kiribati has developed a solid waste management model that incorporates a recycling system to increase the existing aluminium can recycling, and include cardboard and plastic bottles. GPS and GIS will help organise and monitor the recycling operation, and will make the system transparent, which would enable it to be transferred to other Pacific Island Countries.

Department of Agriculture

The Department of Agriculture wants to establish a GIS to map the vegetation of the islands in Kiribati. There are five main reasons:

- **o** Coconut cover. Coconut productivity of palms tends to decrease over a certain age. Areas that need replanting have to be identified by estimating the age of coconut palms (Figure 2). This is not an easy task.
- **o** Increased demands on the ground water by new water supply systems will lower water level thus affecting the vegetation cover because a) the roots have to grow deeper to reach the ground water and b) salt water will penetrate into some water lenses.
- **o** Taro is still a main crop resource especially in outer islands. Comparing yield and population provides a gauge of community self sufficiency. The farming practises required to grow taro also provides an ideal environment for mosquitoes to breed. It is anticipated that it is only time before dengue becomes a health problem in Kiribati.

GIS Units in Kiribati

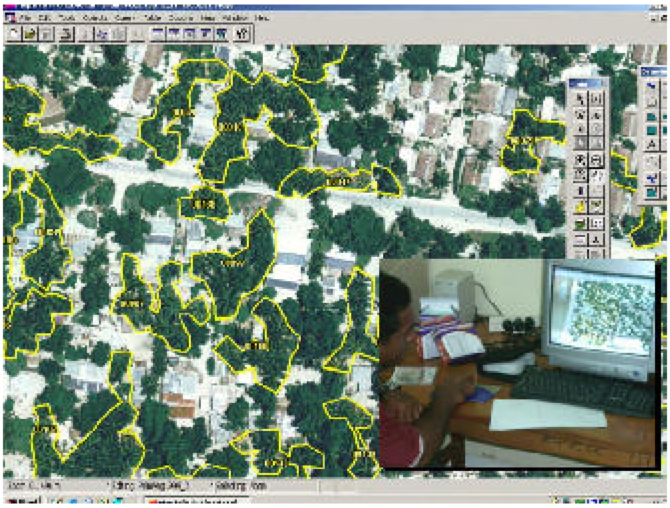


Figure 2 Onscreen digitising of coconut cover using historical aerial photography.

The Public Utility Board (PUB), Electricity and Water

The electricity and water utility of PUB have separate GIS units established before the SOPAC EU Project. All asset items such as poles, transformers, pipes, nodes, etc. are stored. The utilities will work together in developing common tables such as Households.

Telecom Services Kiribati Limited (TSKL)

The purpose of the TSKL GIS is similar to the PUB GIS units: asset management and customers support. The Accounting division has a separate database not linked to the current GIS. The information about asset items and customers was transferred to a SQL 2000 database and the GIS will be linked step by step to the SQL 2000 tables which are based on a different server. TSKL management want to visualise answers to questions such as:

o Which handsets are connected to a joint, or pillar? (Figure 3)

o Where is a house phone number connected to?

o Where we have difficult connections today?

To answer these questions queries are created in Access searching SQL 2000 tables with the results displayed in MapInfo.

Recommended Common Layers and Tables

Through consultations with the various departments and agencies, there are some tables required by several GIS units such as:

o Village Names

o Island Names

o Households

o Persons

o Boats

o Wells

Other layers that will be provided through the SOPAC EU Project will be made available on the Kiribati MapServer:

o Buildings

o High Water Mark

o Roads

o Bathymetry

o Image Data Aerial Photography

o Image Data IKONOS

Collaboration between the agencies would reduce duplication and ensure that all have the same base data from which to work. Base data already in existence has been freely distributed between the GIS units. These layers are not static and need to be updated regularly. This responsibility needs to be given to an individual or agency.

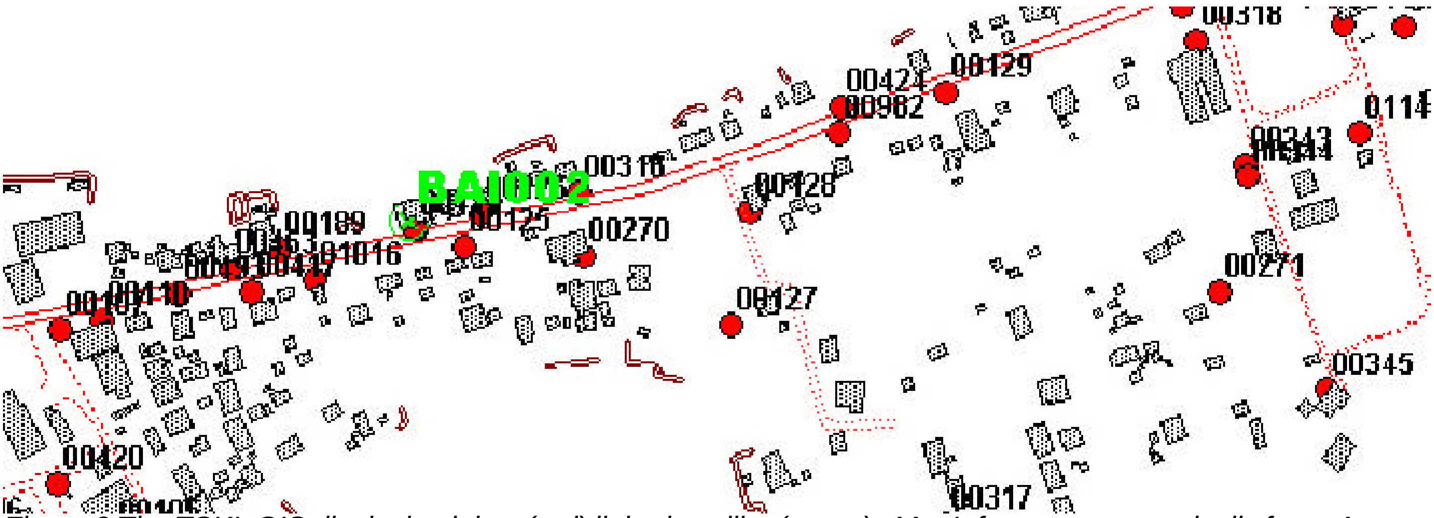


Figure 3 The TSKL GIS displaying joints (red) linked to pillar (green). MapInfo starts automatically from Access following ‘Make a Table query’.

3D Urban Spatial Data

Conway Pene
University of the South Pacific

Introduction

Spatial data of urban areas has traditionally been collected and managed in 2 dimensional systems, reflecting the tradition of cartography and mapping that underlay modern, computer based GIS. In recent years, the power of computers and in particular the advances in 3 dimensional visualisation systems has seen tremendous progression, largely as a result of the computer gaming industry. GIS are slowly picking up on this trend, and now offer increasingly sophisticated 3D visualisation capabilities. This article presents the results of a study to produce such 3D visualisations of the Suva urban area, using off-the-shelf GIS, and existing spatial data available from various spatial data custodians.

The study reveals that while such visualisation products are possible, underlying issues with data structure and acquisition remain a stumbling block to the full utilisation of this information.

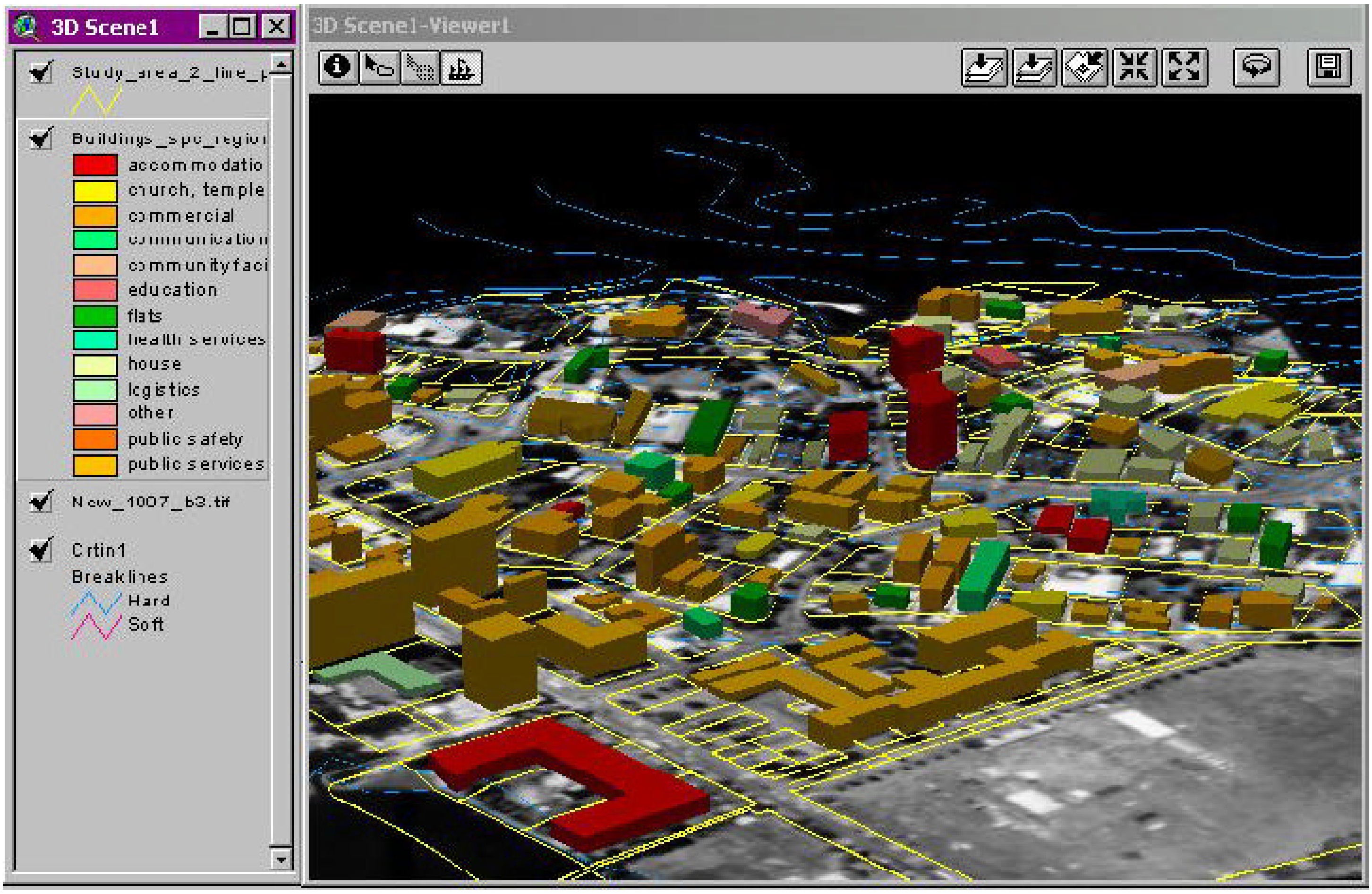
Data sources and software used

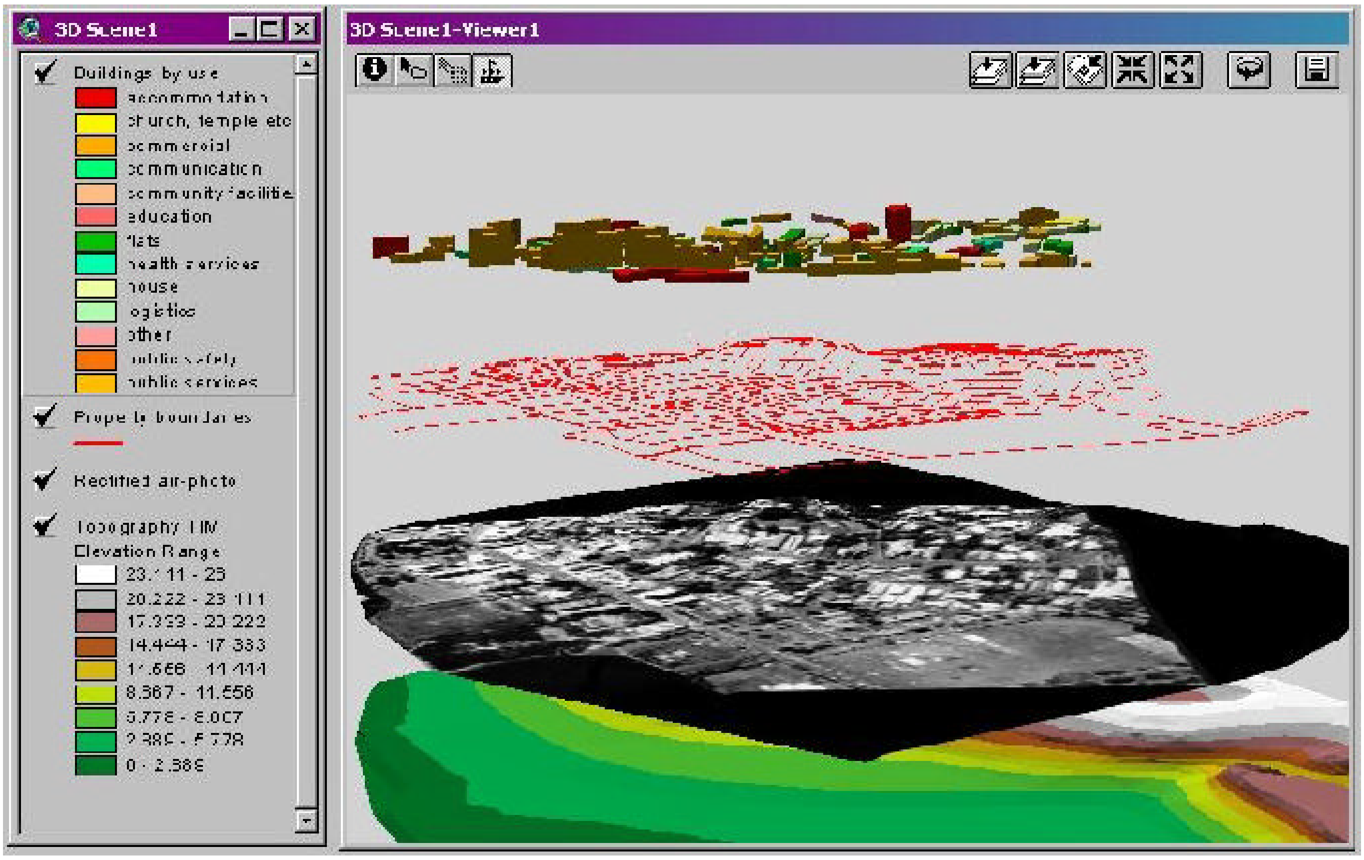
A variety of data was acquired from various agencies holding spatial data in the Suva area. Primary among these were the Fiji Land Information System (FLIS) Support Centre (cadastral boundaries and property identification data), Suva City Council (land use zones) and SOPAC (building attributes). Also included in the data for this project were a series of geo-reference aerial photographs for parts of Suva, and a digital elevation model DEM from the FLIS topographic data.

This data was acquired primarily in MapInfo format, and converted to ESRI shapefiles, for use in ArcView. ArcView was chosen for this project because of its ability to easily produce 3D models with the 3D Analyst extension.

Methodology

The first step in this project was to collect the existing available digital data in a central environment and common software format and projection. The cadastral boundaries and the aerial photographs were then used as a basis for digitising building outlines. These were digitised as polygons and then linked to the SOPAC building survey data. The SOPAC building survey data stored each building as a point, with its associated attributes. In over 95% of cases, the building point feature lay within the digitised polygon





of the building outline. A spatial query was then used to transfer the attributes from the point to the polygon.

The 3D aspect of the data was generated using ArcView 3D Analyst. Each building was given a height value based on the number of floors of the building. The shape of the landscape was generated from the DEM contours. The cadastral and land use base layers were then draped over this, followed by the building layer. The individual buildings were projected vertically according to their height value. 3D Analyst navigation and query tools were then used to move through the area and query individual objects such as buildings and land parcels.

Results and conclusions

Two sample areas were produced for 3D visualisation. The first was a residential area in Vatuwaqa, and the second was a built up area on the edge of the central business district of downtown Suva. Screen captures from various orthographic perspectives were made to show the range of views that could be generated, and a 3D fly-through movie file was also recorded.

As the pictures show, these simple tools provide a powerful method of urban data visualisation. Off the shelf GIS packages such as ArcView provide the capability for generating such visualisations. However, the underlying data must be correctly structured, with useable attributes, before such visualisation can be produced.

Report for the 2nd Pacific Ocean Remote Sensing Capacity Building Workshop on Remote Sensing for Management of Coral Reefs and Sustainable Fisheries

Akosita Lewai
Department of Forestry

Remote sensing is a tool each country should adopt, a tool to further enhance the managing of marine resources. It can be inshore, offshore or even forest cover. It enhances the role that the Ministry foresees as being committment to sustainable development of fisheries and forest resources and industries.

The Workshop addresses its objectives using a combination of lectures, discussion sessions and hands-on computer based training.

The workshop was put together with guest lectures from various research institutes and universities. Also in attendance were 10 Pacific Island delegates from seven Pacific Island countries, namely: Cook Islands, Fiji, Kiribati, Marshall Islands, Papua New Guinea, Samoa and Tonga. Each country representative provided an update from his or her Fisheries and Marine Resources Department. The presentations gave the lecturers some insight on the development of GIS and Remote Sensing within each Pacific Island, which is lagging not too far behind but moving in the right direction.

The workshop covered various aspects in Pacific Ocean remote sensing from sea colour changes to fisheries management. To clarify these particular topics the presenters gave adequate examples on their management. For example, Chris Roelfsema gave examples from a research they are conducting on the Great Barrier Reef. Most of the coral reef ecosystems are similar to that of the Pacific Island countries, and these could provide an exchange in research techniques or for advice on how to initiate future projects.

GIS Development and Enhancement in Fiji's Pine Industry

Naca Yalimaitoga, Satya Nand, Isireli Buwawa
Fiji Pine Limited

Introduction

The pine industry in Fiji started in the early 1970s with the setup of the Fiji Pine Scheme as a Pine arm of the Forestry Dept. Its main role was to rehabilitate an area, which had been subjected to regular fires and overgrazing. The area chosen was the Ba closed area, now part of the Lololo forest. Seeing the success of this venture Government envisaged that large-scale pine plantations could be established utilising the large areas of idle talasiga land in western Viti Levu.

In 1976 the Fiji Pine Commission (FPC) was established with a partnership between government and landowners where the former was to provide funds and expertise and the latter providing land base. It was promised that the industry would be transferred to landowners to own and manage once the viability of the industry was realised. FPC therefore expanded its pine plantations into Nabou, Ra, Bua in Vanua Levu and Nadi.

In 1987 large scale harvesting commenced with the setup of the Sawmill/Chipmill complex in Drasa today known as Tropic Woods. This is presently wholly owned by FPL.

In 1990 Fiji Pine Limited was setup to take over the assets and liabilities of the Fiji Pine Commission as well as the management of the privately owned pine schemes or extension plantations, which were previously looked after by Forestry Department.

In 1999 as per Government's vision Fiji Pine Limited transferred its landowner development and pine extension advisory functions to Fiji Pine Trust who are the trustees for the landowner shares.

Presently Fiji Pine Limited has a total of 46,000 hectares of pine plantations spread over 6 forest locations in Lololo, Ra, Nabou and Nadi on Viti Levu and in Bua and Macuata in Vanua Levu. It leases a total of 71,000 hectares from 396 landowning units, which consists of 119 villages. A further 12000Ha is leased from the State. It pays out around $419,000 in land rental and around $200,000 in harvesting premium when the trees are harvested around 18-20 years after planting.

Presently our method of planning and monitoring is based on the conventional method of mapping, area calculation and field verification. The area database currently in use is DOS based.

Some of the problems encountered with the current system included:

- The maps produced were often cluttered with information that were not necessary for particular projects or operations.
- Updating of maps often took a long time.
- Only selected Draughting staff were able to use the system.

Early GIS Development

GIS at Fiji Pine Limited started in 1998, with Jaako Poyry Consultants in from New Zealand submitting a brief proposal to assist FPL with the development of its GIS. The proposal was divided in 3 Phases. Only Phase 1 i.e. the inception phase was completed. FPL spent a total of $65,000 on consultancy fees and purchase of software & hardware equipment.

By the year 2002 we had completed the data capture of most of our forests. We had then started producing outputs that started showing the capability of GIS as a management tool. We had also during this time enquired within the GIS community in Fiji such as SOPAC for a possible assistance in setting up our GIS in a more structured manner as well as providing training to staff that will be operating GIS.

GIS Development in 2003

In February 2003 FPL registered its interest to participate in the SOPAC-EU sponsored Sigatoka Water Catchment project. This was primarily for the reason that part of our forest lies within the vicinity of the project locale and we can use some scientific feedback on silvicultural and management treatments and how it relates to water quality and water run off. In April 2003 Fiji Pine was accepted as a Stakeholder in the SOPAC EU Project.

Dr Wolf and Litea from SOPAC came to Fiji Pine on May 28 & 29, 2003 to look at our system and also the Forest Management System to link all information and the main requirements following their visit were:

1 Structure a link between the spatial data to the existing tabular database in dBase through Microsoft Access. This Access tables will act as a buffer between MapInfo and the existing Area system (dBase).

2 Structure a link of the forest management system that monitors the logging operations to their spatial data (GIS based information system).

3 Integration of GPS operations into the GIS based information system.

During the discussions with Fiji Pine management it was agreed that the coupe be introduced as the smallest management unit, which has to be divided into classes; previously, the stand was the smallest management unit and for practical reasons, these stands were further subdivided into coupes during harvesting as some of these stands were far too large. The forests will then be structured into following area levels:

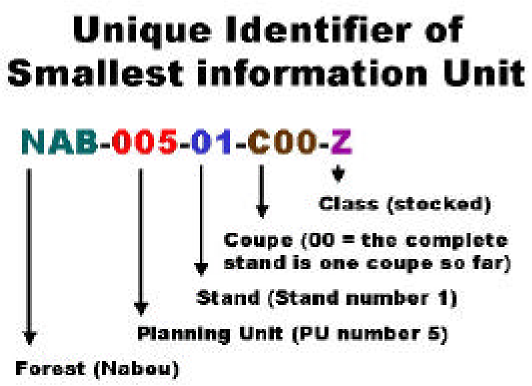


Figure 1: Unique identifier of smallest information unit

The different forest, planning unit, stand, and class numbers are separated by a dash to allow a fast recognition. The change from stand to forest class within a coupe as smallest planning unit also requires an update of the MIS.

Fiji Pine Limited's Area Database

FPL's Area Database was developed by Dr Wolf after the area and coupe identifier mentioned above were agreed upon. The Area Master is an Access based programme that allows queries to be undertaken as well as providing a link to MapInfo; a pictorial representation of the Areamaster Data in the new Access based areamaster was exported from the old DOS-based Area system. The area is based on data that were captured in GIS as this is a more advanced method of area calculation and mapping than our current system of area calculation using planimeters and manual map preparation. This areamaster is also being updated quarterly. Each update is entered into the areamaster database, which summarises information in a tabular format, examples of which are depicted below:

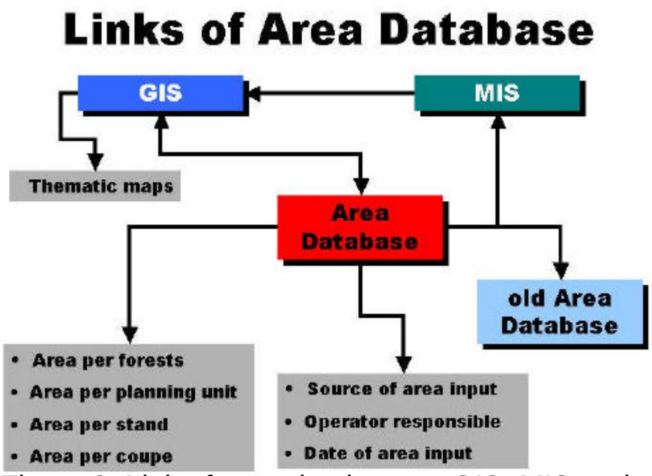


Figure 2: Link of area database to GIS, MIS and old area database.

A link has been created between MapInfo and the Areamaster database so that newly updated area changes in MapInfo are automatically imported into the areamaster database and in turn updates the areamaster table in the access database. To facilitate a user-friendly approach, customised control buttons are created to simplify user functions to a few easy choices. This however, conceals a network of small executable programs that functions at the click of a button behind the scene.

Changes in area are entered into the areamaster database as well as in the old area system. The coupe input form is specially created for new coupe inputs,

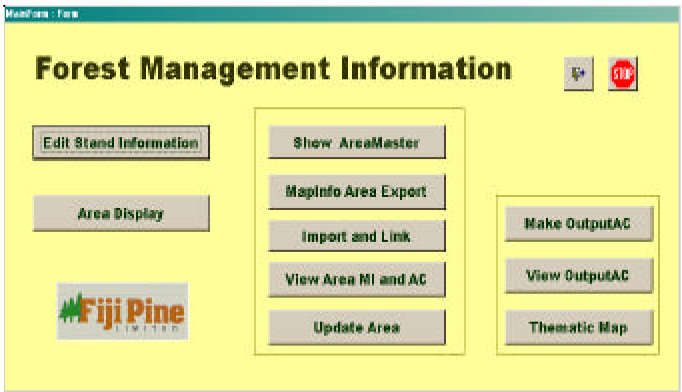
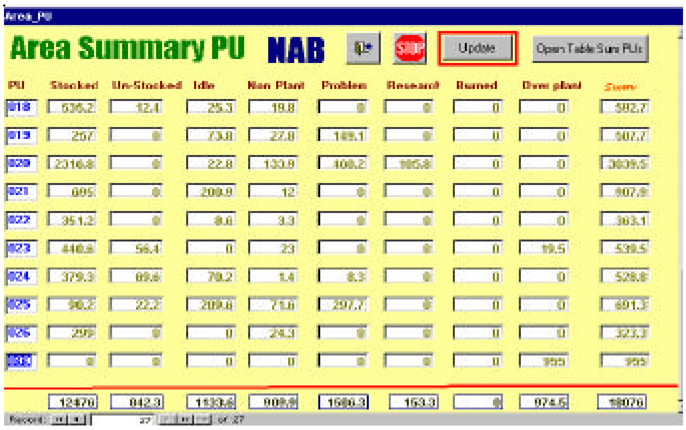


Figure 3: The main menu of the forest management allows update of the Access database with the latest area calculation conducted within MapInfo, an area display summarised by stand or planning unit and the display of thematic maps within MapInfo environment

which simultaneously updates the main table. By clicking on MapInfo Area Export, the spatial representation of updated records in the areamaster database can be automatically opened in MapInfo. The settings in MapInfo are customised so that non-GIS users can easily open the digital data of pine forest. Map displayed here can be altered to show a range of information including: Stand ID, Size of area, Planting year of crop, Crop Species, Roads and Tracks, Hydrology, Contour, Tikina and Mataqali Boundaries.

Global Positioning System

A rover set GeoExplorer II was acquired in 1997 but there were problems in the Trimble software and data couldn't be downloaded. With help from SOPAC, the problem was rectified and GPS data is now being sought extensively by station staff. Our GPS surveys are also being utilised by other interested companies like Pine Landowners Company Limited. Some projects that we've used GPS for are: Marking out roads in newly acquired areas; Distance calculation



PU	Stocked	Un-Stocked	Idle	Non Plant	Problem	Research	Burned	Own plant	Sum
018	536.2	12.4	25.3	19.8	0	0	0	0	592.7
019	257	0	73.8	27.8	149.1	0	0	0	507.7
020	2316.8	0	22.8	133.9	400.2	165.8	0	0	3039.5
021	695	0	200.9	12	0	0	0	0	907.9
022	351.2	0	8.6	3.3	0	0	0	0	363.1
023	440.6	56.4	0	23	0	0	0	19.5	539.5
024	379.3	69.6	70.2	1.4	8.3	0	0	0	528.8
025	90.2	22.2	209.6	71.6	297.7	0	0	0	691.3
026	299	0	0	24.3	0	0	0	0	323.3
030	0	0	0	0	0	0	0	955	955
	12470	842.3	1133.6	909.9	1586.3	163.3	0	974.5	18076

Figure 4: *Area display by stand of a selected planning unit in Access environment .*

of old roads; Boundary survey; and Survey of features in leased areas e.g. caves, historical and sacred sites, old village sites.

Aerial Photo Rectification

Photos at a scale of 1:16,000 are used to identify features of newly acquired areas. Identifiable features on photos (streams, forested areas, talasiga lands, roads, tracks, trigs, villages and settlements) are marked before field inspection is carried out. These features are examined during field visit so as to account for the time difference between the time the photo was taken to when the land was actually acquired.

Previously, after field visits, data from aerial photos were transferred using a direct enlargement method which didn't allow for the necessary corrections to be made (use of plan veriograph). This is a time consuming and tedious method as a person has to organise between reference points common to the map and the aerial photo so that errors are minimised.

In July 2003, through the assistance of SOPAC, FPL

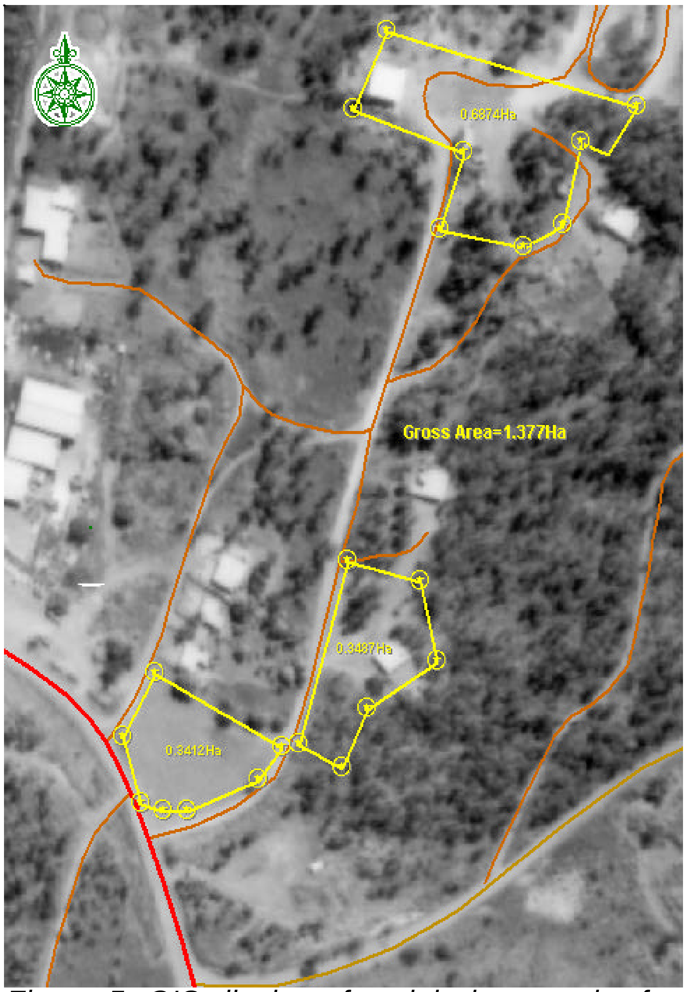


Figure 5: GIS display of aerial photograph after rubbersheet rectification and import to MapInfo.

staff attended a 3-day training course on photo rectification at SOPAC. This training focused on a programme that creates resampled photo images by placing nodal points on distorted features and aligning them with its corresponding linear attribute on another viewer. The points are then resampled according to the affixed points and the resultant image is a rectified photo of the area acquired (Figure 5).

Since the SOPAC training, we have carried out a lot of rectifications, especially to new areas that FPL is interested in acquiring to expand its plantations.

Some Early Benefits

The company's GIS has really made significant progress only since early 2003 but it is already reaping some early benefits including:

- A savings of around $175,000 to the end of September with a more accurate determination of the distance between the Tropik mill in Drasa and the areas logged as the log cartage rate is dependent on distance.
- A more accurate determination of the economic distance that FPL can expand its plantation to.
- A better definition and delineation of the total areas that could be planted out of the total areas to be acquired allowing for a more effective lease payment particularly after land rental was increased by almost 100% from January 2003.
- Capturing and storage of damages to plantation from fires to assist in better decision making, including any fires that may occur in the same area, in the future. The rectified photo of a newly acquired area (Nadrugu, Central Viti Levu). Plantable area markings can also be seen.

Further Developments

Currently, we are documenting step-by-step procedures in the use of GIS applications The areas that we will be developing further will include:

- Creating thematic maps, by linking the spatial data to the existing tabular database in dBase through Microsoft Access and also to the existing tabular data.
- Creating customised menus in Map Basic that will allow our FPL management to operate, access GIS data and display tabular data in a spatial environment.
- Developing new methods to improve on management activities through increased adoption of remote sensing, GPS and GIS tools.
- Image to image rectification utilising satellite images.
- Use of colour aerial photos.

Acknowledgements

Fiji Pine Limited wishes to extend its appreciation to Mr Baskar Rao the National representative of Fiji Islands to SOPAC in this EU Project for agreeing to include Fiji Pine as a stakeholder in this Project.

Our special thanks also goes to SOPAC and its staff, in particular Dr Wolf, Litea & Elizabeth for their time and dedication for helping Fiji Pine Limited in this initial stages of setting up our GIS.

We have no doubt that this commitment and assistance will continue so that this national important resource will continue to be effectively managed as it has far reaching implications to the economy and the environment.

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Biophysical Remote Sensing by the University of Queensland, Australia

Chris Roelfsema, Karen Joyce, Dr. Stuart Phinn

During the 2nd South Pacific Remote Sensing Workshop in Brisbane we (Dr. Stuart Phinn, Karen Joyce and Chris Roelfsema) learned from the delegates that they would like to hear more from the remote sensing activities in Australia. With Wolf Forstreuter (SOPAC) we discussed that the newsletter will be an ideal tool to inform you about our research or important developments. The workshop was hosted by the Biophysical Remote Sensing Group, which is part of the school of Geography, Planning and Architecture at the University of Queensland (UQ).

1. The Biophysical Remote Sensing Group

The Biophysical Remote Sensing Group (BRG) is a small research group run by Dr. Stuart Phinn that consists mainly of honours, masters and PhD students (10 in total). One of the students, Karen Joyce, is doing her PhD on Coral Reef Remote Sensing. Chris Roelfsema is Marine Remote Sensing officer at BRG, and works directly with the Marine Botany Group at the Centre for Marine Studies, UQ.

The mission statement of BRG is to provide the necessary academic and professional environment for the highest standard of: teaching, research, collaborative and consulting resources capable of delivering effective remotely sensed solutions to environmental monitoring, modeling and management problems.

Several types of remotely sensed imagery are being analysed by BRG for the different research projects. Examples are: aerial photography, digital aerial photography using ADAR camera, Landsat TM/ETM, Radar, hyperspectral airborne sensor imagery such as CASI, hyperspectral satellite sensor imagery such as Hyperion, MODIS and SeaWiFs imagery. For the image analyses and presentation several software packages are used such as ArcView, ARCGIS, ERDAS Imagine, ENVI. Since BRG is part of UQ, the team has direct access to a range of infrastructure such as cars, boats, diving facilities, research stations.

The links that BRG has with the Marine Botany group assists to integrate the application of Remote Sensing in research conducted by these groups. This research is focused on ecosystem health issues along the coastal zone. Some examples of these research projects are mapping mangrove dieback, algal blooms and water quality monitoring.

BRG is working closely together with the Environmental Remote Sensing Group at CSIRO Land & Water in Canberra. This group is specialised in studying water quality using remote sensing and has a range of high tech equipment for this type of research.

2. Research projects

The current marine related research topics are focused on: Coral Reefs, Wetlands/Coastal zone, Habitat Mapping and Remote Sensing Theory. Our research extents geographically from the Coastal regions such as Moreton Bay, Mackay and Port Curtis, to rainforest (Daintree and Cairns), to coral reefs in the most southern part the Great Barrier Reef.

The results of the research are directly used in workshops and undergraduate and postgraduate courses that we are teaching. The course topics are focused around: mainly Remote Sensing, GIS, Marine Botany and Coral Reefs.

Some of the projects will be discussed in this paragraph and in later issues of the GIS&RS newsletter we will address these projects in more detail.

Coral Reef Habitat mapping

Over the past few years Karen , Stuart and Chris have been involved in various projects aimed to produce either geomorphic or substrate maps of coral reefs using remotely sensed data. This work has been focussed primarily on Heron Reef and the surrounding Capricorn-Bunker Group in the southern Great Barrier Reef. They have been fortunate enough to obtain a wide range of image data in the area including high resolution multispectral digital imagery, IKONOS, Landsat TM/ETM+ and CASI hyperspectral data. Over the period of image acquisition, the team has also been involved in extensive field survey for image calibration and validation, with the intention of using Reef Check substrate classes in an image classification scheme for these data types.

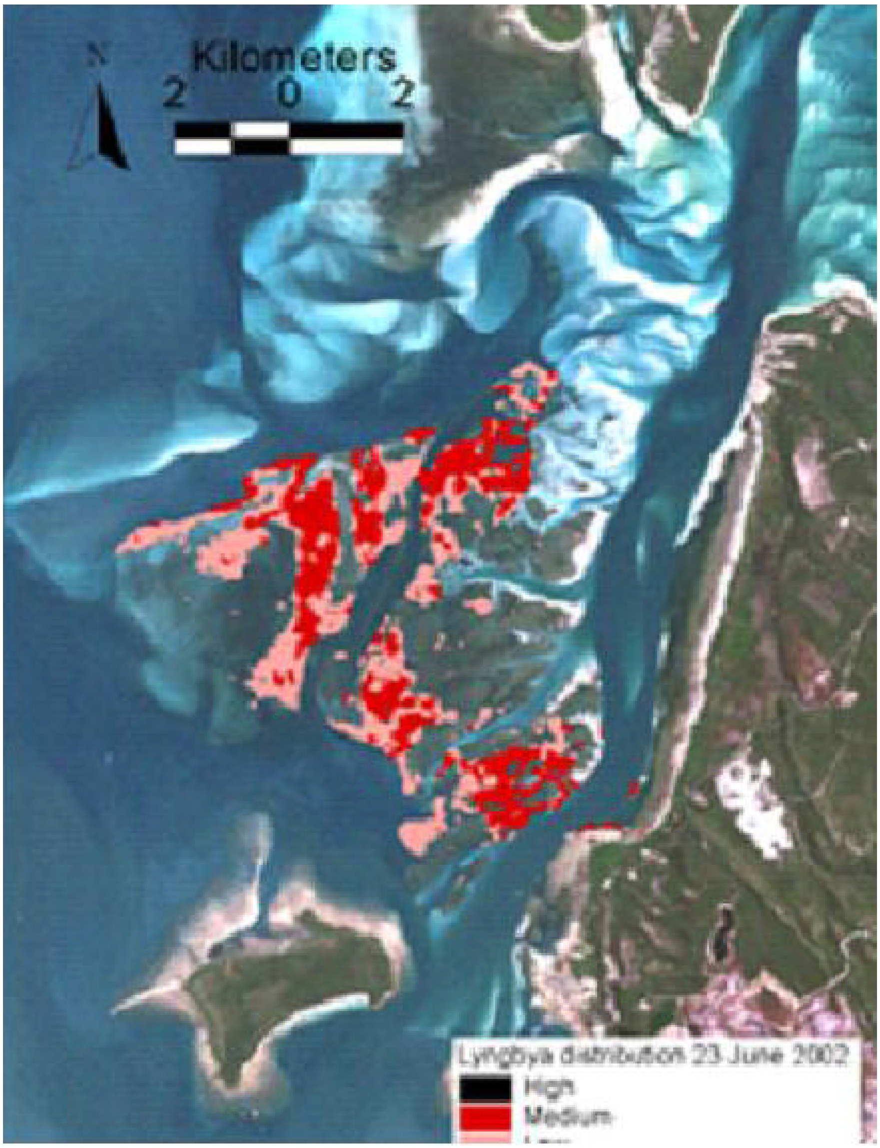

Figure 1 Landsat 7 ETM classification of the Eastern Banks are in the Moreton Bay presenting the Lyngbya majuscula cover.

Toxic algal (*Lyngbya majuscula)* bloom monitoring

In the Moreton Bay region toxic algal blooms occur of *Lyngbya majuscula*. The Lyngbya is attached on the seagrass and can cover a large extent of these seagrass beds. These blooms are impacting the environment. Therefore, understanding and management of the bloom is needed. Part of the management requires monitoring the spatial and temporal dynamics of the bloom. BRG developed a combined field and remote sensing monitoring program. As part of the program, Marine Park rangers collect field data pertaining to Lyngbya coverage coinciding with Landsat ETM over flights. When there is a bloom, a cloud free satellite imagery will be acquired. This image and the field data is then used to map the algal bloom in the clearer waters of the Moreton Bay. The result of the field work and/or image classification is then posted on the Internet to inform the community of the location of the *Lyngbya majuscula*.

Water quality in estuarine systems such as the Moreton Bay

As we all know water quality is influencing marine ecosystems. As part of monitoring the ecological health in Moreton Bay, monthly water quality parameters are sampled. The parameters looked at are chlorophyll, turbidity and Secchi depth (which is a measure for how deep you can look in the water and indicates water clarity). BRG, CSIRO and Marine Botany are developing methods to analyse imagery for water quality, calibrated and validated by water quality samples acquired in the field. CSIRO measured optical water quality characteristics and is using them to design a model which simulates the water column in the Moreton Bay. This model can be applied to imagery

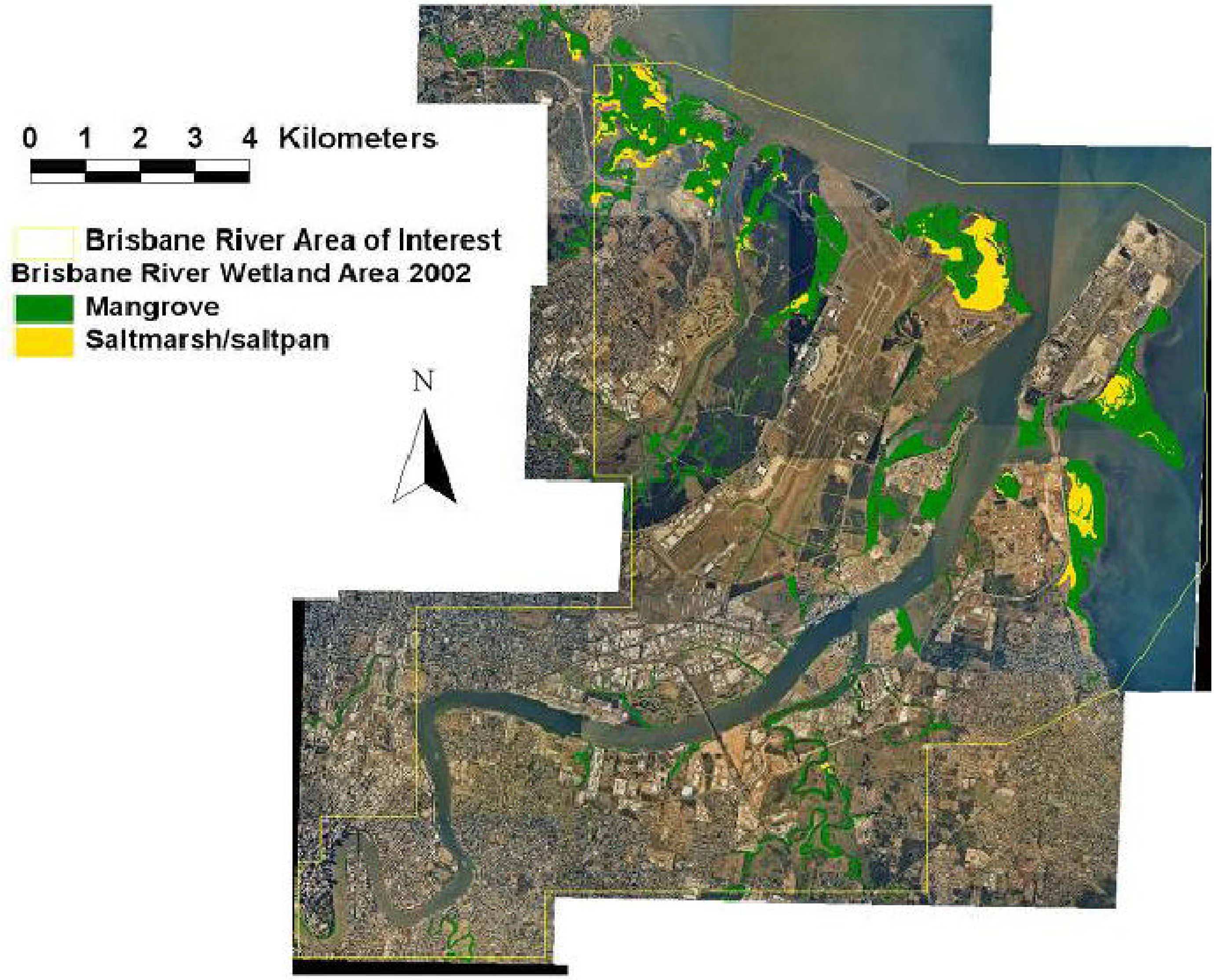

Figure 2 Classification of mangrove areas using aerial photographs as part of Historical Coastlines project of the Coastal CRC.

and will result in maps of chlorophyll and organic matter. These maps will give managers a better view of the water quality in the bay.

Historical changes in mangrove cover

Changes in mangrove habitats along the Queensland coastline and the causes of these changes are studied by Dr. Norm Duke, the mangrove scientist at Marine Botany. Part of that study is to determine the extent of mangrove habitats by digitising aerial photographs. For this, a series of aerial photographs of the mangroves areas in the region of interest are collected. The photographs are scanned and then mosaiced when necessary, using ADOBE Photoshop. The mosaic is then georeferenced to a Landsat image of the same area. The mangrove areas in the georeferenced digital mosaic are then digitised using a GIS program Surface area is calculated for the different areas of mangrove and where multi-date images are available, change detection will be conducted. The knowledge gained, helps to understand where and why mangrove dieback has occurred along the Queensland coastline.

Monitoring marine habitats using volunteer divers

Marine habitats have been studied also by Unidive (Queensland University Underwater Dive Club) where they received community funding for two major projects. Both projects had close involvement by BRG and Marine Botany since Chris is/was project coordinator. The first project assessed the ecological health of some major dive sites around Brisbane. The second project mapped the critical habitats of the endangered greynurse shark. Both projects trained volunteer divers in using survey techniques to determine abundance and species of fish, inverts and substrate. They involved transect line techniques, video monitoring, bathymetry mapping, GPS feature mapping and GIS applications. Both projects resulted in the production of reports, posters, video and interaction between community groups and researchers.

In future editions of GIS&RS newsletter we will tell more details about these projects and of further developments in the field.

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http://www.marine.uq.edu.au/marbot/

GIS for Real Estate Data Management

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The University of the South Pacific

Many realtors have discovered the value of showing available residential property on a map prior to actually showing the client the property. This project was set up to examine methods to use the capabilities of GIS technology to build a real estate database with a web interface. Such a system would enable a real estate agency to make their work easier by allowing promotion of their data on the web for clients in remote locations to view maps of properties and apply queries to filter properties according to their own requirements.

Common issues in real estate data management

The following issues were determined to be the mina concerns of real estate agencies in terms of their data.

Paper data – for retrieval purposes it is a concern having to search through large numbers of paper files to find comparable sales for valuation purposes and it is even harder having to look through files to find a particular type of property required by the agency's client.

Unlinked digital data – the property data available are separated into different files. Having to find a property match is difficult in this manner. For example data is typically stored across a number of separate spreadsheets and database files. These data are not integrated thus not easy to work with or make quick analysis with.

Difficult to apply multiple queries – obviously with paper data one cannot do much querying and this also goes for unlinked digital data which are sitting on different software or stored separately. Quick analysis of such data is merely possible.

After identifying these problems the next step of the project was to look at what the real estate agency would like incorporated in their GIS.

Typical Real Estate Agency Requirements

The following were identified as the main requirements for the GIS. Firstly, real estate agencies required more efficient access to data in digital form. Secondly, they wanted to be able to quickly query or filter the data

igure 1 Web Interface for users to view layers and run queries

according to customer requirements such as price, size etc. Thirdly, they wanted customers to can make their own search or query over an Internet connection.

The requirements were broken down in to 3 main areas for the project. The first area was the collection and integration of the property and real estate data in digital format. Various layers of data were created from public data sets (such as the cadastral base), and sales and rental data from the estate agent's various property data sets.

The second part of the project was the creation of customised queries that could be used to search and filter the available properties according to common criteria such as price range, number of bedrooms etc.

The third part of the project was the development of a web interface to the data. This interface would allow users to view the same layers and run the same queries, but from a remote

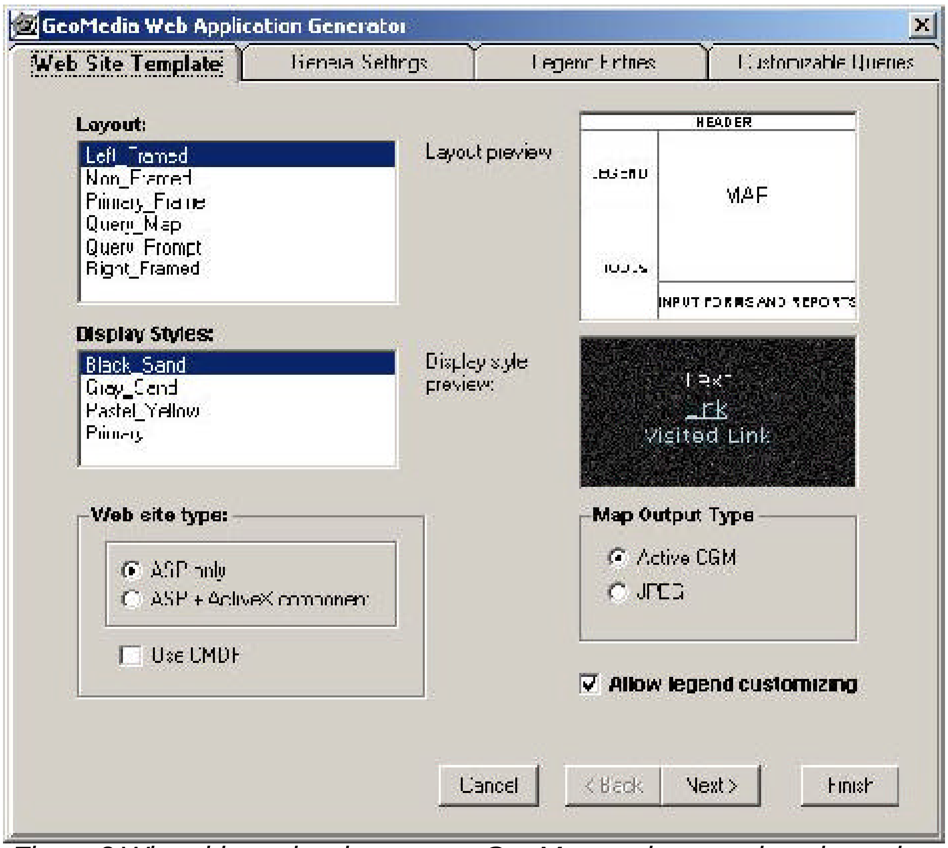

Figure 2 Wizard-based tool to convert GeoMap workspaces into dynamic web pages

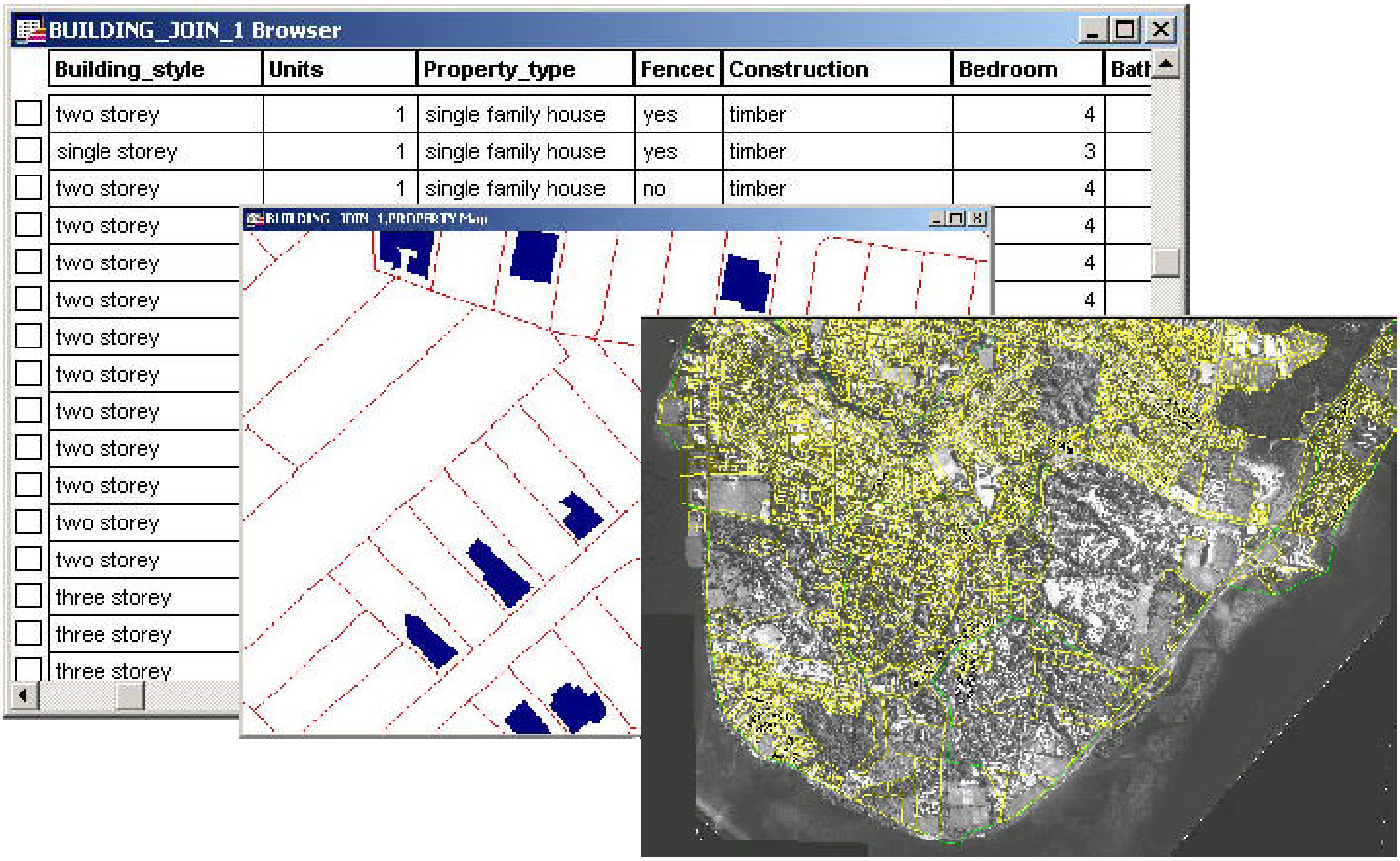

Figure 3 Sources of data for the project included property information from the Real Estate Agency, cadastre from FLIS and stitched rectified aerial photograph of Suva peninsula.

location.

Project Resources

Two main GIS software were used for this project. MapInfo Professional was used to create the data layers, with all the data being stored in MapInfo .TAB format. Once the data was created, Intergraph GeoMedia was used to create a connection to the MapInfo data, and a number of queries were created within GeoMedia. GeoMedia Web Application Generator was then used to create the web interface to the data. The data and web server were hosted on the GIS Unit server at USP, and tested internally on the USP network. The use of GeoMedia Web Application Generator was chosen for its ease of use. It is a wizard-based tool that converts a GeoWorkspace (maps, tables and queries) in to a series of dynamic web pages on a Microsoft Internet Information Services web server Figure 2).

Data Sources

Data from a variety of sources was used for this project (Figure 3). The cadastral base of central Suva was acquired from the Fiji Land Information System Support Centre. This included the property boundaries and lot and plan numbers and property title. The other main data source was from a real estate agency's files. This included a list of properties on the market, and a series of attributes for each property (such as sale or rental price, number of bedrooms and bathrooms, house or flat size etc.). These properties were identified on a geo-referenced aerial photograph of Suva, and the building outline digitised as a separate layer. Each building was then linked to it various attributes from the estate agency data.

Conclusions

This project demonstrates some of the possibilities for using GIS in the housing and property market in Suva. This is a dynamic and competitive market, and GIS tools to manage data have the potential to make a significant contribution to the activities of estate agencies. Much of the necessary data for creating a GIS already exists and can be integrated in to a GIS with a relatively small amount of effort. The use of Internet technologies, especially interactive web mapping such as this, is still new for Fiji, but the tools exist for easy implementation of such a system.