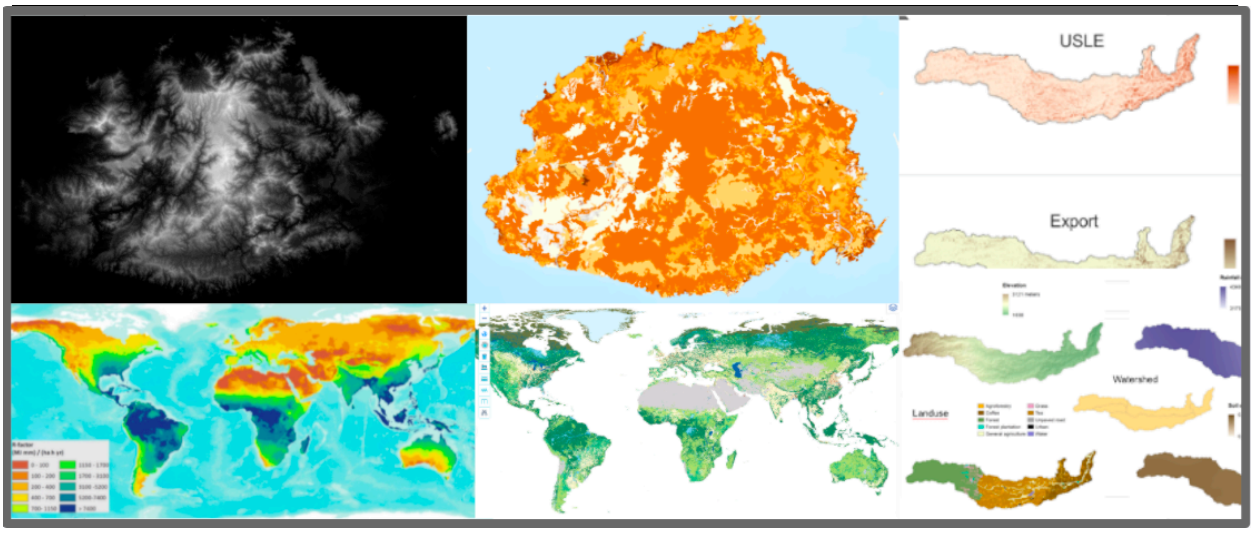
INTERNATIONAL WATERS EXPERIENCE NOTES

2021-02

Spatial Prioritization and Planning Procedures – Planning Trials in several PICs



Abstract:

The resourcing and capacity to collect field data and conduct environmental monitoring watersheds and coastal areas throughout an entire catchment and country is limited. Spatial prioritisation and environmental modelling using global dataset inputs can help fill data gaps, earmark specific priority catchments and spatial zones for environmental monitoring and model various future scenarios. The aim of this study was to assess the potential for replication of this approach. The spatial prioritisation approach outlined in Vanuatu using Natural Capital InVEST models and ArcGIS / QGIS hydrological modelling toolboxes has the potential to address the requirements for spatial prioritisation on IW R2R program contexts. However, the replication of this method may not be particularly easy because this method requires significant groundwork to research, download and process all data inputs into the model. The study identifies some of the key barriers and enablers in this process.

Nicholas Metherall
nicholas.metherall@anu.edu.au
Pacific Institute of Environment and Sustainable Development (PaCE-SD)
University of the South Pacific

Spatial Prioritization and Planning Procedures – Planning Trials in several PICs

Experience of the GEF - sponsored
GEF/SPC: GEF International Waters Pacific R2R
GEFID: 5404, [[GEF Agency Project ID]]: 00092601

PROJECT DESCRIPTION

The project's objective is for the Consultancy to support delivery of the Science Workplan for the Regional International Waters Ridge to Reef (IW R2R) Project. The timeframe from the project contract document states a project commencement in December 2020 with the aim for completion by September 2021.

The specific project activity is output of milestone 3: Spatial prioritization procedures. This work includes making inputs into local & national scale modelling & trials, packaged models and maps. This will also include data collection for model calibration including:

- Inputs into terrestrial and marine models calibrated with national data
- Inputs into local & national scale reporting

This experience note sets out some of the learnings about the major barriers and enablers identified in following this method of spatial prioritisation and enabling replication for local stakeholders in SPC member countries' Government and students from the Pacific.

THE EXPERIENCE

Issue: ridge-to-reef ecosystems are increasingly vulnerable to expanding settlements, land use change, point and non-point source pollution, distorted sediment and nutrient transport cycles and the associated changes to water chemistry. This increasing exposure threatens various ecosystem services, biodiversity, and livelihoods. The resourcing and capacity to collect field data and conduct environmental monitoring watersheds and coastal areas throughout an entire catchment and country is limited.

The project activity of spatial prioritisation is proposed to mitigate the problem by providing a robust and quantifiable scientific evidence base to earmark specific priority catchments and spatial zones for environmental monitoring.

Addressing the Issue: within ridge-to-reef monitoring, spatial prioritization aims to provide scientific evidence base as a decision-making tool. Spatial prioritization and modelling include two main components:

1) a tool to highlight the priority areas for further environmental monitoring
2) a method for modelling outcomes under various scenarios of land use change (e.g., conservation vs further land clearing).

The specific actions undertaken in this work includes the following:

1) Review of reports on past examples of IW R2R GIS spatial prioritization and the environmental modelling land-sea framework.
2) Review of peer-reviewed scientific journal articles on the GIS spatial prioritization and the environmental modelling land-sea framework.
3) Stocktake and drafting checklist of existing and required datasets
4) Downloading relevant datasets
5) Processing datasets
6) Trialling InVEST Sediment Delivery Ratio Model for Solomon Islands / Fiji depending on data availability for volcanic island case study.
7) Trialling InVEST coastal vulnerability model for low-lying atoll country case study.
8) Troubleshooting with Dr Delevaux and Natural Capital Project support team, Stanford University.
9) Seeking first round inputs, feedback, and verification from SPC Science Team including Dr Sauni.
10) Seeking inputs, feedback and verification from Dr Delevaux and Natural Capital Project support team, Stanford University.
11) Revising approach to focus on available datasets (delayed Solomon Islands case study to focus on Fiji).
12) Seeking final inputs, feedback, and verification from SPC Science Team including Dr Sauni.

RESULTS AND LEARNING

As a result of the research into spatial prioritisation, it was found that the case studies undertaken have significant potential to shed light on IW R2R program contexts. However, this method requires significant groundwork to research, download and process all data inputs into the model.

The methods outlined in the Vanuatu spatial prioritisation report provides a useful overview of the methodology used for spatial prioritisation. This consultancy will undertake further work will be needed to outline all the steps taken to generate all the data inputs and modelling outputs in greater detail to allow for replication noting this will require more time.

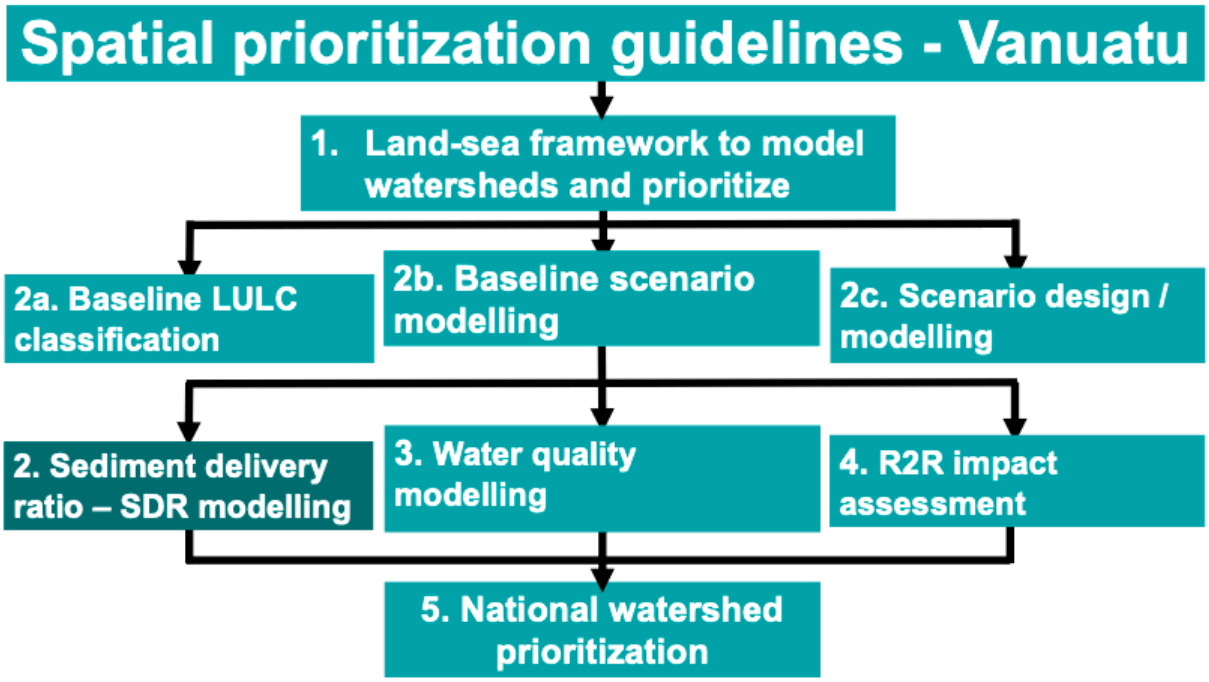


Figure 1. High level overview of steps followed in spatial prioritisation process for the Vanuatu report. This study focused on the sediment delivery ratio (SDR) InVEST Model.

From the research into the Sediment Delivery Ratio (SDR), it was found that the following dataset sources can be used for this model and others.

1. DEM – NASA Aster and SRTM dataset via Earth Engine - NASA ASTER GDEM 30m resolution: https://asterweb.jpl.nasa.gov/gdem.asp
2. Erosivity – Global Erosivity: https://esdac.jrc.ec.europa.eu/themes/global-rainfall-erosivity
3. Erodibility – ISRIC soils library: https://www.isric.org/explore/library
4. Landcover – GLOBELAND Cover http://globallandcover.com/
5. The InVEST Model Guidelines: https://storage.googleapis.com/releases.naturalcapitalproject.org/invest-userguide/latest/getting_started.html#formatting-your-data

Further time will be needed to complete this research and scoping process for the three required case studies (e.g., Fiji, Solomon Islands, and a low-lying atoll case study) and to write up a set of guidelines for replication.

REPLICATION

In terms of replicating these methods, figure 2 highlights the breakdown of a general workflow of how time will be required for each of the steps. Note that significant time is required for the collation of model input data, processing of datasets, digitisation where needed and trialling and troubleshooting. There are many sub-steps required for each of these processes that are not fully outlined in existing guidelines. Therefore, this consultancy will work on developing more comprehensive guidelines.

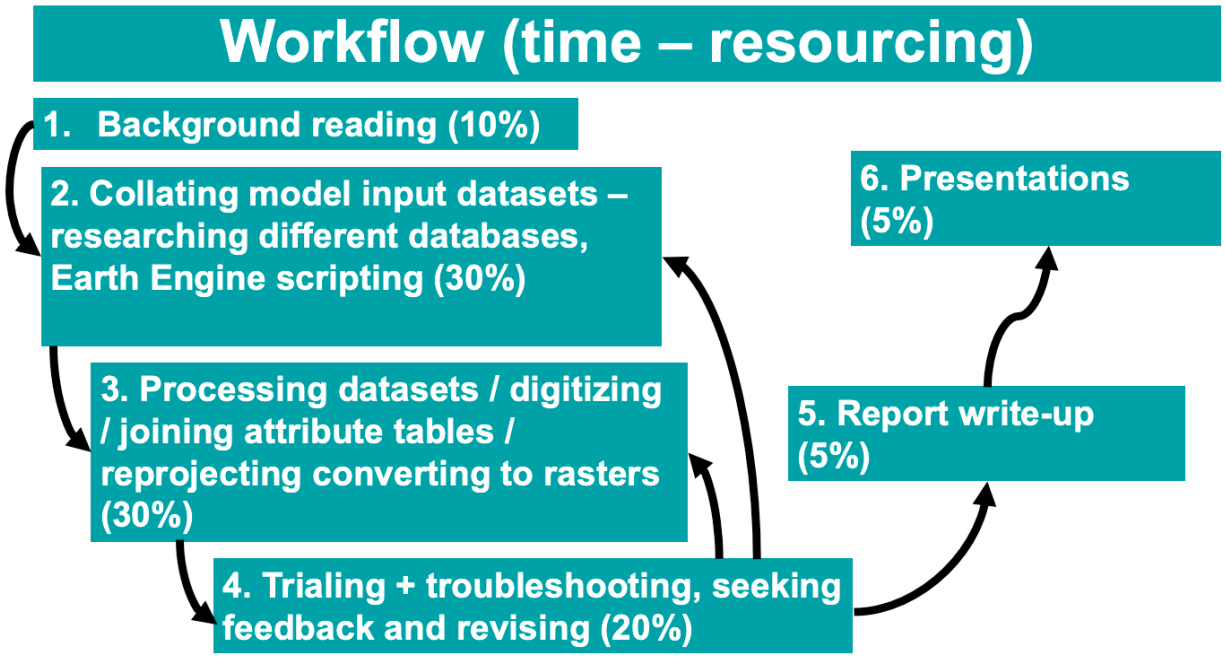


Figure 2. Workflow of time and resourcing for steps needed for replication of this method.

Due to the significant groundwater to research, download and process all data inputs into the model, this will not always be a user-friendly nor and accessible method to follow. Adequate time and training will be required including multi-day capacity building workshops if partner country staff are seeking to replicate these methods. An example of a step that could potentially require more time would be the digitisation and processing of soil layers for more accurate results as shown in figure 3. In cases where this is not possible or where data is incomplete (i.e., Solomon Islands), we will be able to make use of global datasets.

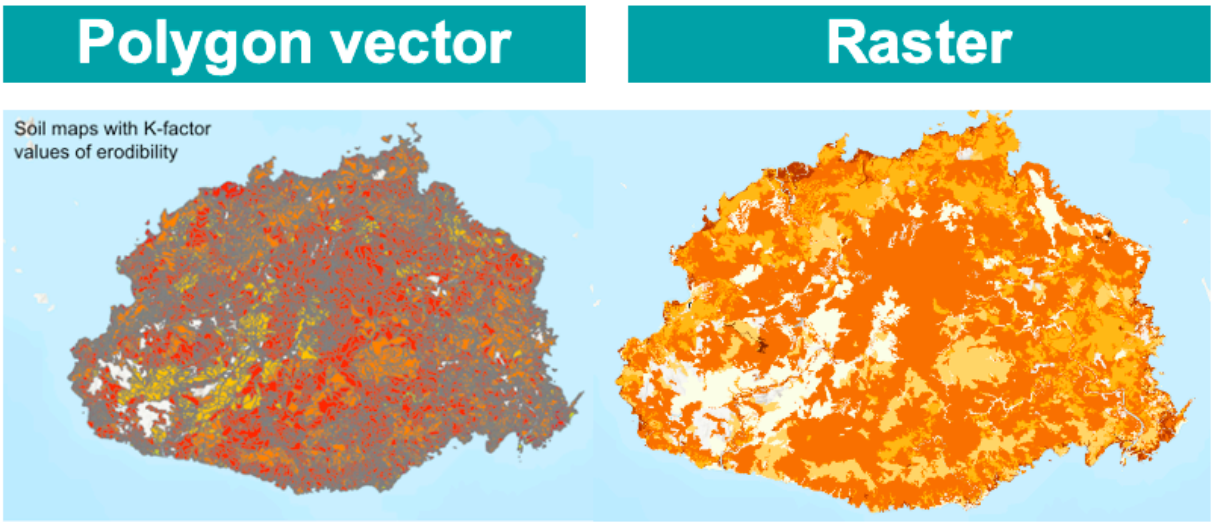


Figure 3. Processing polygon vector spatial data and joining attribute tables with additional soil description data to convert soil composition to an erodibility K-value and then visualise this. The polygon vectors should also be converted to rasters.

The InVEST Model Guidelines are informative and provide the overviews of all datasets. However, the guidelines do not provide all steps required to complete a model and therefore some of the work of this consultancy will be to develop method guidelines for processing the data and preparing it for the models.

There have been some issues with the Model software including various errors with version updates, data inputs, formatting of data and data outputs. The support community through the Natural Capital Project and Stanford University are a responsive and helpful community that have provided some inputs to help with troubleshooting these issues.

The software required is all open access so there is no pay barrier for this software. However, the processing can be aided with an optional ArcGIS subscription as this is more accessible and efficient than the open-source QGIS option.

SIGNIFICANCE

Spatial prioritisation and environmental modelling have the potential to support decision making. The use of remote sensing global, national-scale data inputs has the potential to fill many data gaps. This becomes increasingly important during a global pandemic with associated travel restrictions that limit the ability to capture field data and conduct environmental monitoring.

REFERENCES

Anderson, T. R., Fletcher, C. H., Barbee, M. M., Romine, B. M., Lemmo, S., & Delevaux, J. M. (2018). Modeling multiple sea level rise stresses reveals up to twice the land at risk compared to strictly passive flooding methods. *Scientific reports*, *8*(1), 1-14.

Ashiagbor, G., Forkuo, E. K., Laari, P., & Aabeyir, R. (2013). Modeling soil erosion using RUSLE and GIS tools. *Int J Remote Sens Geosci*, *2*(4), 1-17.

Borselli, L., Cassi, P., Torri, D., 2008. Prolegomena to sediment and flow connectivity in the landscape: A GIS and field numerical assessment. Catena 75, 268-277.

Delevaux, J. M., Whittier, R., Stamoulis, K. A., Bremer, L. L., Jupiter, S., Friedlander, A. M., ... & Ticktin, T. (2018). A linked land-sea modeling framework to inform ridge-to-reef management in high oceanic islands. *PloS one*, *13*(3), e0193230.

Delevaux, J., Winter, K. B., Jupiter, S. D., Blaich-Vaughan, M., Stamoulis, K. A., Bremer, L. L., ... & Ticktin, T. (2018). Linking land and sea through collaborative research to inform contemporary applications of traditional resource management in Hawai ʻi. *Sustainability*, *10*(9), 3147.

Dumas, P., & Printemps, J. (2010, April). Assessment of soil erosion using USLE model and GIS for integrated watershed and coastal zone management in the South Pacific Islands. In *Proceedings Interpraevent, International Symposium in Pacific Rim, Taipei, Taiwan* (pp. 856-866).

Ram, A. R., Brook, M. S., & Cronin, S. J. (2019). Engineering geomorphological investigation of the Kasavu landslide, Viti Levu, Fiji. *Landslides*, *16*(7), 1341-1351.

Ram, A. R., Brook, M. S., & Cronin, S. J. (2018). Geomorphological characteristics of slope failures in northeast Viti Levu Island, Fiji, triggered by Tropical Cyclone Winston in February 2016. *New Zealand Geographer*, *74*(2), 64-76.

Ram, A. R., & Terry, J. P. (2016). Stream turbidity responses to storm events in a pristine rainforest watershed on the Coral Coast of southern Fiji. *International Journal of Sediment Research*, *31*(4), 279-290.

Ram, A. R., & Terry, J. P. Land use and erosion risk in small forest catchments on the Coral Coast of Fiji: baseline estimates of sediment inputs to coastal lagoons.

Stamoulis, K. A., & Delevaux, J. M. (2015). Data requirements and tools to operationalize marine spatial planning in the United States. *Ocean & Coastal Management*, *116*, 214-223.

Stamoulis, K. A., Delevaux, J. M., Williams, I. D., Poti, M., Lecky, J., Costa, B., ... & Friedlander, A. M. (2018). Seascape models reveal places to focus coastal fisheries management. *Ecological Applications*, *28*(4), 910-925.

KEYWORDS

- GIS
- modelling
- Forest
- Water basin
- Monitoring