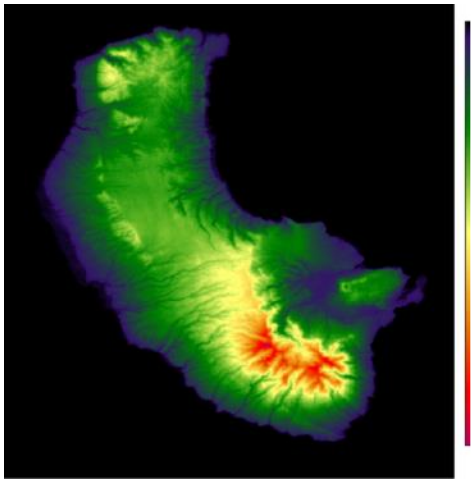
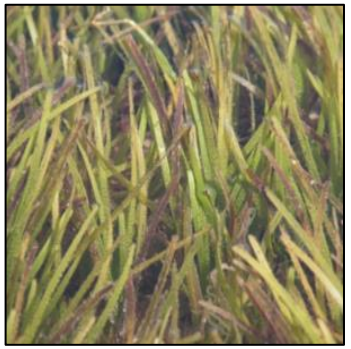
Griffith ESRAM Team
Methodology & Results-to-date









Griffith ESRAM Team

Project director

Prof Brendan Mackey

Project manager

Dan Ware

Terrestrial ecosystems

Dr Willow Hallgren

Prof Brendan Mackey

Marine ecosystems

Prof Rod Connolly

Tyson Martin

Micro-economics

Assoc Prof Chris Flemming

Dr Prof Jim Smart

Social Science

Dr Johanna Naulu

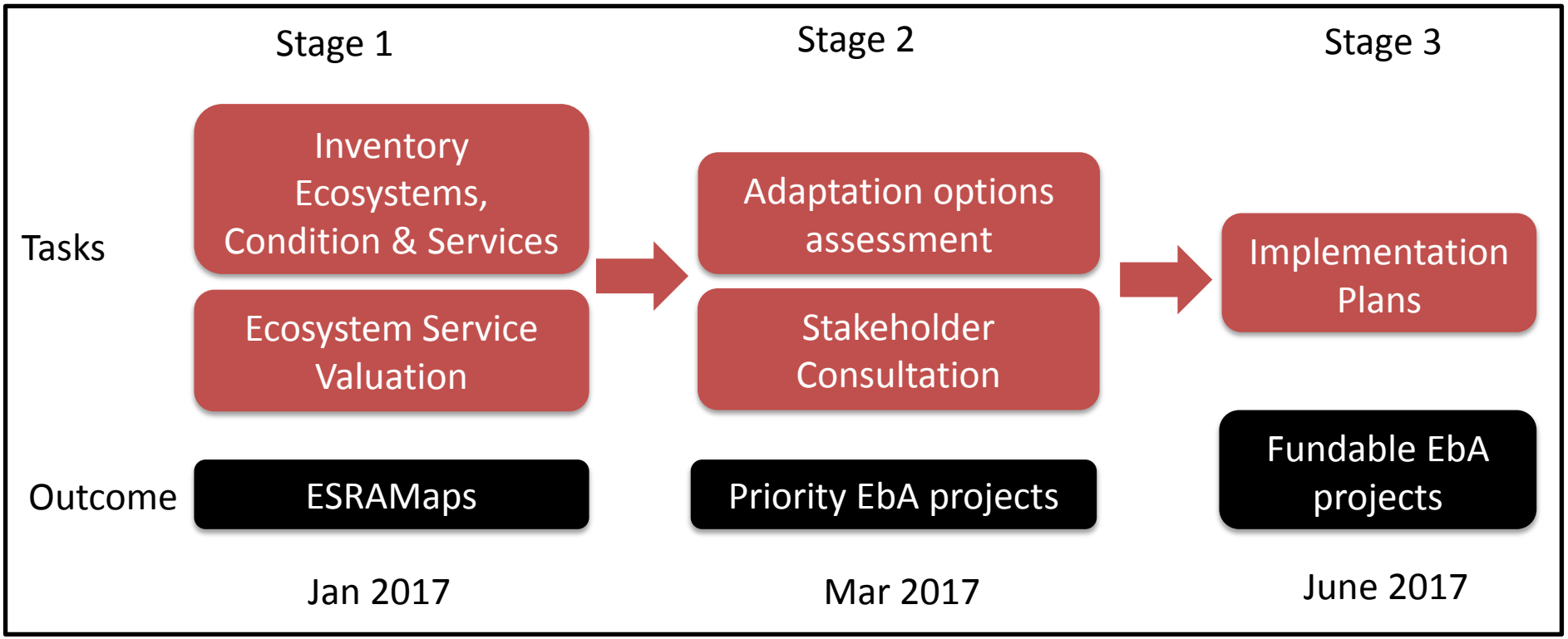
System integration & decision support

Dr Oz Sahin

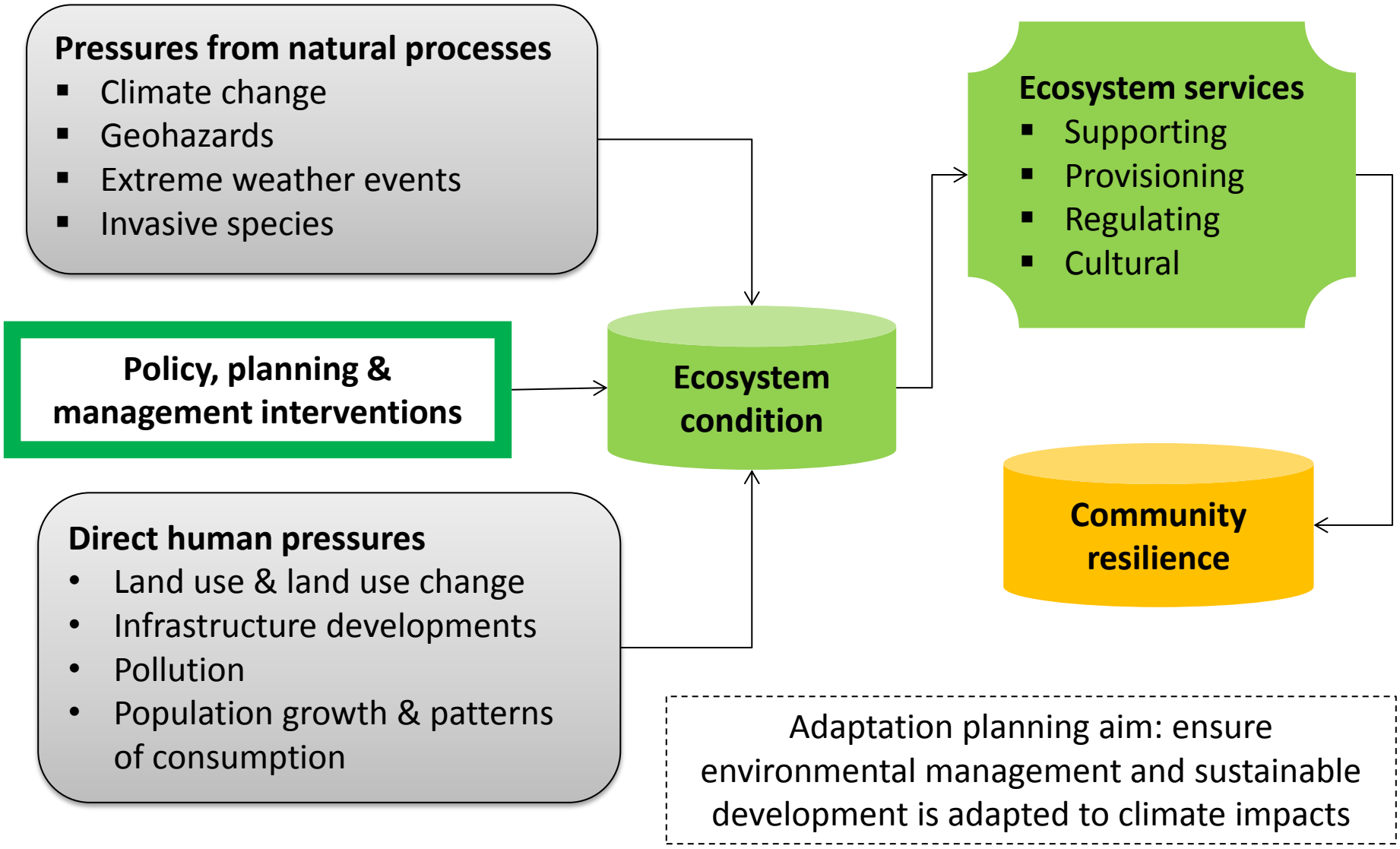
Project Outputs & Timeline

1. **Vanuatu national level ESRAM**
- The 'map' is GIS database and decision support systems

2. **Tanna Island ESRAM**
- ESRAMaps
- Project options assessment
- Project implementation plans



Conceptual Framework



Adaptation

'*The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects*.'

Adaptation enables the **resilience** of a system (socio-ecological, societal, ecosystem) to be maintained or strengthened to current or future pressures (threats, stresses, shocks)

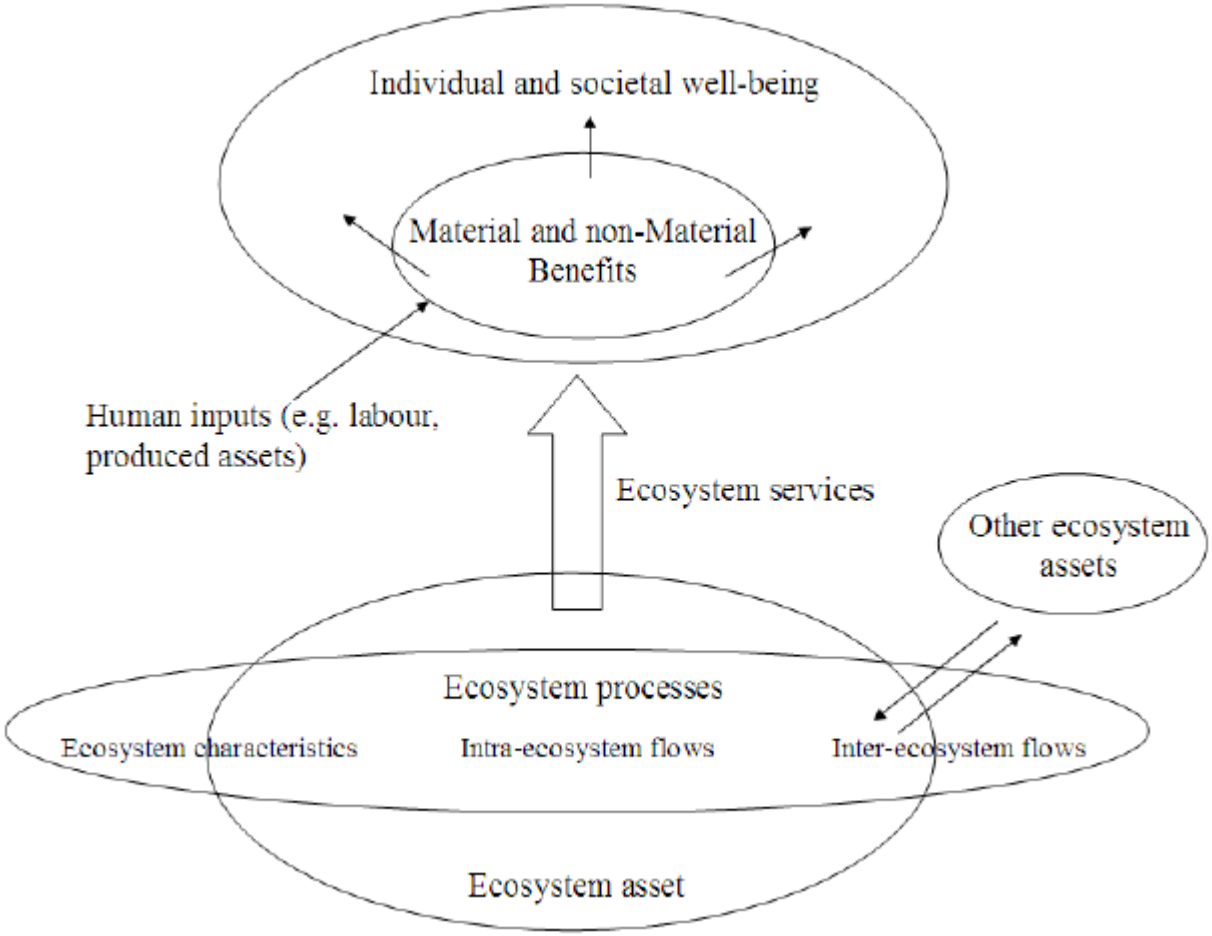
The pressures (threats, stresses, shocks) may be so great that the current system is maladapted. In which case, the system needs to have sufficient adaptive capacity to be **transformed** into a different kind of system, one that is resilient to the new circumstances.

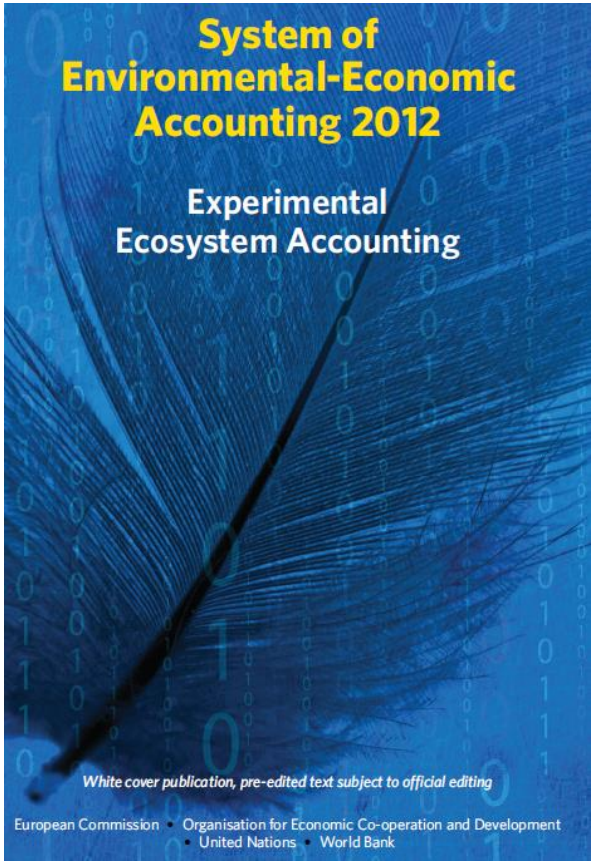
Adaptation planning & Decision Support

- The complex and integrated social, economic and environmental dimensions of climate change adaptation cannot be effectively managed using traditional approaches that focus only on one dimension and are unable to examine adaptation strategies in the face of alternative future scenarios, large uncertainties, and a range of stakeholder needs.
- Approaches are needed that are accessible (including for 'non-modellers'), reliable given the best available data, integrate social, economic and environmental factors, examine the trade-offs between different goals, and can account for the future impacts of a rapidly changing climate.
- A key aim is to identify planning options that are likely to be robust and result in desirable outcomes under a range of scenarios (i.e., plausible futures) given current and future development pathways and climate change impacts, among other things.

> *A first step towards adaptation to future climate change is reducing vulnerability and exposure to present climate variability (high confidence). Strategies include actions with co-benefits for other objectives.'* (Source: IPCC AR5 WGII)

What are ecosystem services





Ecosystem services do not result only from the harvesting or extraction of materials from ecosystems. They also result from the general functioning of the ecosystem (and to other characteristics of an ecosystem. Thus the term “services” is used here in an all-encompassing manner covering the various ways in which humans may benefit from ecosystems.

Ecosystem Services

Provisioning services

Products obtained from ecosystems

- Food
- Freshwater
- Fuelwood
- Fibre
- Biochemicals
- Genetic resources
- …
- …

Regulating services

Benefits obtained from regulation of ecosystem processes

- Climate regulation
- Disease regulation
- Water regulation
- Water purification
- …
- …
- …

Cultural services

Nonmaterial benefits obtained from ecosystems

- Cultural heritage
- Spiritual &religious
- Recreation & ecotourism
- Aesthetic & Inspirational
- Educational
- Sense of place
- …
- …

Supporting services

Services necessary for the production of all other ecosystem services

- Soil formation
- Nutrient cycling
- Primary production
- Pollination

Ecosystems & Human Wellbeing: a framework for Assessment. Millennium Ecosystem Assessment Report (2003)

Ecosystem Assets

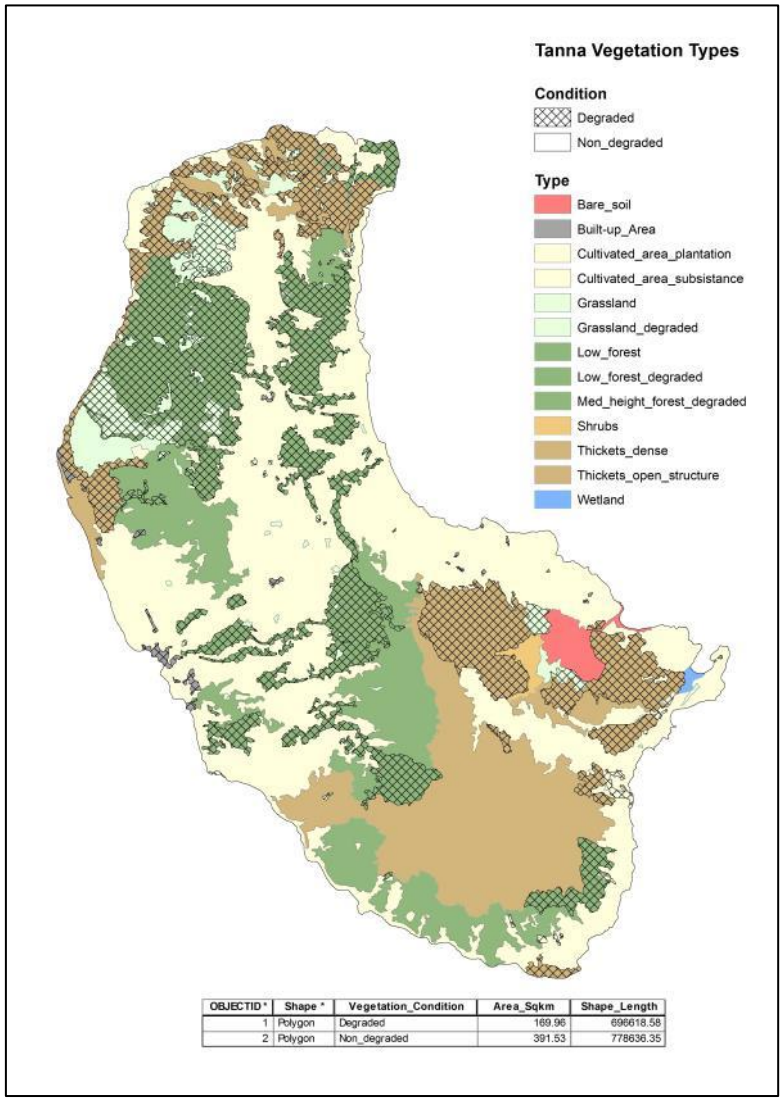
Ecosystem assets are spatial areas containing a combination of biotic and abiotic components and other characteristics that function together.

Ecosystem assets are measured in terms of:

1. Ecosystem type
2. Ecosystem extent
3. Ecosystem condition and
4. Ecosystem services

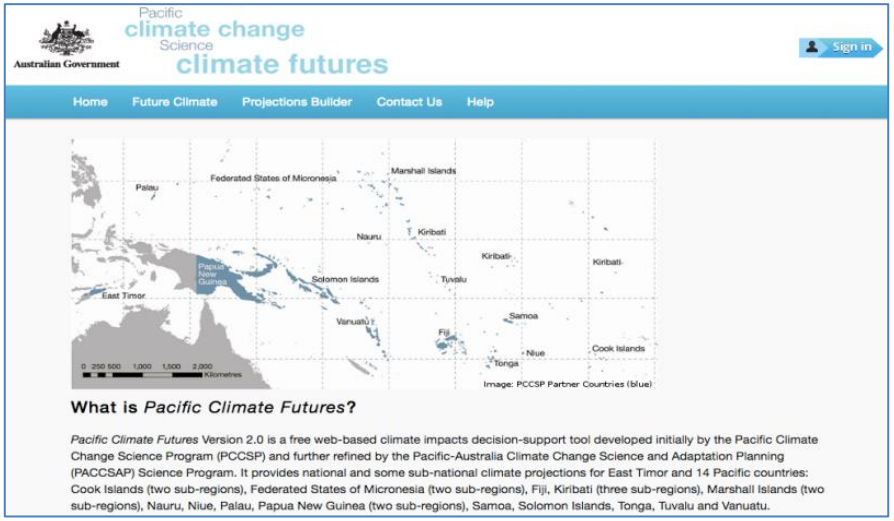
Progress on National Level ESRAM

Vanuatu Forestry Department Vegetation Map

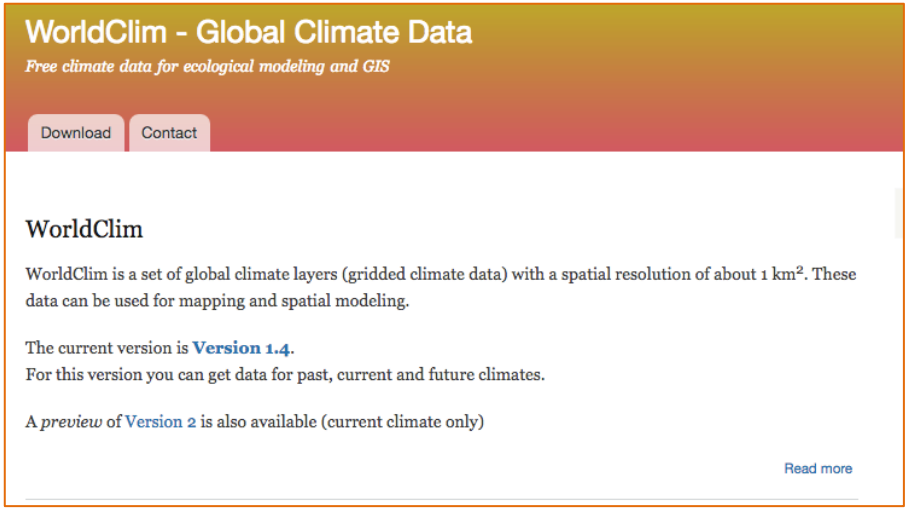


OBJECTID *	Shape *	Vegetation_Condition	Area_Sqkm	Shape_Length
1	Polygon	Degraded	169.96	696618.58
2	Polygon	Non_degraded	391.53	778636.35

Climate Change Impacts



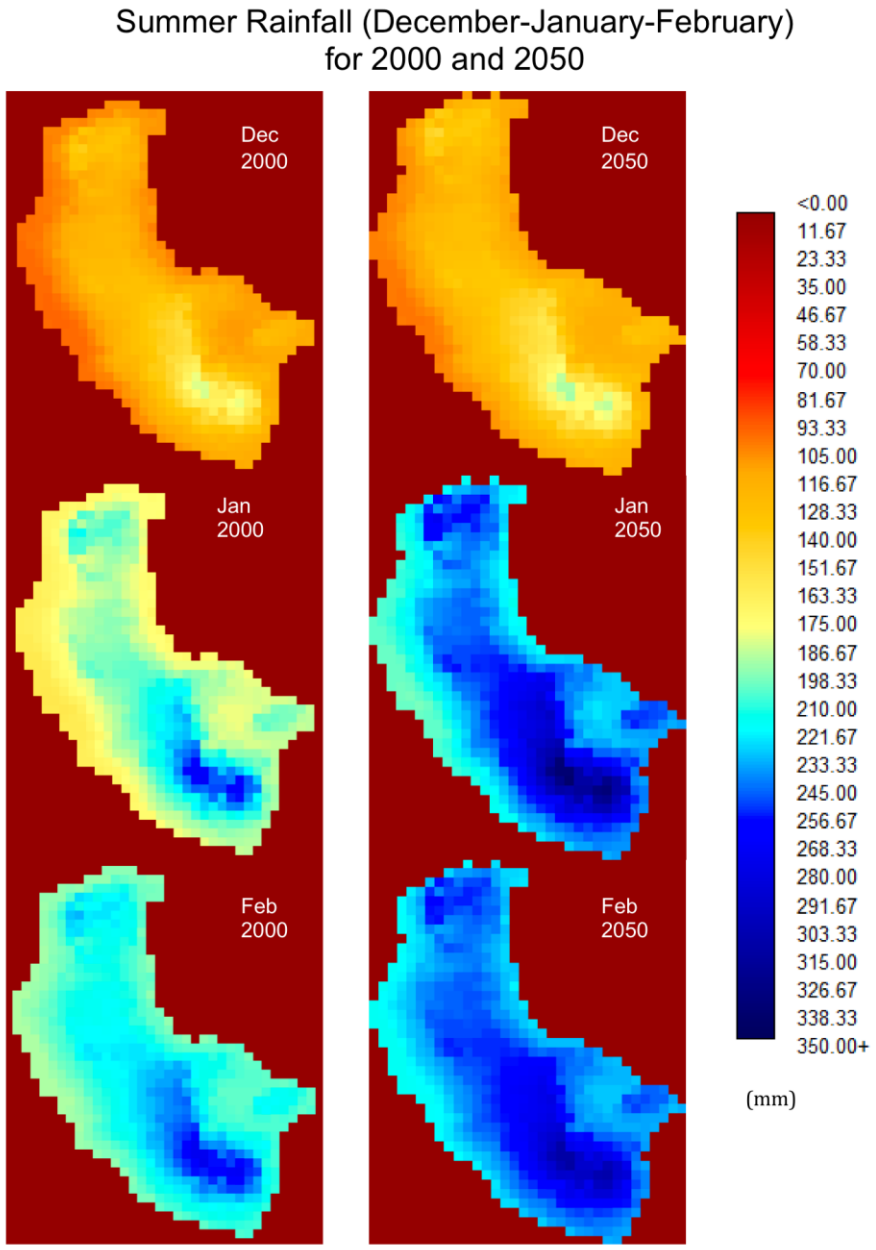
Which climate change model output should we use?



GIS data mapping current and future (2050 & 2070) climate

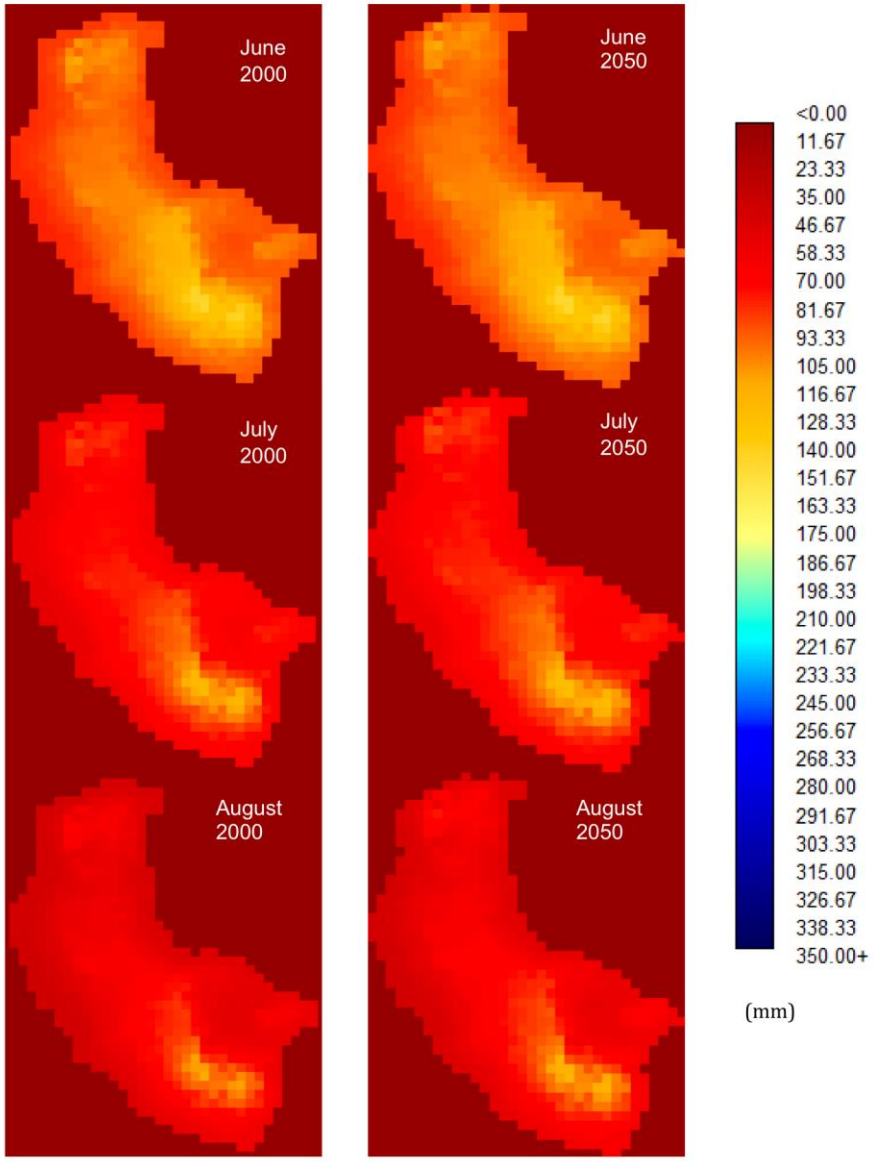
- mean monthly rainfall, min/max temperature
- Probability distribution function for extreme events

Climate change analysis for Tanna Island 2000-2050



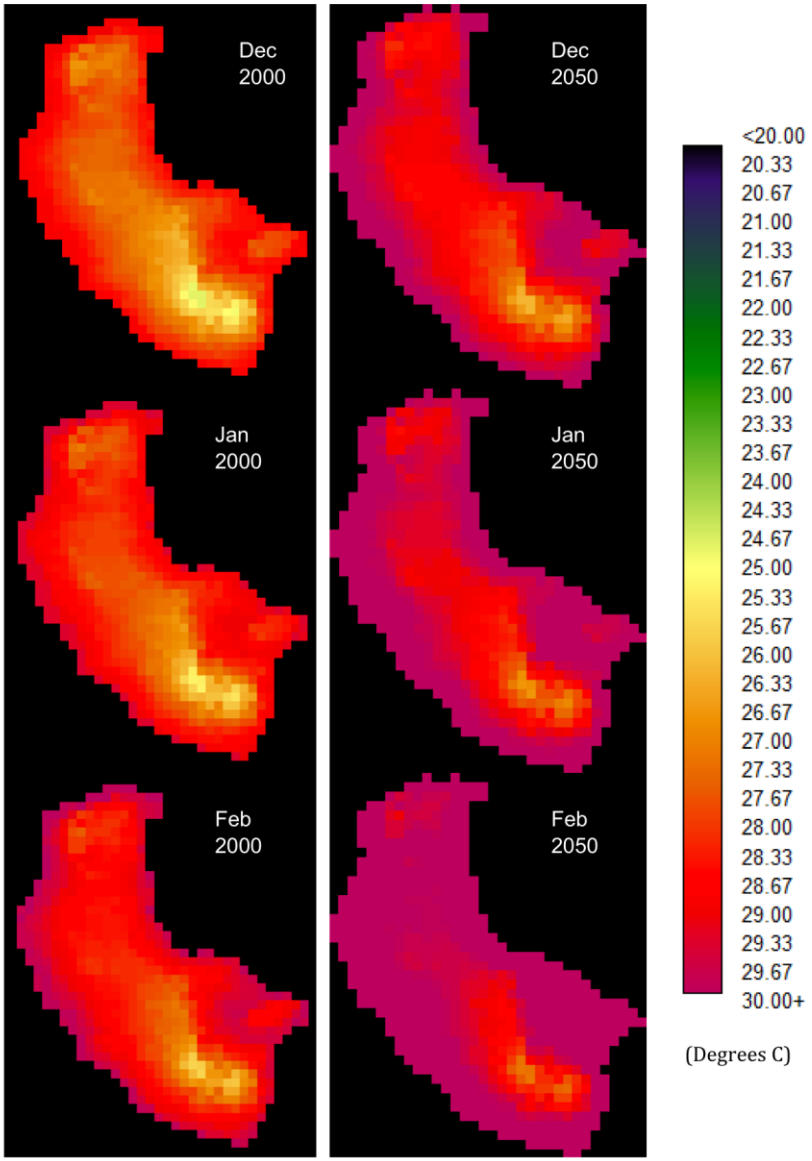
- Summer rainfall increases from December to February
- Highest rainfall in southern mountainous region
- Driest area on the west coast
- Major changes seen in Summer rainfall
- Slight increase in December
- Large increases in January and February
- January rainfall increases most

Winter Rainfall (June-July-August) for 2000 and 2050

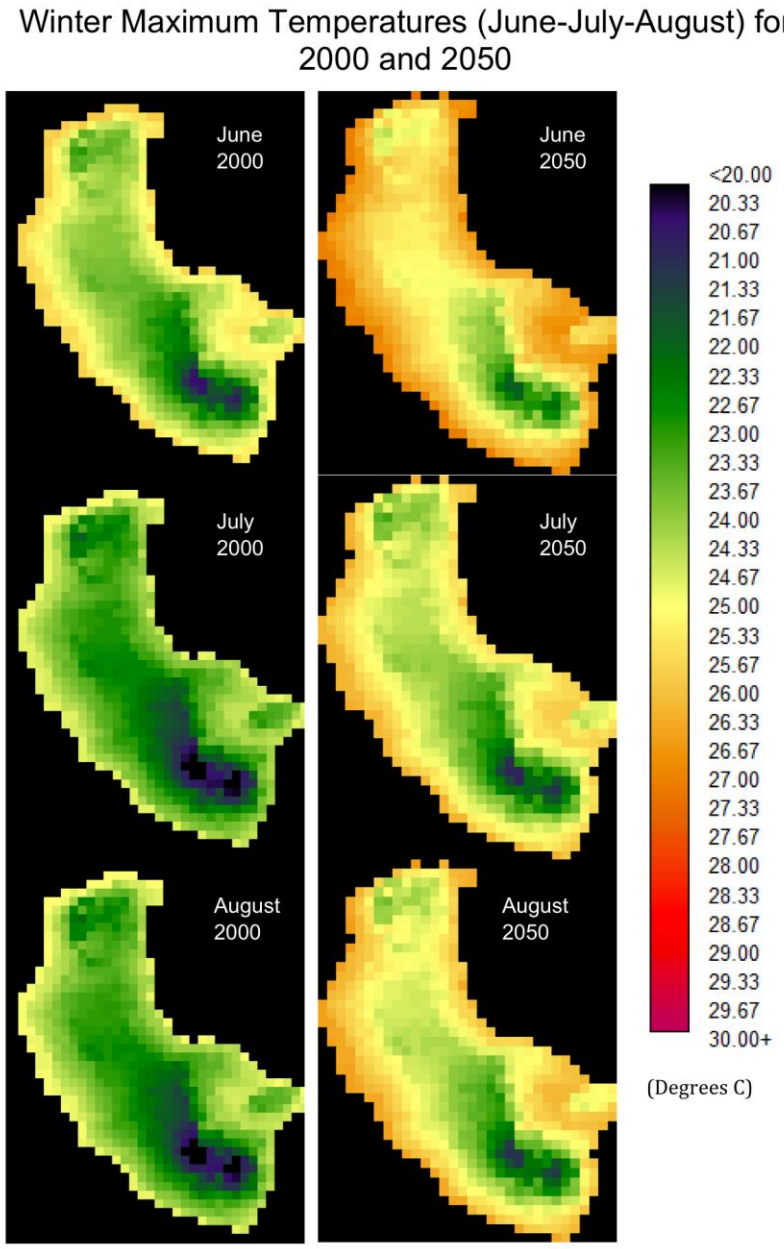


- Almost no change seen in Winter rainfall

Summer Maximum Temps (December-January-February)
for 2000 and 2050



- Maximum temperatures increase throughout the summer months
- Highest temperatures around the coastal areas, cooler temperatures with increasing elevation
- Moderate changes seen in Summer maximum temperatures
- Higher maximum temperatures are predicted for December, January and February



- Temperatures cool as the season progresses from June to August
- As for summer, coolest temperatures are at highest elevations; the coastal areas and lowlands are several degrees warmer
- Major changes seen in Winter maximum temperatures
- June is particularly warmer in 2050
- Difference in temperatures between the coast and mountains increases in 2050

A country-scale estimate of the monetary value of ecosystem service flows

Approach

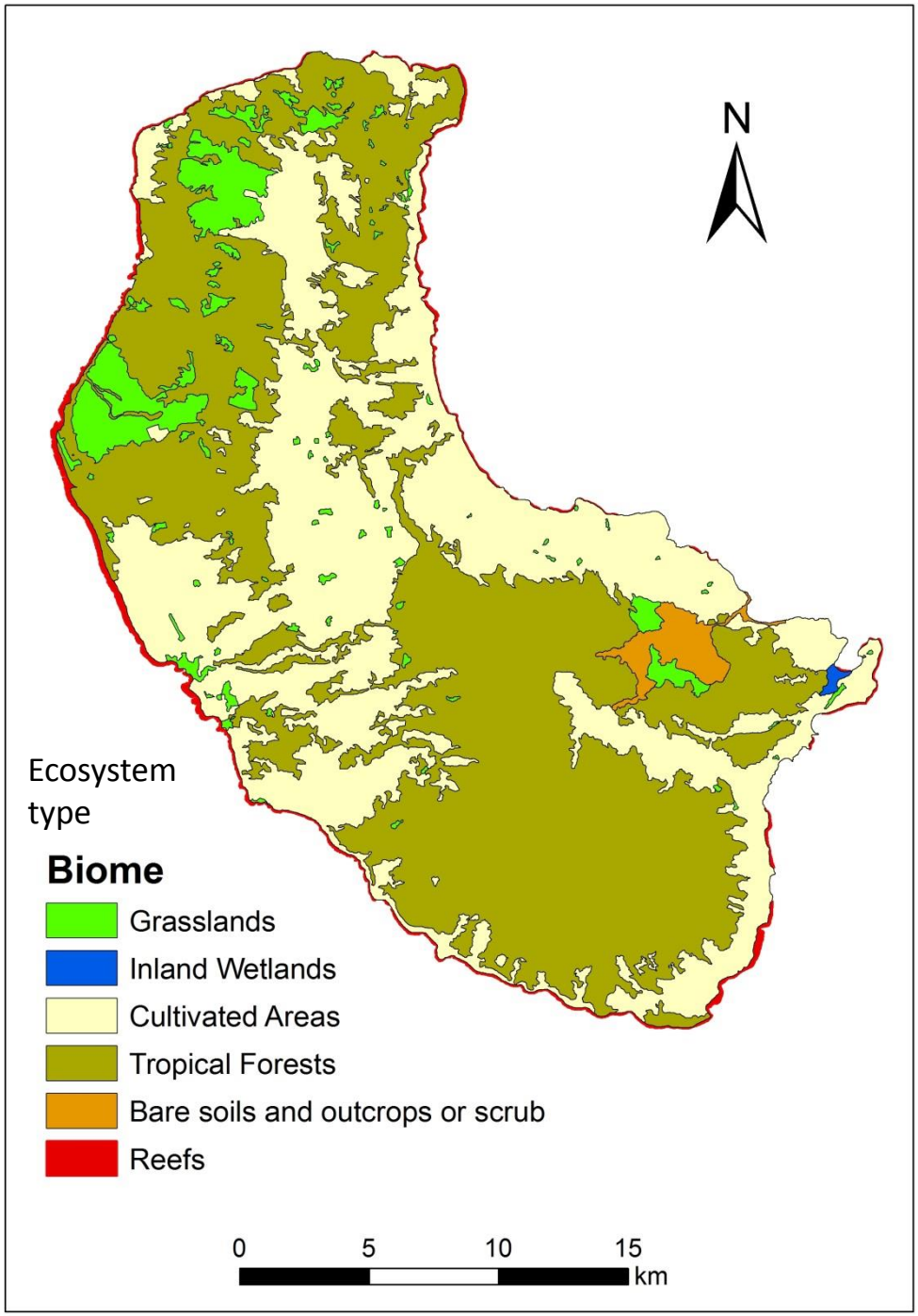
Our approach is to use data derived from de Groot, et al. (2012) to estimate a monetary value for seven relevant ecosystem types, for each ecosystem service flow, for each of the eight most populated islands in Vanuatu (Ambae, Ambrym, Efate, Epi, Espiritu Santo, Malakula, Pentecost and Tanna).

Together these islands account for approximately 85% of the population of Vanuatu. These monetary values will then be summed to yield an approximate country-wide estimate.

De Groot, R., Brander, L., Van Der Ploeg, S., Costanza, R., Bernard, F., Braat, L., ... & Hussain, S. (2012). Global estimates of the value of ecosystems and their services in monetary units. *Ecosystem services*, 1(1), 50-61.

Monetary values – Provisioning services

Service (USD/ha/year)	Coral reefs	Coastal systems	Coastal wetlands	Inland wetlands	Fresh water	Tropical forests	Grassland
Food	$201	$138	$342	$52	$1,573	$25	$1,359
Water	N/A	N/A	$54	$127	$3,096	$42	N/A
Raw materials	$36,672	$1	$105	$35	N/A	$47	$5
Genetic resources	$37,675	N/A	N/A	N/A	N/A	N/A	N/A
Medicinal resources	N/A	N/A	$344	$112	N/A	$1,715	$1
Ornamental resources	$895	N/A	N/A	$130	N/A	N/A	N/A


N
Ecosystem type
Biome
Grasslands
Inland Wetlands
Cultivated Areas
Tropical Forests
Bare soils and outcrops or scrub
Reefs
0
5
10
15
km

Monetary value of ecosystem types (Tanna Island)

	Coral reefs	Coastal systems	Coastal wetlands	Inland wetlands	Fresh water	Tropical forests	Grassland
Extent (ha)	N/A	N/A	N/A	58	N/A	30,053	2,924
Value (USD Million/ha/year)	$256,649	$29,670	$8,204	$8,441	$7,071	$3,202	$1,473
Value (USD Million/year)	**N/A**	**N/A**	**N/A**	**$0.5**	**N/A**	**$96.2**	**$4.3**

Progress on Tanna Island ESRAM

National vegetation map will be updated for Tanna Island using:

- RapidEye Satellite Image of Tanna Island (5m resolution)
- ‘Segmentation’ classification plus field data plus existing land cover mapping
- For mapping terrestrial and marine ecosystem

Terrestrial Ecosystem Condition Assessment

Vegetation class	0	I	II	III	IV	V	VI
	Bare	Intact & largely unmodified	Modified	Transformed (Highly modified)	Replaced-adventive (invasives)	Replaced – managed (cultivated	Removed
Current regenerative capacity						V.1 Healthy V.2 Degraded	
Vegetation structure							
Vegetation composition							

Reporting vegetation condition using modified the Vegetation Assets, States and Transitions (VAST) framework

Source: Thackway R. and Lesslie R. (2006) Ecological Management & Restoration 7 S1, S53-S62


Coastal Ecosystems
Condition Assessment

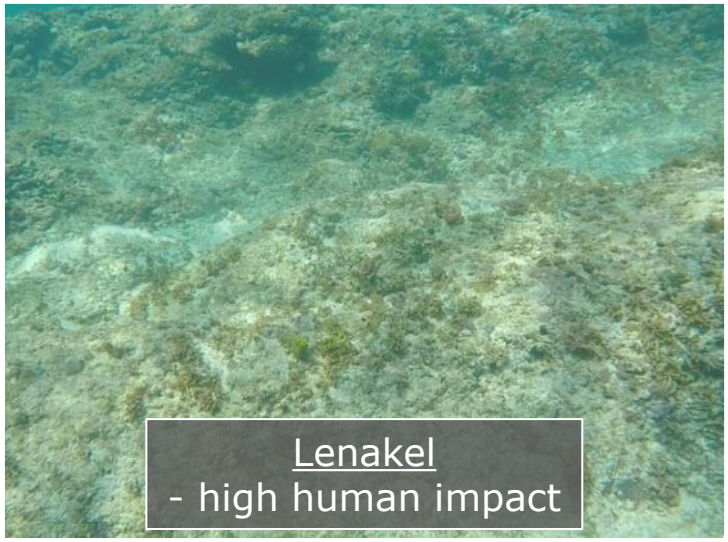
Marine Ecosystem Condition Assessment

Coral reefs *Seagrass meadows* *Mangrove forests*



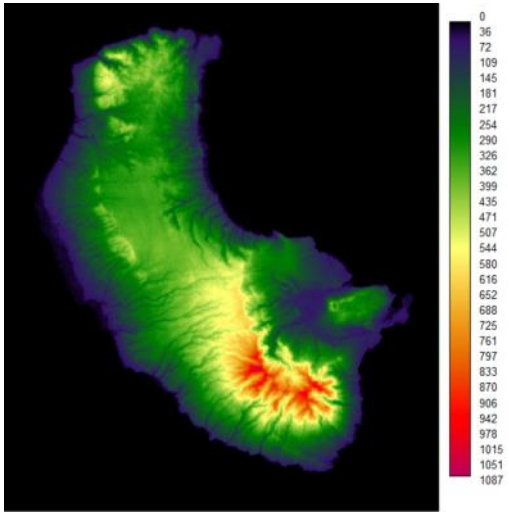
Detailed fish and coral surveys: Health, extent, species


North-west Whitegrass
- low human impact

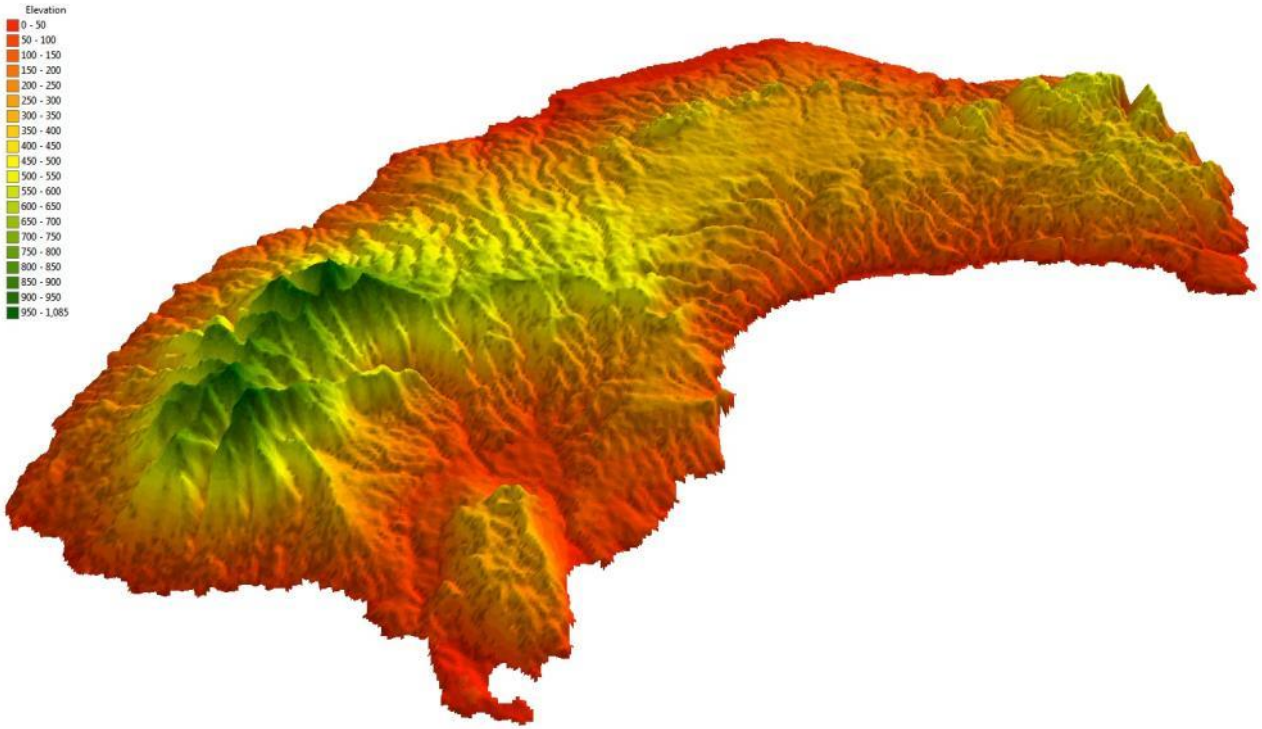

Lenakel
- high human impact


Port Resolution
- medium human impact

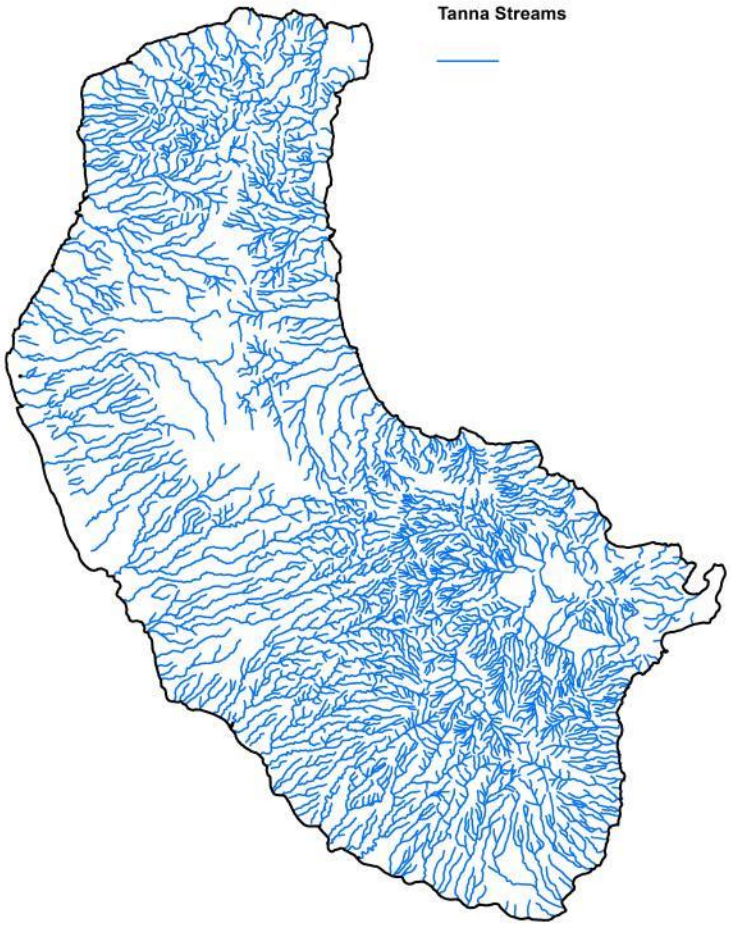
GIS-based Approach to ESRAM



ASTER Digital Elevation Model (DEM) of Tanna Island (30m resolution)

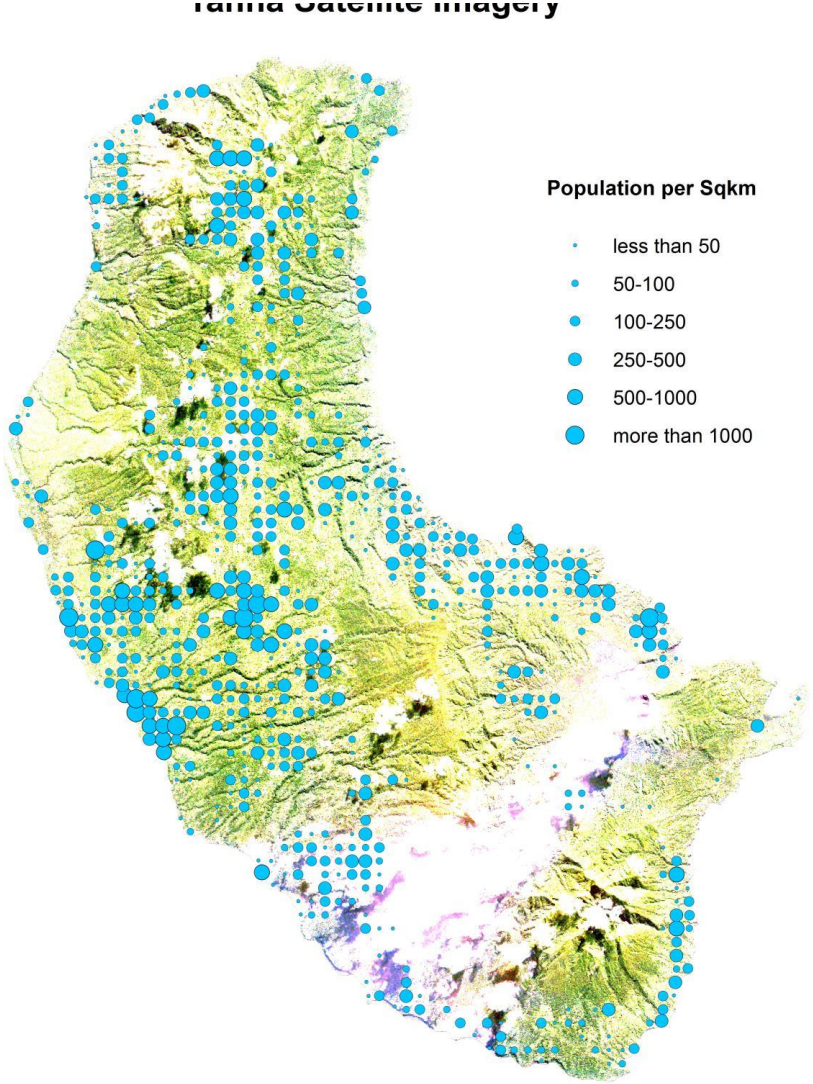


Stream Network

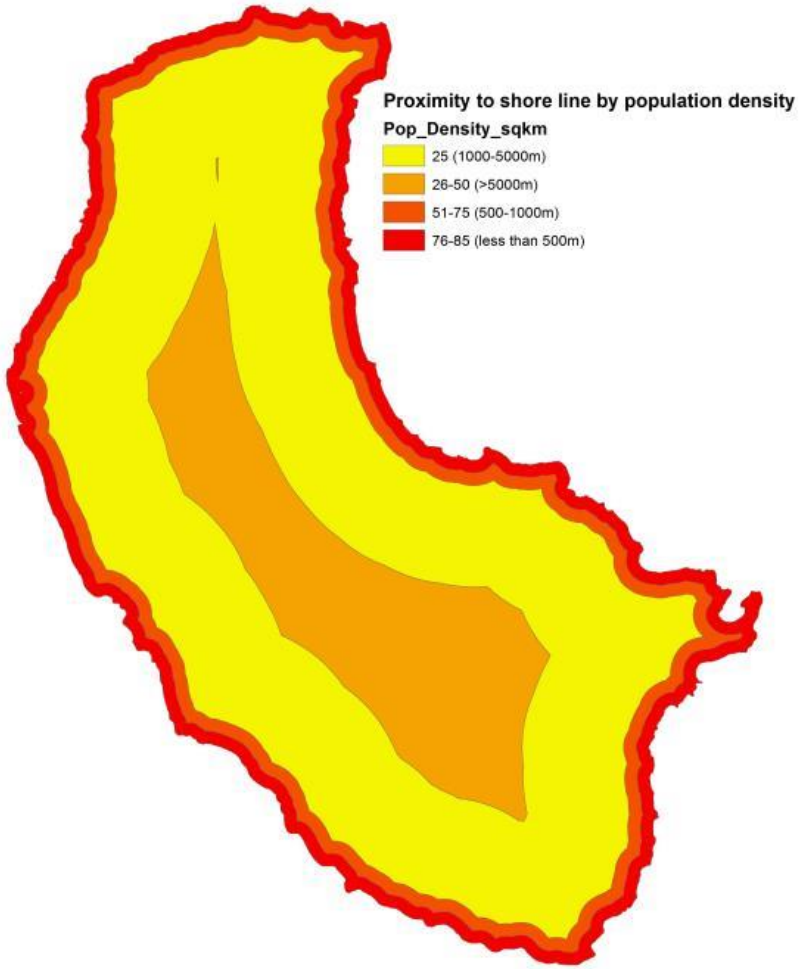


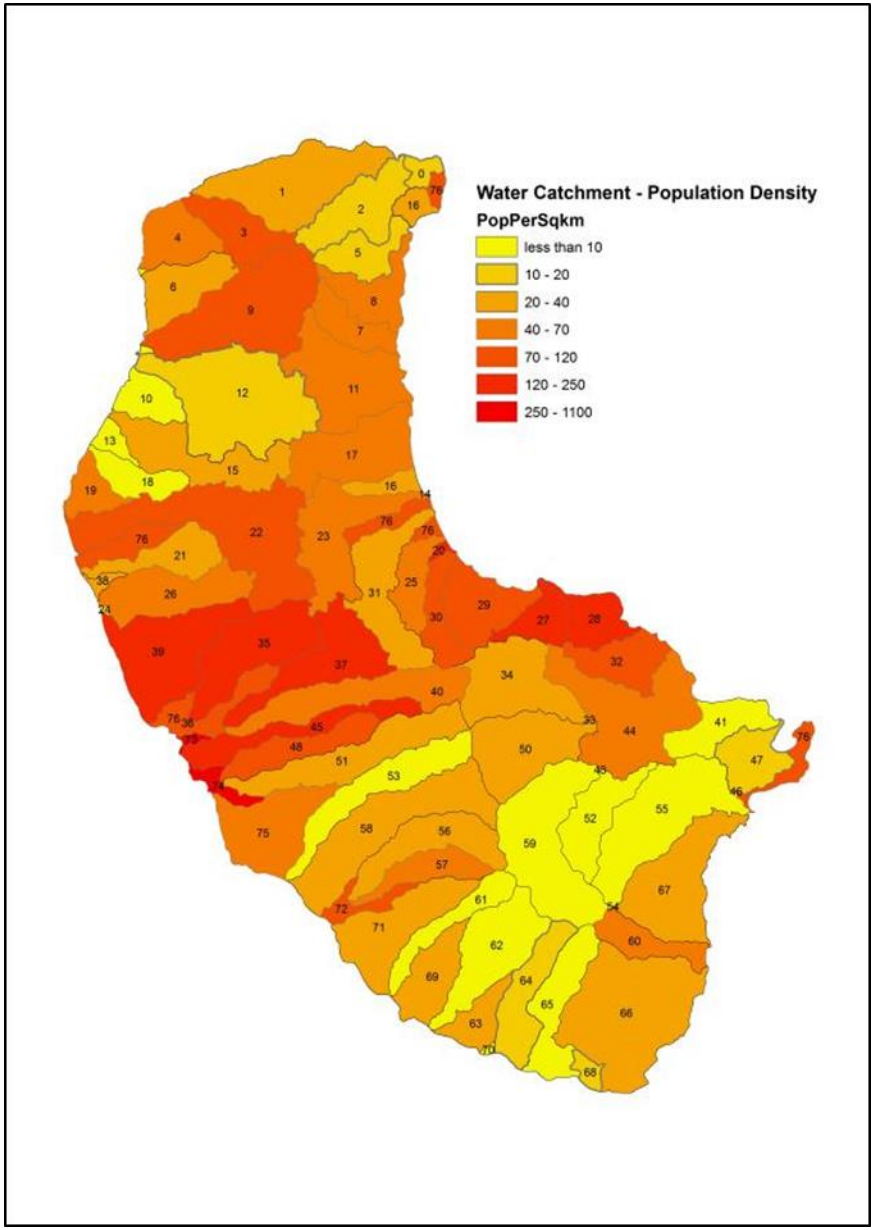

Tanna Catchments

Population from 2009 national census

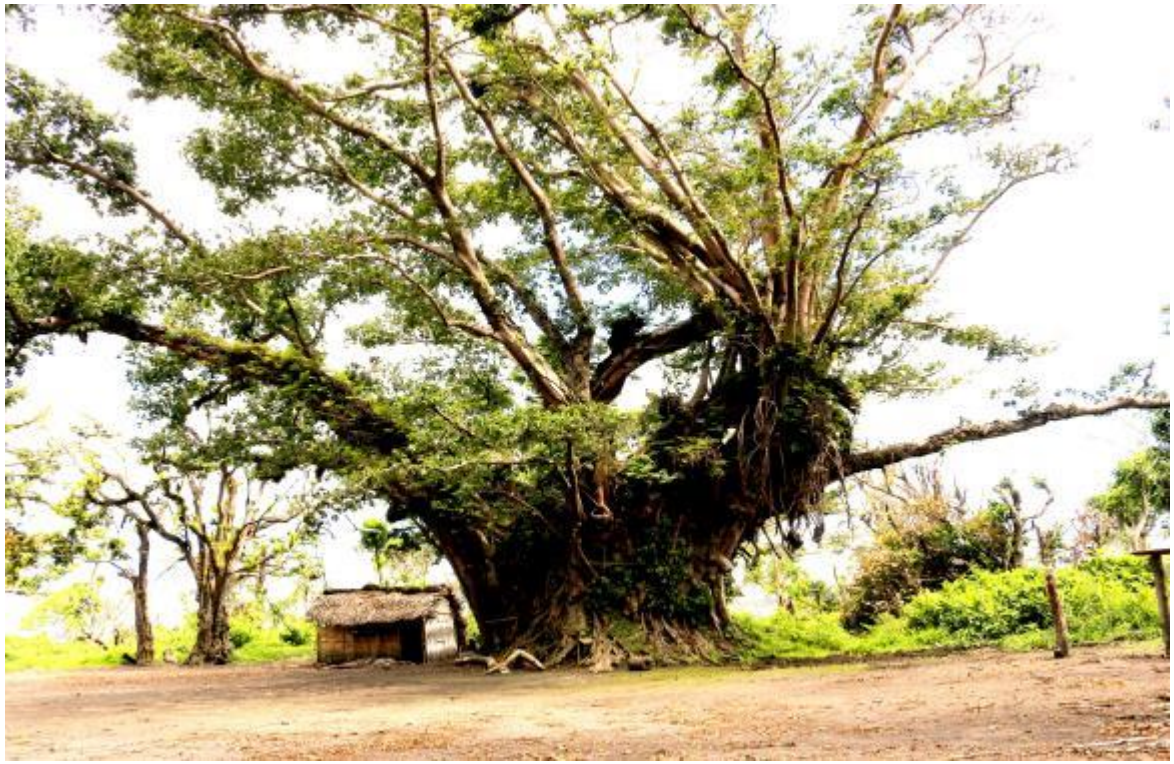


Analyses enabled by a GIS-based Approach





Tanna island
Social Science component



Tanna island

- 44 000 people, 7 different languages
- Most famous for strong ‘kastom’
- Home for the Yasur volcano

ESRAM Social Science Methodology

Engaging with the communities in the ESRAM process:

- Meeting with tribes in case study/project locations: meeting first with chiefs to discuss the projects, and conducting community discussions with both women's and men's groups
- Local fieldwork assistants as interpreters (from Tannese to Bislama/English)
- Meetings and workshops also with provincial government, NGOs, and tourism operators
- Subsequent semi-structured interviews for more detailed information where feasible

ESRAM Social Science Methodology

Engaging with the communities in the ESRAM process:

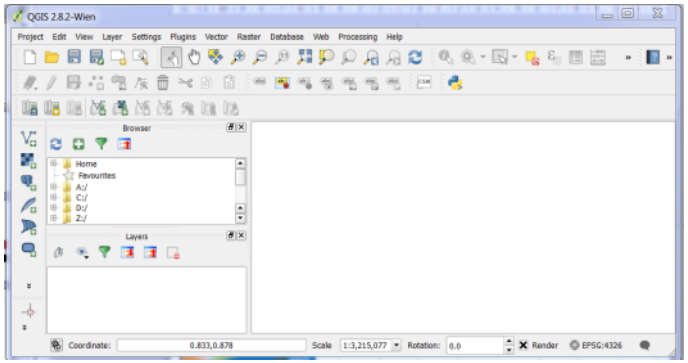
- Scoping out main development and livelihood issues with the communities → creating context-specific understanding of the challenges and opportunities
- Development of Community-based Monitoring and Evaluation (M&E) processes and indicators
- Identifying relevant Traditional Knowledge practices (kastom) to be included in each project activity
- Integrating gender equality in project roles and management practices

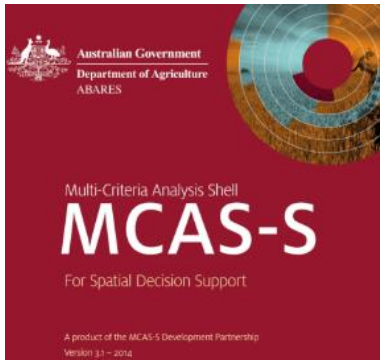
Governance & Stakeholder consultations

Who

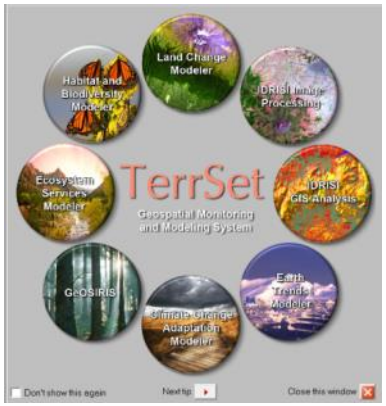
- Tanna Customary land owner communities – men, woman
- Tanna Area Councils
- Tanna Council of Chiefs
- Tafea Provincial Government officers
- Vanuatu Government
- Other IGOs and NGOs
- Businesses

Planning & Decision Support Tools



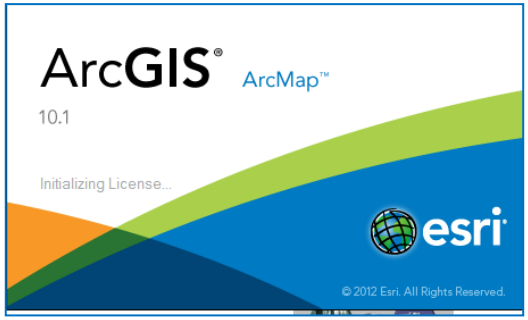


High level DST for stakeholders to explore scenarios, options and trade-offs



Mid-level modelling & visualisation tool

- Ecosystem service evaluations
- Catchment processes
- Land cover and land use change
- Future climate impacts



Advanced GIS for mapping and spatial analysis

Potential Project Pressures & Solutions

1st Stakeholder Workshop, Lenakel, Tanna Island, November 2016 where participants discussed: (1) ecosystem benefits, (2) pressures and (3) solutions

Key issues:

- Declining subsistence food security
- Declining water supply and quality
- Degradation of forest and coral reef ecosystems
- Environmental and social impacts of rapid tourism development and associated infrastructure
- Rising levels of waste, including plastics & pollution
- Social impacts of modernisation and challenges to kastom governance

Possible Solutions:

- Community Conservation Areas
- Sustainable subsistence food production systems
- Sustainable Development Planning
- …