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CTI Marine Values Framework:

PNG Implementation

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Department of the Environment

Australian Aid
The Nature Conservancy
Protecting nature. Preserving life.
CORAL TRIANGLE INITIATIVE
ON CORAL REEFS, FISHERIES AND FOOD SECURITY

CSIRO Oceans and Atmosphere Business Unit

Coastal Development & Management Program

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Executive summary

In order to maintain marine and coastal ecosystem services, stakeholders and decision-makers require spatial information to enable governance for sustainable development and management of natural resources and cultural heritage. The Commonwealth Scientific and Industrial Resource Organisation (CSIRO) has developed a *Marine and Coastal Values Framework* that can be applied to natural resource, ecological and socio-cultural data to comprehensively value ecosystem features and cultural assets. This project is a part of the Australian Government's commitment to the Coral Triangle Initiative (CTI).

CSIRO have applied spatial information collected in Papua New Guinea, New Britain Provinces to the framework and created the values database for this region, which includes the Bismark Sea "Seascape". The information came from existing information and new data collected during the participatory workshops.

To date the database contains over 7,000 values records of natural resource, ecosystem structure and processes, ecosystem regulation and socio-cultural values attached to features from high mountain forests to deep offshore waters. From this map products and a GIS mapping tool have been developed. The database and the products from it has supported three (3) workshops run in New Britain by CSIRO and The Nature Conservancy (TNC).

The Database will be delivered as a standalone GIS package, including spatial layers suitable for uploading to existing centralised spatial data infrastructure within PNG National Government ministries. It will also be uploaded into the National Biodiversity Information System (NBIS) being implemented by the PNG Conservation & Environment Protection Authority (CEPA). CSIRO will also provide training on the maintenance and use of the database for ministry staff.

1 Introduction

1.1 Purpose

Integrated spatial planning, ecosystem based natural resource management, sustainable development, climate change adaptation and disaster and incident response all endeavour to protect and enhance human wellbeing while maintaining ecosystem health and cultural heritage. A key requirement for these tasks is accurate spatial information on the character and value of ecosystems and cultural heritage assets. This information is often lacking, inaccessible or in incompatible formats that makes informed decision making difficult. This is also true for integrated approaches to managing "seascapes" (Atkinson et al., 2011) within the CTI (CTI, 2012) – one of the first steps being the collation of ecosystem and heritage values that occur within the region.

There are many approaches to valuing ecosystems, including ecological (e.g. biodiversity, productivity), economic (e.g. economic benefits from harvesting and regulation) and socio-cultural domains (e.g. spiritual fulfilment, aesthetic enjoyment). While it is important that ecosystem values information reflects the held values of communities at different scales, the most useful information is that required by mangers and other stakeholders to carry out their objectives, especially in the Melanesian context of nested governance from local community based management to national EEZ scales (Skewes et al., 2011; Butler et al., 2012a, 2012b; Wise et al., 2014), and the sometimes competing objectives of human use (e.g. fishing, mining) and maintaining ecological and heritage values (e.g. biodiversity, sacred areas).

This information needs to be readily accessible to decision makers and stakeholders and the content must be transparent, relevant, replicable and credible to justify actions that sometimes will be counter to economic and development trajectories. This demands approaches for valuing ecosystems that are comprehensive, is applied at different scales, and provides disintegrated information on a range of value types so that decision-makers, stakeholders and other practitioners can integrate that information and make decisions.

Discussions with stakeholders in PNG indicated that decision-makers currently have very little information on ecosystem values to make decisions (Skewes and Wise, 2015). Since most decisions have a strong spatial component (sites for industrial development, protected areas, local human use), the best information is in the form of spatial information (maps and computer based spatial data inventory (SDI).

1.2 Background

CSIRO has developed a comprehensive Marine and Coastal Values Framework (Skewes et al., 2017) that can be applied to existing and new natural resource, ecological and socio-cultural data to comprehensively value ecosystem features and cultural assets. It includes four value categories and 18 value types (Figure 1-2). The value categories and metrics are based on best practice approaches for environmental valuation and is capable of integrating a broad range of

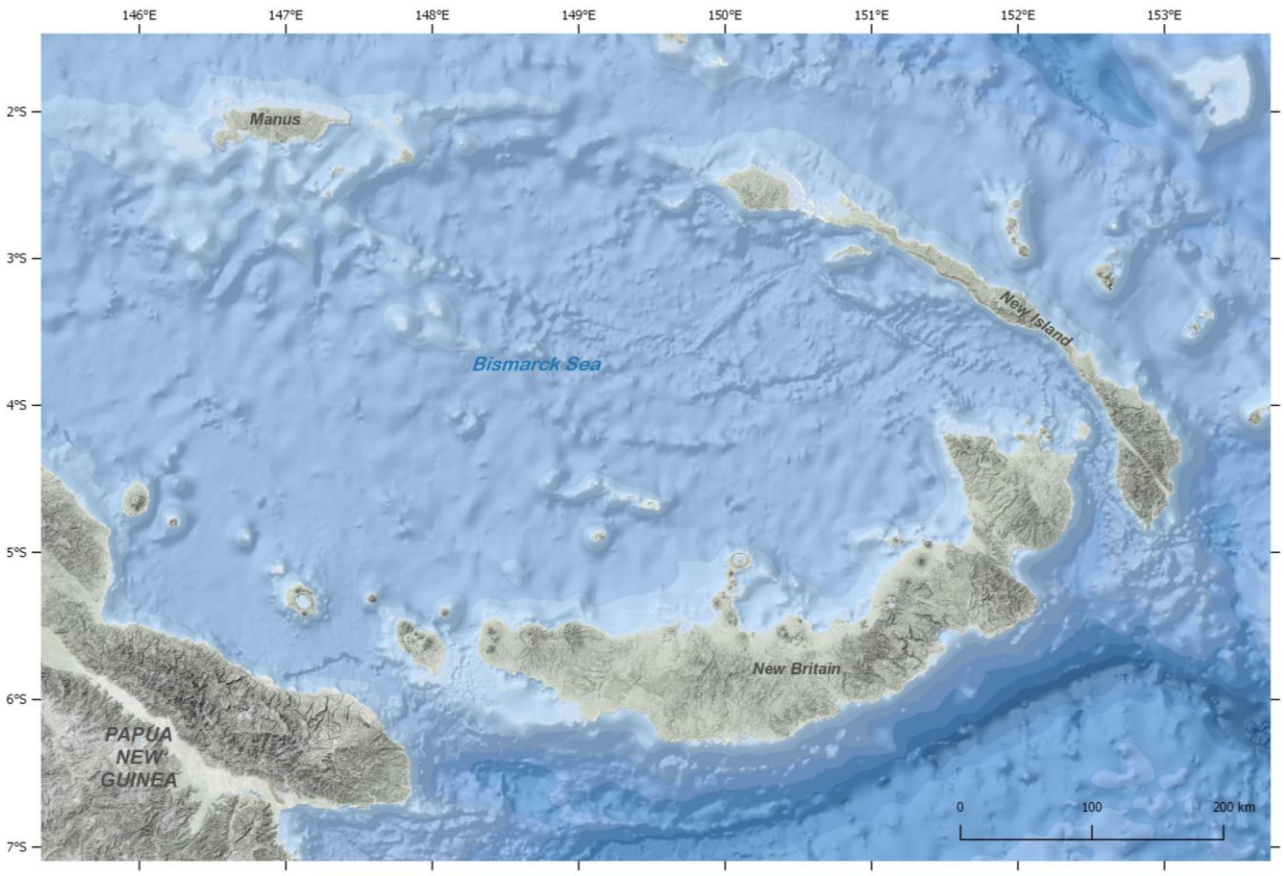

Figure 1-1 Map of New Britain Island, PNG and Bismarck Sea

environmental, socio-cultural and resource-use data (Table 1-1). Values can be applied at all scales, but is particularly useful for information targeted at the local government scale.

CATEGORIES	Ecosystem structure and process	Ecological regulation	Natural resource use	Socio-cultural benefits
TYPES	1. Biological diversity 2. Rarity/uniqueness 3. Importance for ETD* species or habitats 4. Naturalness 5. Vulnerability or sensitivity 6. Connectivity 7. Productivity	1. Hazard reduction 2. Carbon sequestration 3. Purification or pollution control 4. Water regulation	1. Contribution to Human well-being 2. Contribution to Food security 3. Contribution to Income 4. Significant natural resource locations	1. Spiritual fulfilment 2. Cultural heritage 3. Recreation, tourism or aesthetics 4. Information services

Figure 1-2. Value categories (attributes and benefits) expressed within the Marine and Coastal Values Framework. *ETD = endangered, threatened or declining.

Table 1-1. Value descriptions for the Spatial Values System for application in PNG and Solomon Islands. (EGS=ecosystem goods and services)

Value category	Value type	Metric	Estimation approach	Ancillary metrics	Scales and stakeholders	Rationale
1. Ecosystem structure and process	1.1 Biological diversity	Relative diversity level (Baseline (0), High (1), Very high (2))	Expert knowledge, literature review	Number of species per unit area; standard biodiversity indices.	Not scalar	Underpins ecosystem function and resilience. Intrinsic and non-use cultural services (existence, bequest) values.
	1.2 Rarity (species) or Uniqueness (communities, habitats)	Relative rarity or uniqueness (Baseline (0), High (1), Very high (2))	Expert knowledge, literature review	Species or habitat total range.	Provincial, National, Global	Risk of permanent loss of species or habitats. Intrinsic and non-use cultural services (existence, bequest) values.
	1.3 Importance for endangered, threatened or declining (ETD) species or habitats	Relative importance of area for ETD species or habitats (Baseline (0), High (1), Very high (2))	Expert knowledge, literature review (local legislation; IUCN Redbook)	Number or type of rules and conventions.	Not scalar	Risk of permanent loss of species or habitats. Intrinsic and non-use cultural services (existence, bequest) values.
	1.4 Naturalness (level of disturbance)	Relative level of naturalness (Baseline (0), High (1), Very high (2))	Expert knowledge, literature review	Estimates of degradation.	Not scalar	Important to maintain these areas as reference sites to safeguard and enhance ecosystem resilience.
	1.5 Vulnerability or sensitivity	Relative vulnerability or sensitivity (Baseline (0), High (1), Very high (2)).	Expert knowledge, literature review	Area of habitat or number of species that are functionally fragile to disturbance.	Not scalar	Risk of permanent loss of species or habitats if human activities and impacts are not managed effectively.
	1.6 Connectivity	Relative degree of connectivity with adjacent areas (Baseline (0), High (1), Very high (2)).	Expert knowledge, literature review (current modelling, migration routes)	Connectivity metrics.	Provincial, National, Global	Underpins ecosystem function and resilience. Risk of habitat/species loss from disturbance (can incur benefit for sink and detriment for source areas).
	1.7 Productivity	Relative productivity of system or habitat (Baseline (0), High (1), Very high (2)).	Expert knowledge, literature review, remote sensing	Quantity of biota or habitat that are active primary producers.	Not scalar	Underpins ecosystems productivity and functions which affects Natural resource provision.
2. Ecological regulation	2.1 Hazard reduction (e.g. coastal protection, erosion protection)	Hazard impact mitigation potential (Baseline (0), High (1), Very high (2))	Targeted research, risk analysis, benefit transfer	Economic valuation (value of protected infrastructure, agric.)	Not scalar	Provides economic and life benefits to humans through reduced impacts from hazards.
	2.2 Carbon sequestration	Carbon sequestration potential (Baseline (0), High (1), Very high (2))	Targeted research, benefit transfer	CO_2e stock and flow; Economic benefit valuation	Not scalar	Reduces climate change impacts on human societies.
	2.3 Purification or pollution control	Purification potential (Baseline (0), High (1), Very high (2))	Targeted research, benefit transfer	Denitrification (kg/ha/yr); Economic benefit valuation	Not scalar	Reduces pollution impacts on human societies.

Value category	Value type	Metric	Estimation approach	Ancillary metrics	Scales and stakeholders	Rationale
	2.4 Water regulation	Water retention capacity (Baseline (0), High (1), Very high (2))	Targeted research, benefit transfer	Water retention capacity in soils or at surface; Economic benefit valuation	Not scalar	Infiltration and gradual release of water underpins healthy ecosystems, agriculture and human use.
3. Natural resource use	3.1 Contribution to human well-being	Importance for human well-being (% of overall human well-being (per unit area)	Elicitation workshop, literature, expert knowledge, TEK	Economic valuation	Local, Provincial	The well-being of local communities is highly reliant on local natural resources in the PNG. Takes wellbeing from external sources into account.
	3.2 Contribution to food security	Importance for food security (% of overall food security (per unit area))	Elicitation workshop, literature, expert knowledge, TEK	Economic valuation	Local, Provincial	Food security of local communities is highly reliant on local natural resources in PNG. Takes food security from external sources into account.
	3.3 Contribution to income	Importance for income (% of overall income (per unit area))	Elicitation workshop, literature, expert knowledge, TEK	Economic valuation	Local, Provincial	Income of local communities is highly reliant on local natural resources in PNG. Takes income from external sources into account.
	3.4 Significant natural resource locations	Has significant natural resource importance (1)	Elicitation workshop, literature, expert knowledge, TEK	Size of user group, Number or type of rules and conventions	Local, Provincial, National	Some locations will have higher than average importance for the provision of natural resources, due to accessibility or natural resource abundance.
4. Socio-cultural benefits	4.1 Spiritual fulfilment	Has significant spiritual importance (1)	Local elicitation	Size of user group, Number or type of rules and conventions	Local, Provincial, National	Benefits people through spiritual fulfilment gained from sacred natural sites.
	4.2 Cultural heritage	Has significant cultural heritage importance (1)	Elicitation, Government legislation	Size of user group, Number or type of rules and conventions	Local, Provincial, National	Benefits people through cultural heritage information attached to natural and man-made sites.
	4.3 Recreational, tourism or aesthetic importance	Has significant recreational or tourism importance (1)	Elicitation, Industry and government data	Size of user group, economic valuation, rules and conventions.	Local, Provincial, National	Benefits people through recreational activities and income from tourism.
	4.4 Information services	Has significant information services importance (1)	Elicitation, Industry and government data	User group, rules and conventions.	Local, Provincial, National	Benefits people through production of knowledge.

EGS = Ecosystem Goods and Services. Each value also has a narrative that includes: General description of area, feature, habitat or species; Status and trends; Rules, regulations and conventions; Pressures; Confidence; Information sources (literature, study date, workshop date, information location, links).

1.3 Environmental and Livelihood Values Interrogation System - ELVIS

We have developed a database-linked GIS based system for connecting values in the marine and coastal values framework with spatial ecosystem features for display, interrogation and the production of electronic and hardcopy maps (Figure 2-1). The platform is based on open source GIS software (QGIS, www.qgis.org). The system is designed to enter, view and query values based on the value categories in Table 1-1, in point and area (polygon) formats (Figure 1-3).

All values are assigned to a feature in a GIS/Spatial management system (Figure 2-1). Some ecosystem features (EF) were available as spatial layers previously mapped by ecosystem mapping projects but others needed to be constructed from descriptions given by local stakeholders (**Error! Reference source not found.**). EF definition can be done using various sources of information, from existing digital maps of habitats (e.g. Millennium reef mapping coral reef maps) and areas of interest to participatory mapping exercises at participatory planning workshops such as TNCs Ridge to Reef mapping approach (TNC, 2013).

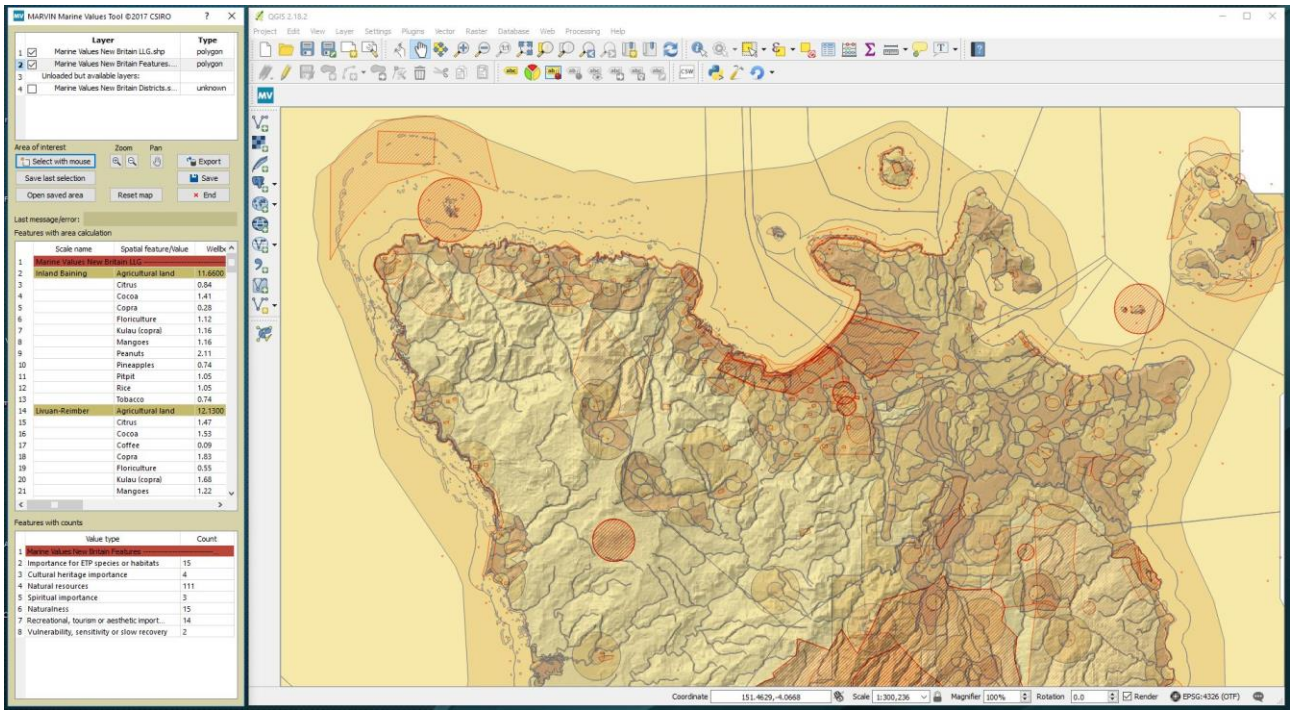

Figure 1-3. QGIS based values spatial system and interrogation tool - ELVIS..

2 New Britain Marine and Coastal Values Database

The project goal was to build a comprehensive Marine and Coastal Values Database for New Britain (East New Britain and West New Britain Provinces) as a resource to contribute to the sustainable development of the Bismarck Sea "Seascape". The database was populated using the approach developed as the *Marine and Coastal Values Framework*. Resource use and ecosystem attributes data collected from various sources was entered into database using the framework to construct the Values Database ready for use as spatial maps and in a GIS program (QGIS), so that it can be used for marine and coastal management and decision making in New Britain and the Bismarck Sea seascape.

2.1 What are the data layers?

We have aggregated 7502 individual spatial value records for New Britain using the framework (Table 2-1). Sixteen of a possible 18 value types are represented in the database (only Connectivity and Purification value types are not represented at this stage). The greatest number of value records were associated with Natural resource values and its contribution to Food Security, Human Well-being and Income (1,675 record each). The next highest number of records was for sites with high Natural Resource importance (1,372 sites).

Most of the values were collected at the Local government (Local Level Government – LLG) scale (Table 2-2). This included most of the Natural Resource values and Socio-cultural values. The database holds values for all LLGs on New Britain Island including all provinces in East New Britain and West New Britain.

2.2 Where did the data come from?

Most of the values data was sourced from workshops associated with two CTI based projects, Building Capacity for Sustainable & Responsible Development in the Bismarck Sea (CSIRO), and Bismarck Sea Ridge to Reef project (TNC) (Table 2-3).

Other sources of data were habitat mapping from various global, national and local spatial mapping products (e.g. Global coral sea reefs), which involved the assignment of values information to those spatial features using published information.

Although most of the data was able to be sourced, there were a number of values that needed to be calculated. Regulatory values for carbon sequestration and hazard reduction were calculated following methods from previous studies (Donato et al. 2011; Murray et al. 2010; Pascal, 2013; Pascal, 2015).

Table 2-1. Records in New Britain Marine and Coastal Values Database by value category and value type.

Value category	Value type	Records
Ecological regulatory values	Carbon sequestration	2
Ecological regulatory values	Hazard reduction	31
Ecological regulatory values	Water regulation	22
Ecosystem structure and process values	Biological diversity	9
Ecosystem structure and process values	Importance for ETP species or habitats	261
Ecosystem structure and process values	Naturalness	121
Ecosystem structure and process values	Productivity or nutrient cycling	27
Ecosystem structure and process values	Rarity/uniqueness	2
Ecosystem structure and process values	Vulnerability, sensitivity or slow recovery	23
Natural resource values	Contribution to Food security	1,675
Natural resource values	Contribution to Human well-being	1,675
Natural resource values	Contribution to Income	1,675
Natural resource values	Natural resource Importance	1,372
Socio-cultural values	Cultural heritage importance	194
Socio-cultural values	Recreational, tourism or aesthetic importance	323
Socio-cultural values	Spiritual importance	90

Table 2-2. Records in New Britain Marine and Coastal Values Database by Scale type.

Scale type	Records
District	540
Local Government	6,950
Province	12

Table 2-3. Data sources for information in the New Britain Marine and Coastal Values Database

Data source	Records
Building Capacity for Sustainable & Responsible Development in the Bismarck Sea. 1st District Meeting for Gazelle, Rabaul and Kokopo, Workshop # 1. Kokopo March 2016.	264
Building Capacity for Sustainable & Responsible Development in the Bismarck Sea. 1st District Meeting for Gazelle, Rabaul and Kokopo, Workshop # 2. April 2016.	2016
Building Capacity for Sustainable & Responsible Development in the Bismarck Sea. 1st District Meeting for Gazelle, Rabaul and Kokopo, Workshop # 2. Kerevat. April 2016.	266
Building Capacity for Sustainable & Responsible Development in the Bismarck Sea. 1st District Meeting for West New Britain, Workshop # 1. Kimbe. April 2016.	281
Building Capacity for Sustainable & Responsible Development in the Bismarck Sea. 2nd District Meeting for Pomio District, Workshop # 3. June 2016.	1095
Building Capacity for Sustainable & Responsible Development in the Bismarck Sea. District Meeting for Pomio, Workshop # 3. Pomio July 2016.	456
Building Capacity for Sustainable & Responsible Development in the Bismarck Sea. District Meeting for West New Britain, Workshop # 2. Talasea. June 2016.	401
Building Capacity for Sustainable & Responsible Development in the Bismarck Sea. District Meeting for West New Britain, Workshop # 3. Kandrian. December 2016.	339
Building Capacity for Sustainable & Responsible Development in the Bismarck Sea. Ridge to Reef Workshops. 2016.	464
Climate futures, ecosystem services and livelihood adaptation strategies in West New Britain Province, PNG. Scopeing workshop. February 2012.	1374
Donato, et al., (2011).	2
ENB Inception Meeting, Workshop # 1, 2nd -3rd March 2016.	540
CTI Marine Values Project; Pascal et al., (2013)	2
CTI Marine Values Project; Pascal et al., (2015)	2
Birdlife International, 2012	3
Kahn & Vance-Borland, 2014	1
WWF – Malaysia & seaturtle.org	2

2.3 Spatial features

Values data collected was then assigned to spatial features using habitat information or by direct assignment to mapped features (Figure 2-1). The spatial feature buffer layers were generated using QGIS using standard GIS algorithms. Other spatial feature files were obtained from varying sources (see Table 2-4). The spatial definition of these layers directly influences the distribution of the values associated with each feature type. This is one area where significant improvements can be made through dialogue with local agencies and communities. For example, we have designated community gardens as 1km buffer around villages. This definition can be improved by incorporating local knowledge.

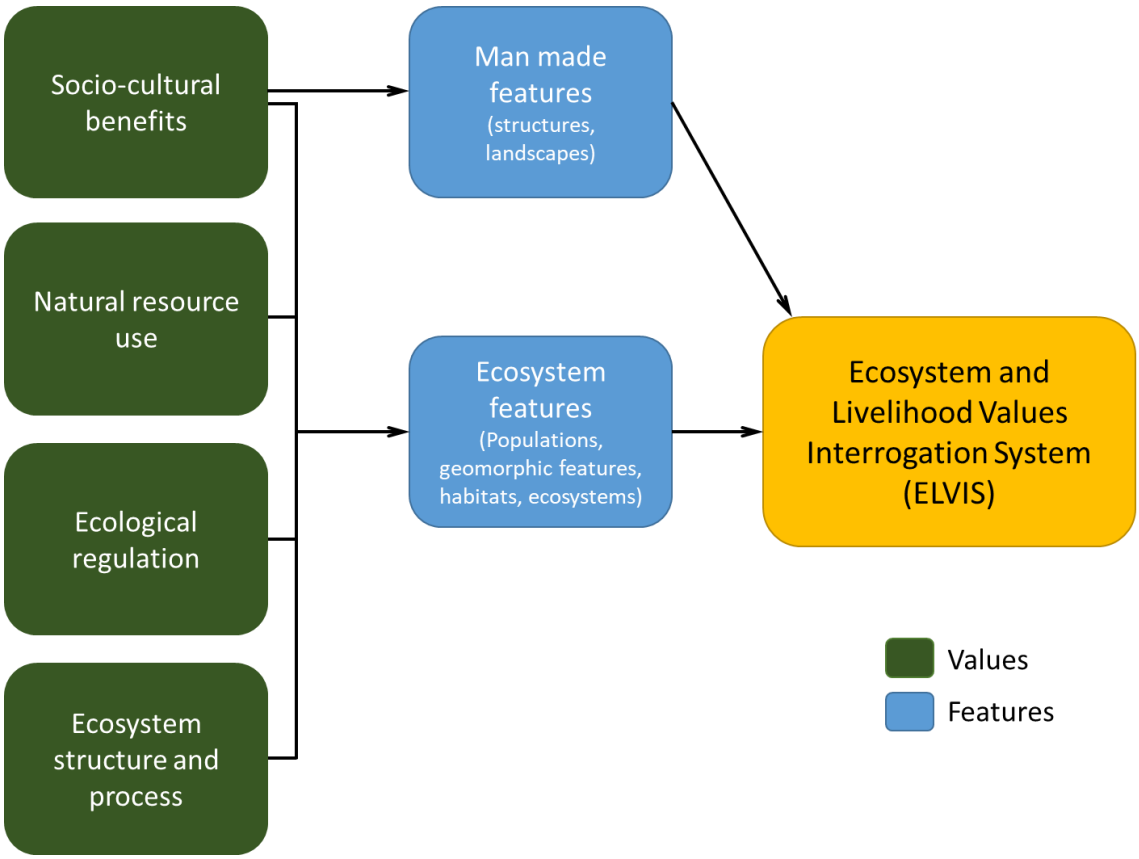

Figure 2-1 Information streams for Environmental and Livelihood Values Interrogation System (ELVIS).

Table 2-4. Spatial feature base layers required for joins

Layer No.	Layer name	Layer description
1	Agricultural land	All land excluding Forest, Urban, Rivers, Community gardens, Plantation land.
2	Marine shelf	Marine habitat shallower than 200m.
3	Marine coastal	500m buffer along coast.
4	Community gardens	1 km buffer around communities excluding forest.
5	Community livestock	3 km buffer around communities excluding forest.
6	Coral reefs	Coral reefs shallower than 30 m. Millennium Coral Reef Mapping Project (2009). Sourced from UNEP-WCMC.
7	Estuaries	500 m buffer 500 m either side of river mouths.
8	Forest	Uncleared or regrowth forest. (FIMS vegetation cover database (Hammermaster E.T. and Saunders J.C. 1995 and PNG Forest Authority)
9	Marine inshore	2 km buffer along coast.
10	Mangroves	All mangrove forests (Global Mangrove Distribution (UNEP-WCMC 2011))
11	Mining areas	Active mining areas or Area of active mining leases (PNG Mineral Resource Authority).
12	Marine offshore	All marine areas excluding 2 km buffer along coast.
13	Plantation land	Designated plantation land (New Britain Palm Oil Limited)
14	River	Rivers and 50 m buffer.

2.4 Environmental and Livelihood Values Interrogation System - ELVIS

We have developed a linked database-GIS based system for linking values in the marine and coastal values framework to spatial ecosystem features for display, interrogation and the production of electronic and hardcopy maps. The system is based on open source software solutions that can be freely disseminated (SQLite, QGIS and Python). The Environmental and Livelihood Values Interrogation System – ELVIS, enables a user to easily work with and query spatial layers containing various marine values objects in the regions of interest (Figure 2-2). It will replace QGIS functionality as described below and offer a single, easy to use interface to complete all commonly used tasks required by the QGIS component of the Marine Values project.

Access to the tool can is auto-loaded on start of QGIS or loaded via a menu point (if it unintentionally terminated or fails). The tool may use a single, stay-on-top window for all tasks. Main QGIS functionality (working with layers, zooming, interrogation) can be performed in the tool. Error handling is performed for user inputs where possible and if errors are raised the function stops and displays an error message.

Within the tool the user can load the existing project and all its shapefiles, create new features, edit and view attributes of a feature, evaluate and end QGIS. Areas of interest polygons can be stored in the database and retrieved to allow different evaluations to run on the same area. Export functionality provides creation of a CSV file that contains all selections (including the polygon definition) and the resulting marine value output.

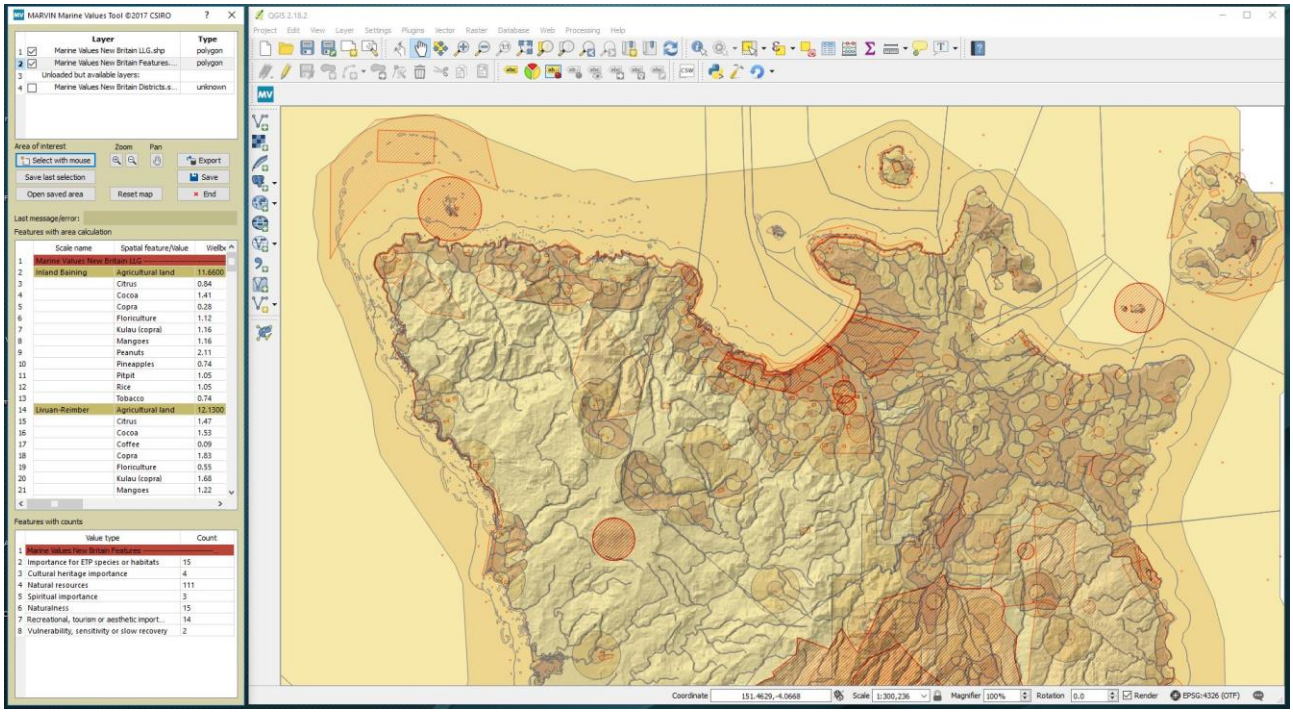

Figure 2-2. QGIS based values spatial system and interrogation tool - ELVIS.

The system is capable of selected area queries that provide a summary of well-being importance of natural resources (EGS) in the area of interest, regulatory value scores, sociocultural sites and size of areas important for ecosystem structure and processes.

2.5 Web based visualisation tools

Marine spatial planning tools (MSP tools) is a web based mapping tool publicly available http://msp.csiro.au providing access to the spatial layers developed for the PNG values data base, Figure 2-7 is an example for the food Security value for New Britain. This tool allows users with access to a web browser to explore the values database.

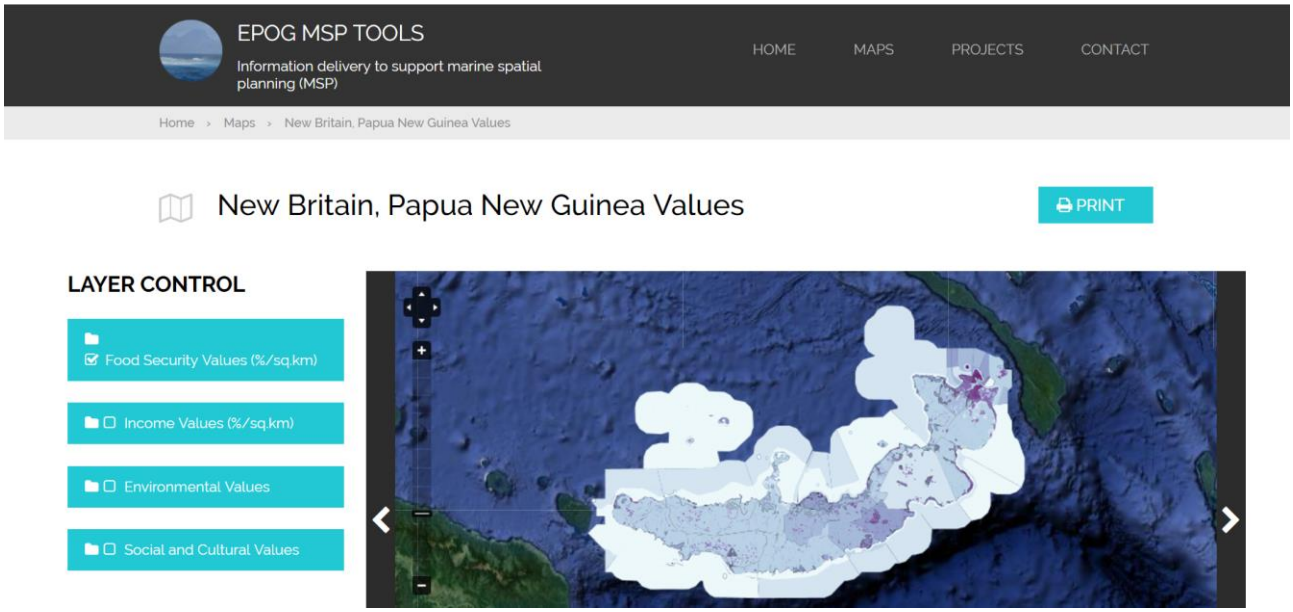

Figure 2-7 Marine Spatial planning tools 'Food Security Value' http://msp.csiro.au

2.6 Map products

Numerous summary map products have been created from the values database. The main purpose of these products has been to support workshops run by CSIRO Land & Water and TNC in New Britain Provinces. These maps were used for land use planning and tourism workshops, enabling workshop participants to see what value ecosystem features has across the various categories and how they need to be taken into consideration during decision-making processes.

For the workshops held so far over 250 hard copy maps have been printed for use by stakeholders at a National, Provincial and Local level. In East New Britain, maps have been produced for 10 Local Level Government areas, as well as for the Gazelle District and East New Britain Province, totalling in 52 electronic maps for this province alone. West New Britain has had maps printed for 2 LLGs, East and Central Nakanai and at the Provincial scale.

Each spatial area printed has a map relating to *the framework*, so each map reflects a different category of the values framework for Food Security (Figure 2-3), Income (Figure 2-4), Ecosystem Structure (Figure 2-5) and Socio-cultural (Figure 2-6) values. The Food Security and Income maps drew information from the Natural Resource Values Category from the *Marine and Coastal Values Framework* (Figure 1-2), whilst the Ecosystem Structure map shows data from the Ecological Regulatory Values and Ecosystem Structure and Processes Values categories of the Framework. Socio-cultural values correlated with the data under the Socio-cultural category of the Framework.

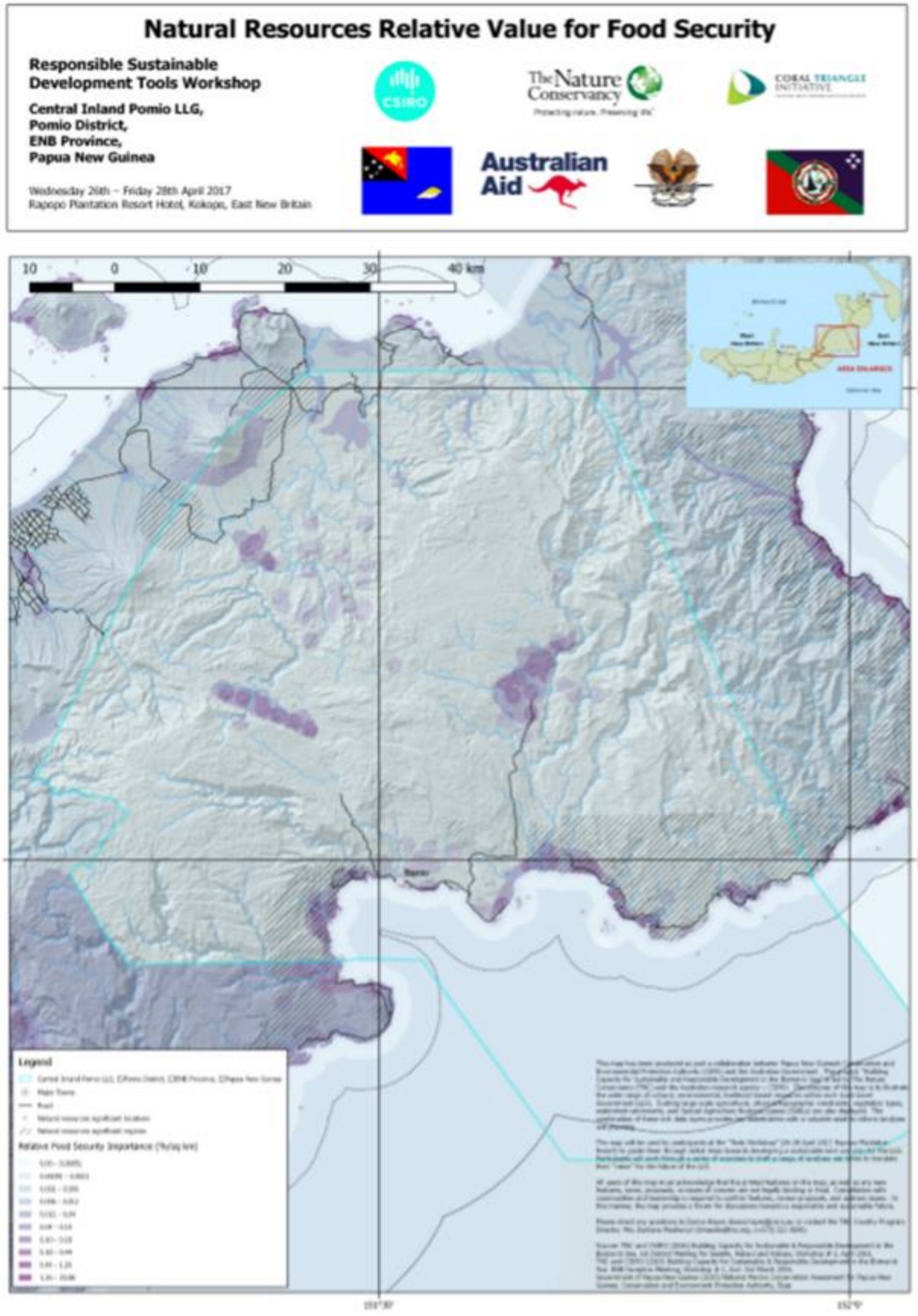

Figure 2-3 Values Map Example for Food Security (Central Inland Pomio LLG)

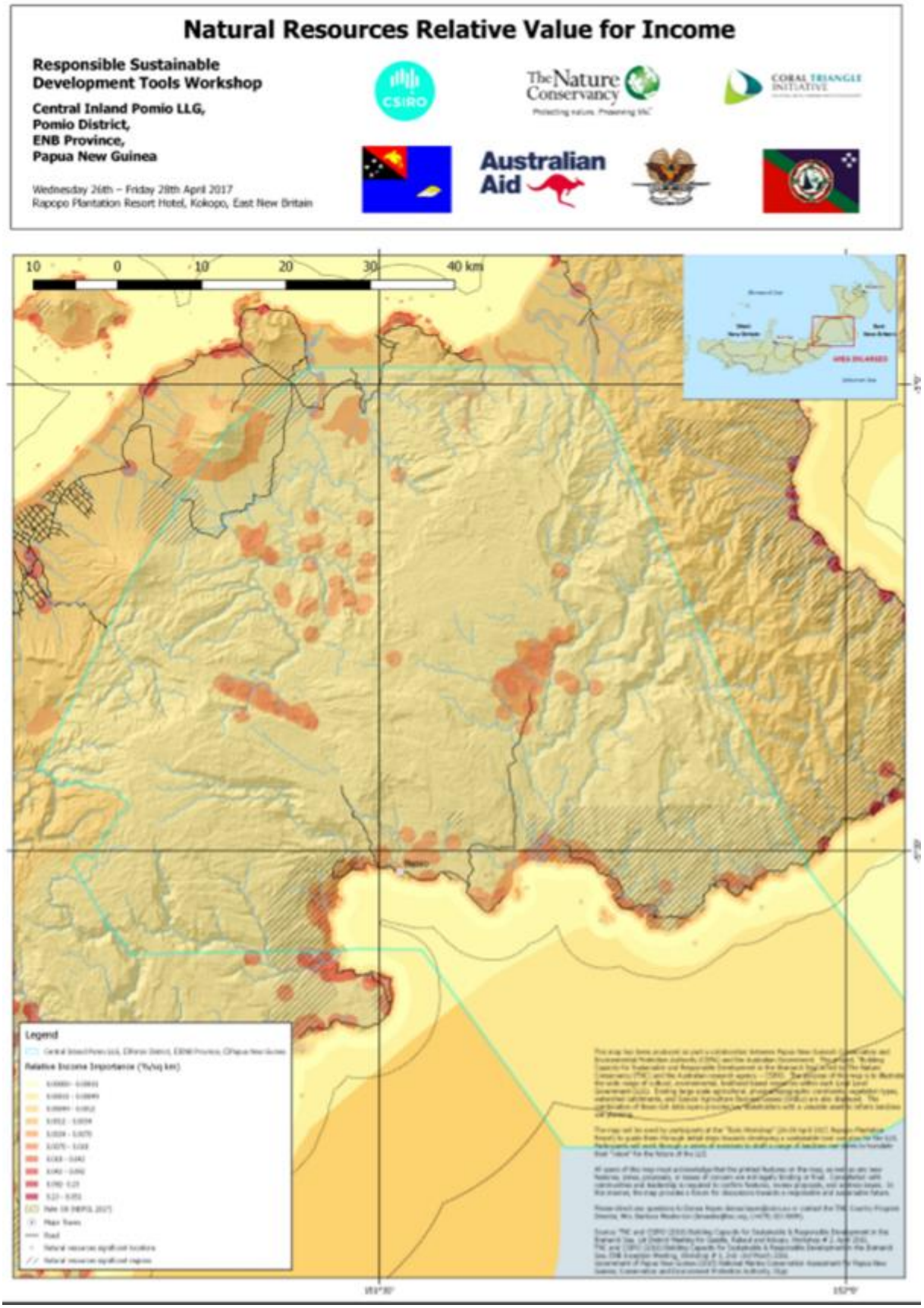

Figure 2-4 Values Map Example for Income (Central Inland Pomio LLG)

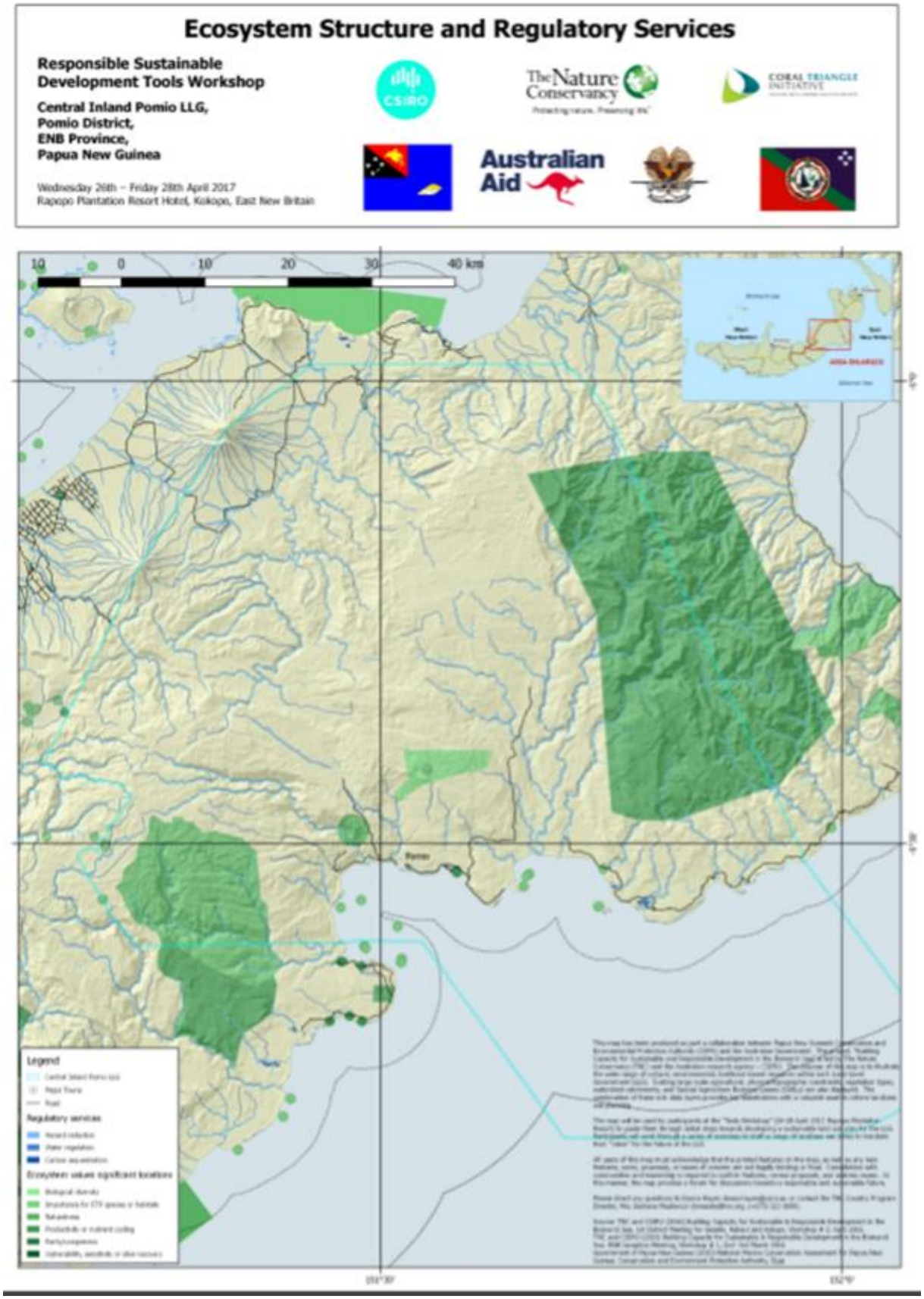

Figure 2-5 Values Map Example for Ecosystem Structure and Regulatory Services (Central Inland Pomio LLG)

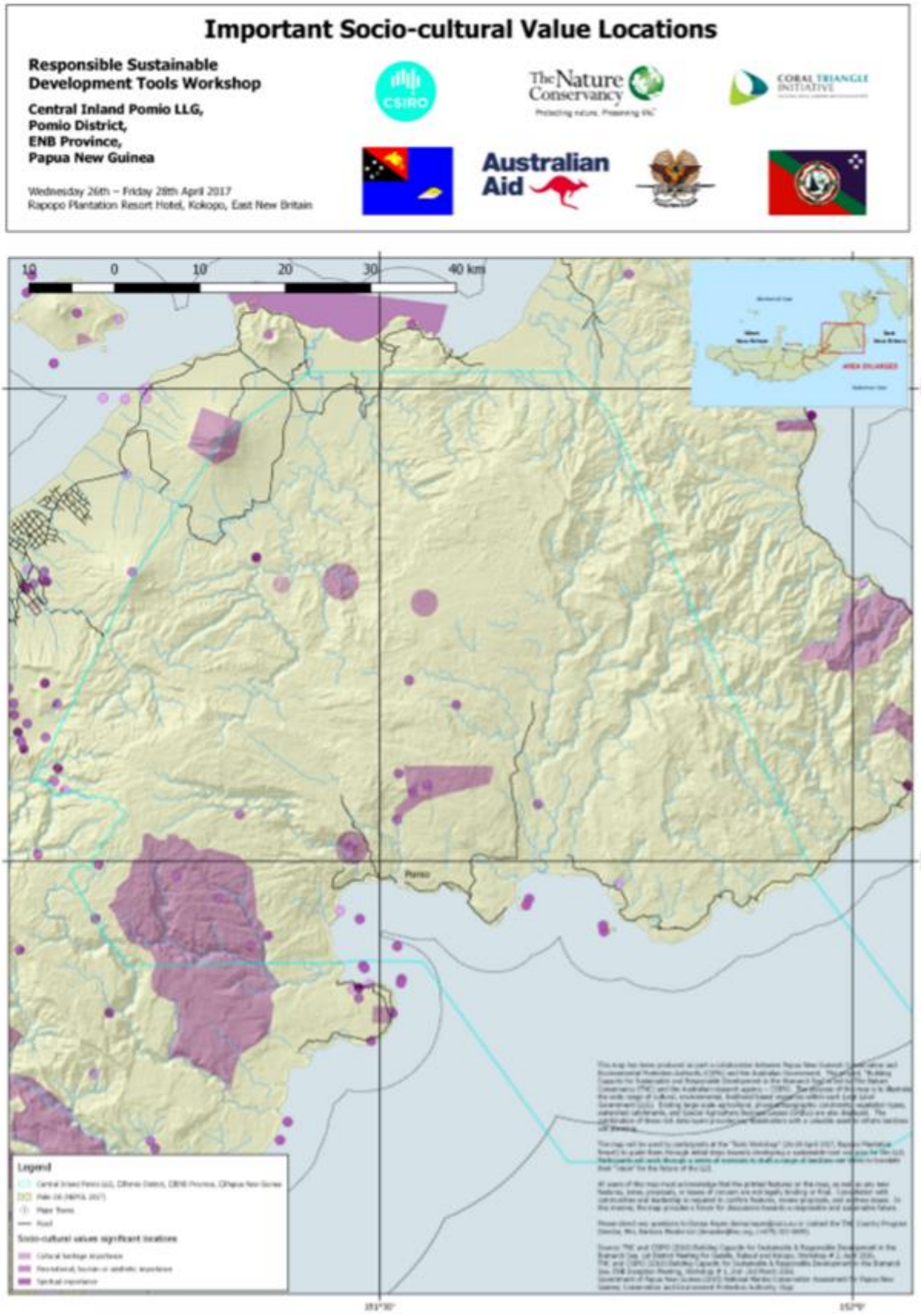

Figure 2-6 Values Map Example for Socio-cultural (Central Inland Pomio LLG)

3 Implementation

The products that were developed by CSIRO Oceans & Atmosphere have been used in a number of applications, with a total of 4 participatory workshops and 3 seminar sessions. The first workshop was held in Kokopo, East New Britain by CSIRO Land & Water (based around oil palm), the second was also held in Kokopo, run by TNC and the third was held in Kimbe, West New Britain by CSIRO Land & Water and focussed on tourism.

We also uploaded the summary layers into CSIROs EPOG MSP Tool web portal (http://msp.csiro.au/).

3.1 East New Britain Pilot Planning Workshop

A workshop was held in September 2016 at Gazelle International, Kokopo, East New Britain. The workshop attracted 65 participants from various backgrounds including, local community members, local land owners, NGO's, ENB Provincial Administration Officers, LLG and District Government officers and officials, Tzen Nuigini Ltd., West New Britain Palm Oil Ltd. and WNB Provincial Administration officers. CSIRO Land & Water led the workshop but were supported by TNC, with a total of 8 facilitators. The values map products were disseminated during the workshop and the maps were used during the activities. From the workshop 33% of participants stated that they felt empowered by attending the workshop (Butler et al. 2016).

3.2 Port Moresby Seminar

During trips to Papua New Guinea for the land use planning workshops run by TNC, the CSIRO Values Mapping team presented the Values Framework and Database to government officials and interested NGOs at Lamana Hotel, Port Moresby. Attendees at the seminar came from Conservation and Environment Protection Authority, TNC, CLMA, Climate, PNG Forestry, CCDA, CEPA, CELCOR, PNGCLMA, Mama Graun, CSIRO and TNC.

The participants got a brief overview of what the impending workshop in Kokopo was to involve, and also saw physical copies of the 4 value category maps for East New Britain. Those who were interested also received an electronic copy of the values maps along with QGIS software and database files with the offer of remote support where needed.

3.3 Pilot Planning Workshop on Oil Palm Development

In March 2017 the Pilot Planning Workshop on Oil Palm Development was held at Rapopo Plantation Resort Hotel, Kokopo, East New Britain. The workshop was led by CSIRO L&W, with contributions from TNC and CSIRO O&A. The workshop worked to explore and improve decision-making about oil palm development in the Bismarck Sea, using Inland Baining and Lassul Baining Local Level Government areas, Gazelle District, East New Britain, as a case study areas. The Marine Values database was used to identify the areas of values that would be impacted by increased oil

palm plantations. Participants integrated the maps to identify trade-offs from oil palm development and to see if the current plans could be modified to improve the outcomes for local communities.

The values framework and database project was presented by Piers Dunstan, with the values summary maps explained and presented on each table. Hard copy values maps for all values types were disseminated to all Local Level Government groups.

3.4 East New Britain Land Use Workshop

In April 2017, after the Port Moresby seminar, a workshop was held at Rapopo Plantation Resort in Kokopo, East New Britain by TNC (Nate Peterson & Geoff Lipsett-Moore). With assistance from CSIRO Oceans & Atmosphere values team members (Donna Hayes & Mibu Fischer), as well as two students from Australia (University of Queensland and James Cook University).

Participants at the workshop represented 11 Local Level Government (LLG) groups within East New Britain, and were varied in their roles within their LLG (i.e. local land owners, government workers and NGO representatives). The participants were split into their LLG groups and worked on creating land use plans for their regions. The 48 values maps produced for this workshop were used in the land use planning activities throughout the 2.5 day workshop, focussing on oil palm development.

The values framework and database project was presented by Donna Hayes, with the values summary maps explained and presented on each table. Hard copy values maps were disseminated to all Local Level Government groups, except Duke of York LLG, who were originally not attending the workshop, they did leave with electronic versions of their LLG values maps.

Each LLG received USBs with electronic versions of ALL LLG values maps for East New Britain, and those who were interested in using the database for themselves for management purposes were given electronic copies of QGIS and values database files (a total of 21 distributions from participating LLG representatives and various organisations including District Education Coordinator, University of Natural resources, Provincial Planning office ENBPA., Policy planning and research division, Forcert Ltd, Gazelle District Lands Coordinator, Lassul Baining Business development Officer, Gazelle District Agricultural officer.

3.5 West New Britain Pilot Planning Workshop

A workshop was held in Kimbe, West New Britain run by CSIRO Land & Water in May 2017. The workshop was supported by TNC staff members, CSIRO Oceans & Atmosphere team member and Masters Student. This workshop focussed on tourism development and used the 4 values maps (Food Security, Income, Ecosystem Structure and Socio-cultural) to help participants plan hypothetical activities in East and Central Nakanai.

The workshop gathered participants from a number of LLG areas within West and East New Britain. Participants ranged from local land owners to government officials (local, provincial and national), representatives from PNG Tourism Promotions Authority to tourism operators.

The values framework and maps were presented to the participants on the second day and the maps were used during tourism planning activities (Figure 3-5, Figure 3-6 & Figure 3-7). Many participants were interested in looking into the maps in further detail. This can be achieved now through the interactive GIS tool, however it was not completed for use at this workshop.

3.6 West New Britain Land Use Workshop

In August 2017, after the Port Moresby seminar, a workshop was held at Liamo Reef Resort in Kimbe Bay, West New Britain by TNC (Nate Peterson & Geoff Lipsett-Moore). With assistance from CSIRO Oceans & Atmosphere values team member, Donna Hayes.

Participants at the workshop represented 11 Local Level Government (LLG) groups within West New Britain, and were varied in their roles within their LLG (i.e. local land owners, government workers and NGO representatives). The participants were split into their LLG groups and worked on creating land use plans for their regions. The 48 values maps produced for this workshop were used in the land use planning activities throughout the 3 day workshop.

The values framework and database project was presented by Donna Hayes, with the values summary maps explained and presented on each table.

Hard copy values maps were disseminated to all Local Level Government groups and all participants received a USB stick with the

- Presentations
- Values data base in shapefiles, CSV and access database
- Copies of New Britain value type maps
- CTI Marine Values Framework: PNG implementation Values summary report
- Values framework and MarVin summary sheet
- Agendas
- QGIS installation files
- QGIS simple user guide
- MarVin installation *(now ELVIS)*

3.7 Values database training and information meetings

In September 2017 CSIRO Oceans & Atmosphere values team members Donna Hayes and Tim Skewes presented to the Conservation and Environment Protection Authority executive on the Values framework and the New Britain implementation. This was followed by a one day training and information session held at the Lamana hotel, Port Moresby attended by a wide range representatives from various national government departments, NGO and representatives from East and West New Britain.

Meetings were also held with NFA, CFDA, Oceans Office, WCS and PNGFA to gauge interest in the values database and receive feedback on what is required by PNG. During these meetings we distributed hard copy maps of outputs of the Values database.

3.8 Sustainable Development Road show, Port Moresby

In October 2017, the CSIRO Oceans & Atmosphere values team provided support to the Sustainable development Road show in Port Moresby (Run by TNC and CSIRO land & Water) and provided value database materials (Maps and electronic resources) and presentations for the meetings in East and West New Britain. At the National meeting in Port Moresby, CSIRO Oceans & Atmosphere values team members Piers Dunstan and Donna Hayes presented the values framework with examples from the New Britain Implementation.

The values database was installed onto a number of participant computers including representatives from East and West New Britain and in a number of government offices (CFDA, CCFA, CEPA, JICA, Oceans Office) during our meetings.

Meetings were held with CFDA, CCFA, CEPA, JICA and the Oceans Office to Discuss the Values Framework and database and how this may be of use by the PNG government to assist them with their sustainable resource management. We also discussed possible deployment pathways for the database.

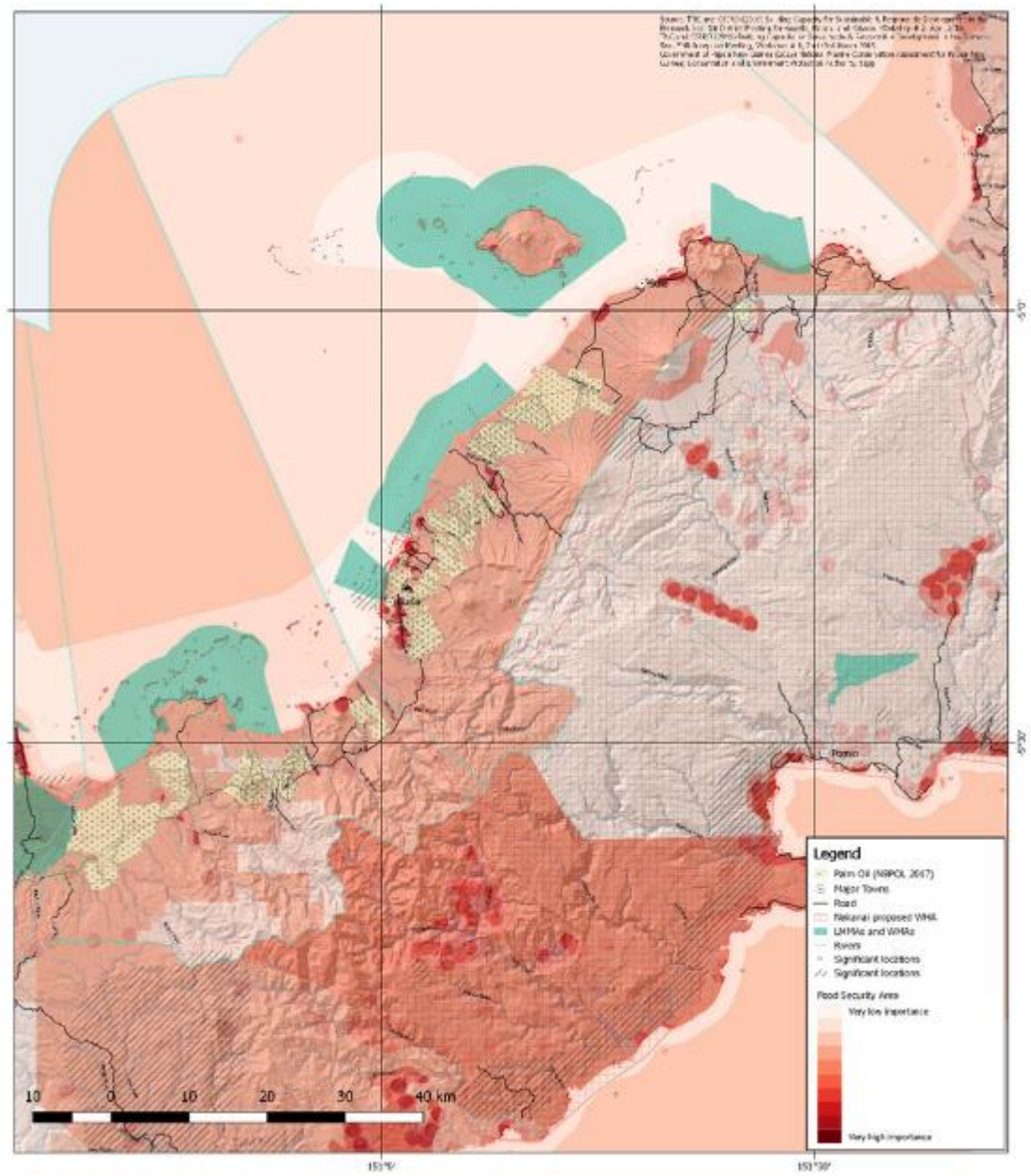

Figure 3-1 This is a map of relative (per area) importance of each ecosystem feature/habitat type for Overall Food security for the people living in East and Central Nakanai, WNB. It also has the locations of significant natural resource areas.

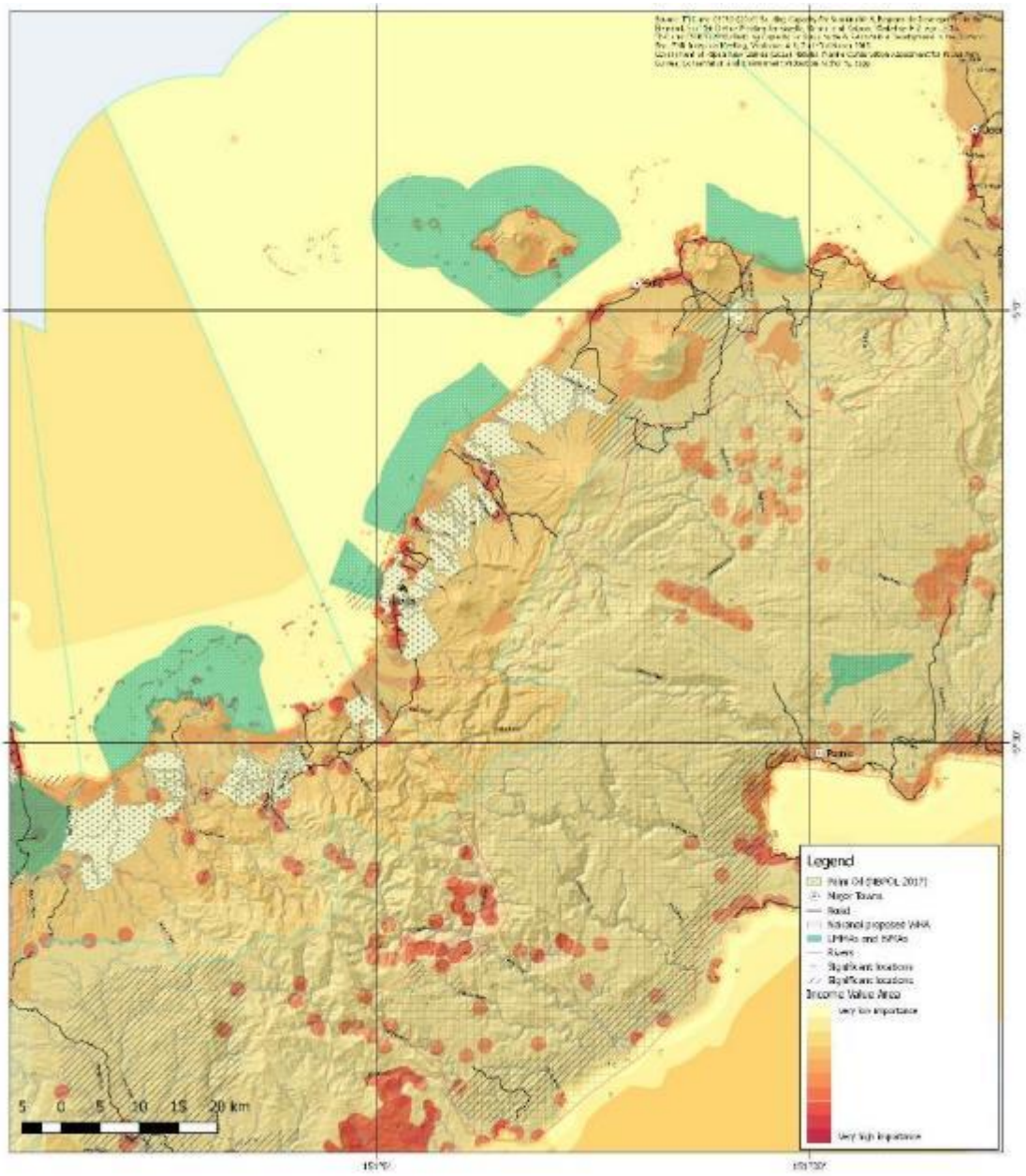

Figure 3-2 This is a map of relative (per area) importance of each ecosystem feature/habitat type for Overall Income for the people living in East and Central Nakanai, WNB. It also has locations of significant natural resource areas.

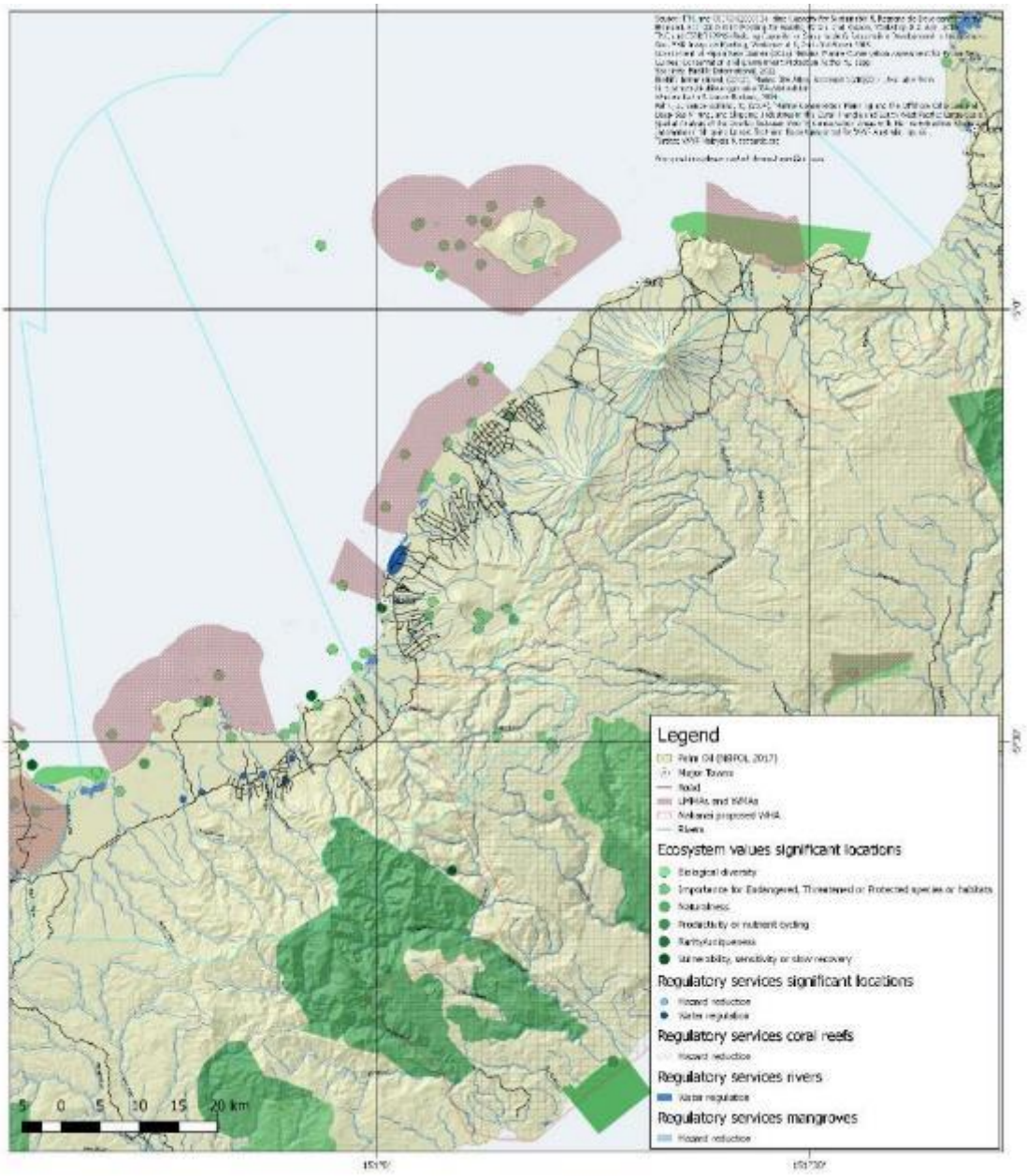

Figure 3-3 This is a map of ecosystem and regulatory values in East and Central Nakanai, WNB.

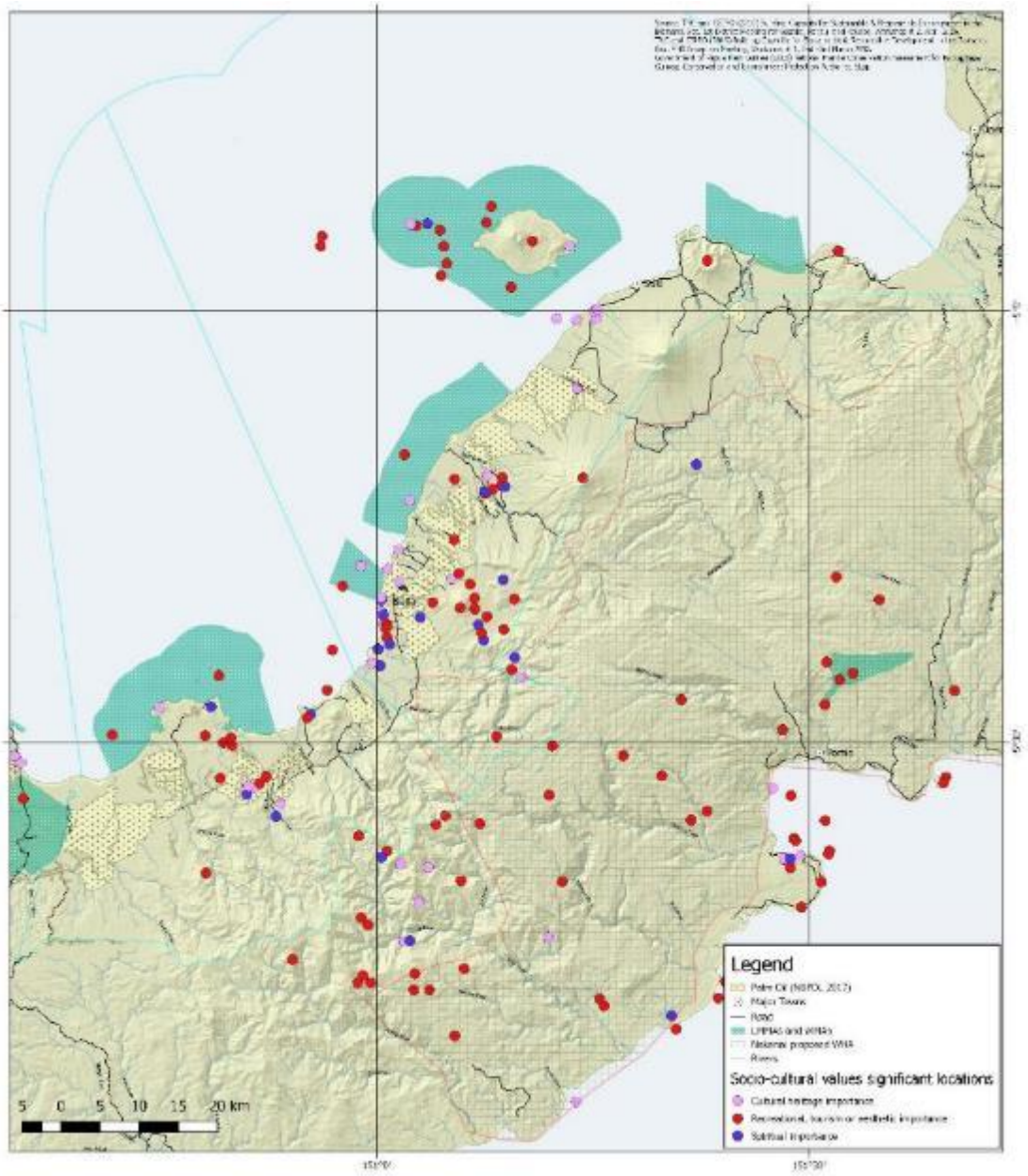

Figure 3-4 This is a map of socio-cultural values for East and Central Nakanai, WNB using existing data and information gathered during the recent TNC R2R workshops.

Figure 3-5 Participant examines Ecosystem Structure Values map for East and Central Nakanai, WNB, with TNC staff member Cosmas Apelis at Kimbe Workshop

Figure 3-6 Participants at Kimbe Workshop using values maps during their activities

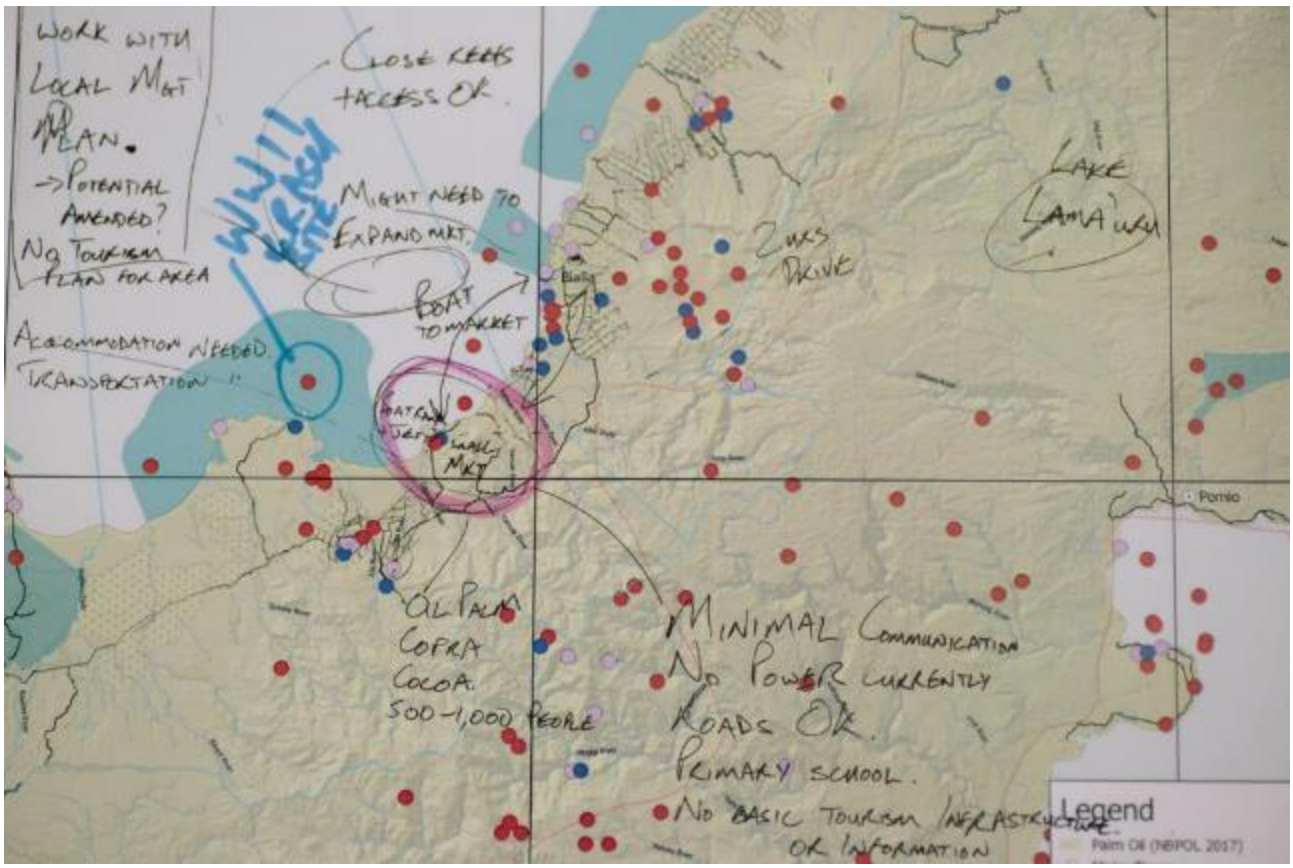

Figure 3-7 Close up of activity work drawn on map of Socio-cultural Values for East and Central Nakanai, WNB.

4 Future implementation activities

We will continue to collate additional data (e.g. cultural heritage sites; Management areas) and integrate into the Marine and Coastal Values Database, including marine values including shipwrecks, LMMA, reefs, tuna spawning grounds – i.e. “known values” from National and Provincial level government agencies to the end of the project.

The Database will be delivered as a standalone GIS package with spatial layers suitable for uploading to existing centralised spatial data infrastructure in PNG ministries, specifically the National Biodiversity Information System (NBIS). We will also provide training on the maintenance and use of the database for ministry staff. CEPA contacts have expressed the willingness to host and maintain the database into the future which will be a key factor in the long term viability and usefulness of the database. We have a planned information and training session for CEPA in October 2017 where they will be provided with training regarding the database and in a specialised tool (ELVIS) which allows the upload of new data to the database. Ministry staff form other national agencies such as Attorney Generals, CC, MNF will be invited to attend.

It will be important that a plan is developed for users at both the National and Provincial level to provide technical support for ongoing use of the database including the addition of ecological, cultural and heritage values they want to see included.

Appendix A Scale name and number of records

Scale type	Name	Records
Local Government	Balanataman	205
Local Government	Bali-Witu	248
Local Government	Bialla	150
Local Government	Bitapaka	230
Local Government	Central Gazelle	220
Local Government	Central Inland Pomio	349
Local Government	Central Nakanai	122
Local Government	Duke of York	271
Local Government	East Nakanai	204
Local Government	East Pomio	371
Local Government	Gasmata	194
Local Government	Gloucester	189
Local Government	Hoskins	201
Local Government	Inland Baining	274
Local Government	Kandrian Coastal	322
Local Government	Kandrian Inland	230
Local Government	Kokopo-Vunamami	198
Local Government	Kombiu	195
Local Government	Kove-Kaliai	261
Local Government	Lassul Baining	312
Local Government	Livuan-Reimber	203
Local Government	Melkoi	215
Local Government	Mosa	186
Local Government	Rabaul Urban	9
Local Government	Raluana	179
Local Government	Sinivit	315
Local Government	Talasea	244
Local Government	Toma-Vundadidir	111
Local Government	Watom Island	162
Local Government	West Pomio	201
Local Government	West Pomio-Mamusi	379
District	Gazelle	156
District	Kokopo	132
District	Kombiu	96
District	Pomio	156
Province	East New Britain	6
Province	West New Britain	6

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