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ALLEN CORAL ATLAS FOR CORAL REEF MANAGEMENT IN INDONESIA: A BRIEF REVIEW

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USAID Sustainable Ecosystems Advanced (SEA) Project

Coral reefs are in decline in Indonesia[1] and worldwide[2]. Coastal development, overfishing, pollution, and coral bleaching are the major pressures and threats for this ecosystem in Indonesia[3]. It was estimated that more than 90% of coral reefs in Indonesia are impacted by various local activities[4] (i.e. destructive fishing, overfishing, anchoring, boat activities, trash etc.). It is obvious that our coral reefs are in a declining state and thus adaptive coral reef management should be quickly adopted and implemented by the Indonesian government to respond to the call to protect our coral reefs.

The lack of accurate data for coral reef management in Indonesia has disconnected the policymakers with the real status of coral reef conditions in the field which can lead to inappropriate decision making. At the regional scale, the Coral Triangle (CT) Atlas has been set up to support the six countries (Indonesia, Malaysia, Philippines, Papua New Guinea, Solomon Islands, Timor-Leste) as part of Coral Triangle Initiative–Coral Reef, Fisheries and Food Security (CTI-CFF) monitoring and evaluation system. However, the CT Atlas team found relatively poor quality and inappropriately-used data when accessing regional and national spatial datasets on coral reefs, mangroves and marine protected areas including such data from Indonesia[5]. Given the relatively weak existing data, planning for ecologically marine protected areas and their networks is difficult and the result affects the success of conservation and coral reef management in Indonesia.

Furthermore, it's very difficult to get accurate and free high-resolution coral reefs datasets through online mechanisms. Lack of data sharing mechanisms and limited budget and resources are key challenges for Indonesia, which needs marine projects to fill in the data gaps on reef and related ecosystems that will be used for the planning of new marine protected areas, marine spatial planning, coral reef management, and ecosystem-based management. For example, the key issues for the coral reef datasets in Indonesia are 1) *out of date (i.e. 2000 reefs data);* 2) *low resolution and very broad classes of reefs (i.e. reef or non-reef);* 3) *lack of data accuracy and* 4) *differences in mapping methods.*

Recently, we heard about the "Allen Coral Atlas" (ACA) supported by the generosity of the late Mr. Paul Allen, co-founder of Microsoft. This atlas (http://allencoralatlas.org) is an online platform that aims to provide a high-resolution map and up-to-date global image of the world's coral reefs with detailed composition and structure. The goal of the Atlas is not only to fill the gaps in coral reef information but also to understand the complexity of coral reef ecosystems and support decision making in coral reef management. Two outputs can be obtained from this atlas including 1) *geomorphic zonation (i.e. reef rim, outer flat, inner flat marine, lagoon, etc.)*; *and* 2) *benthic cover type (i.e. coral,/algae, seagrass, rock, rubble, and sand).* The Planet imagery has ~4 meter spatial resolution. The Atlas maps were generated from complex scientific models in image correction and machine learning processes based on field survey reference data. So far, nine areas have been mapped and interactively accessed on the atlas mapping tool, including Karimunjawa Island in Indonesia. All of Indonesia is scheduled to be mapped later in 2020.

The ACA's interactive maps include Planet's satellite imagery and NOAA's Coral Reef Watch layers. This nice-looking interactive atlas has functional features such as zoom in, zoom out, map legend, mini-map, measure distance, scale bar, coordinate position, upload areas of interest with GeoJSON or KML files. The analysis feature is advanced with a drawing box to select an area and it shows the statistic of coral reef class calculation. Users are enabled to provide feedback to improve the quality of coral reef data. Figures 1 and 2 represent the Allen Coral Atlas maps of geomorphic zones and benthic classes for the shallow reef habitats in Karimunjawa Island in the northern part of Java Island, Indonesia.

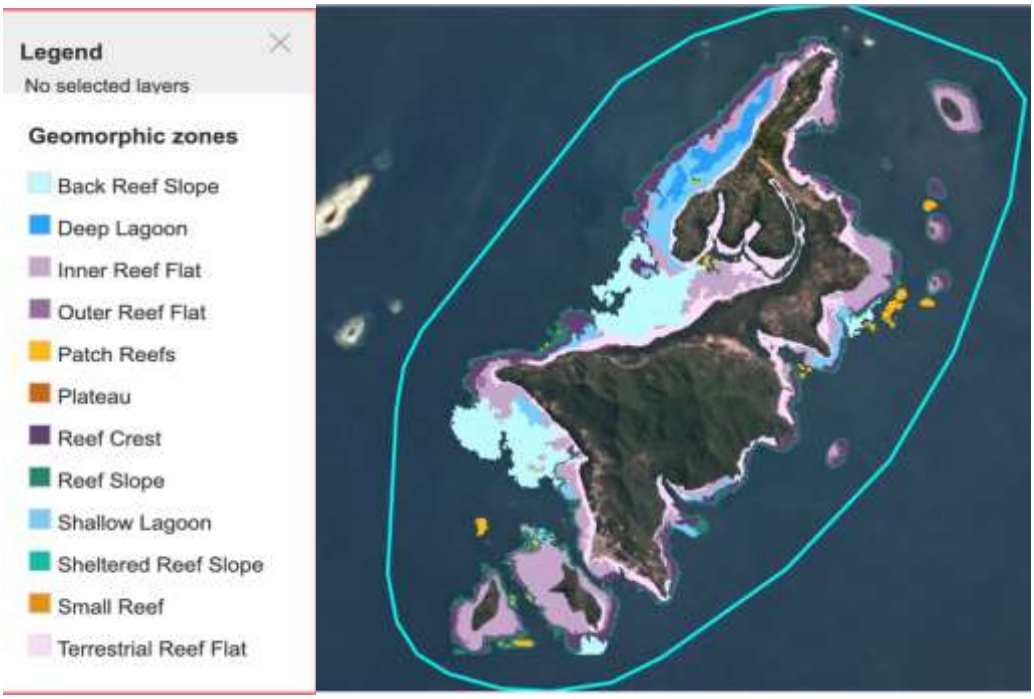
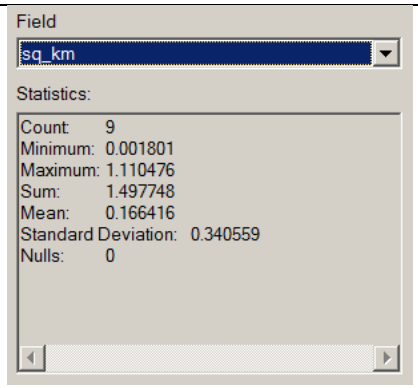


Figure 1. Geomorphic Analysis Map

Figure 2. Benthic Analysis Map

For further analysis, I compared the Allen's coral reef data with UNEP-WCMC global coral reef mapping (downloaded from https://data.unep-wcmc.org/). I found that UNEP-WCMC has estimated the total reef area to be about 1.5 sq.km while the area from ACA's coral reef is about 0.62 sq.km. This large difference is likely due to the Atlas including more classes that are excluded from the UNEP-WCMC data. It, thus, appears that depending on the definition and criteria used there is an overestimation for the reef calculation in the report with UNEP-WCMC data. If the Indonesia reefs are estimated about 25,000 sq.km from UNEP-WCMC, the actual reef area may be considerably less. The Allen Coral Atlas is promising and could help Indonesia refine its actual coral reef area. It is noted, however, that coral reef areas have been measured using different assumptions which need to be clearly determined and communicated.



Allen Coral Atlas Data statistic (approximately 0.62 sq.km)	UNEP-WCMC Reef Data (approximately 1.49 sq.km)

The USAID Sustainable Ecosystems Advanced (SEA) Project is a five-year project (2016-2021) that supports the Government of Indonesia (GoI) to improve the governance of fisheries and marine resources and to conserve biological diversity, specifically in three provinces (Maluku, North Maluku, and West Papua). This project has helped build capacity for the implementation of the ecosystem approach for fisheries management, marine protected areas, the science of marine spatial planning and policy. Given the success of the SEA Project, ongoing government commitments to manage the 30 million hectares of effective marine protected areas will be optimized through support from local NGOs, universities, private partners and other international support (i.e. Allen Coral Atlas). As such, some of the potential users and stakeholders have been identified through the list of priority levels to improve the quality of planning and management for marine biodiversity and threaten species in Indonesia.

Name of Institution	The benefit of using data or technology	Level
Ministry of National Development Planning (BAPPENAS)	The data will be used for RPJMN (National Medium-Term Development Planning) and other strategic plan in Indonesia	High
Coordinating Ministry for Maritime Affairs and Investments	The data will be used for coordination level among ministerial in MPA networks and investment planning	Medium
Ministry of Tourism	The data will be used for National Tourism Plan	High
Ministry of Marine Affairs and Fisheries	The data will be used for MPA planning, National MSP, Inter-region MSP, Fisheries Management, Small Island and so on	High
Ministry of Environment and Forestry	The data will be used for Land-Sea planning and Strategic Environment Assessment	High
Ministry of Home Affairs	The data will be used for Budget Approval and Monitoring Evaluation System at the Provincial Level	High
The Indonesia Institute of Science (LIPI)	The data will be used for scientific publication and other scientific recommendation for national strategy	High
Ministry of Energy and Mineral Resource	The data will be used to evaluate the high impact area with the new potential oil and gas concession	High
Geospatial Information Agency	The data will be integrated into the one map policy	High
Investment Coordinating Board	The data will be used as reference for marine/coastal licensing and permits approval that related to validation or verification	High
University and Learning Centre	The data will be used for research analysis and learning data for students	Low
NGOs and Local Initiative Forum	The data will be used to support the government in the initiation of new MPA sites, MSP plan, fisheries management and outreach materials	Medium
USAID SEA Project	The data will be used to advance the finalization of MPA zoning plan, revisiting the MPA networks, ecosystem approach for fisheries management, law enforcement and policy analysis, integration with SEANODE, to advance the development of National MPA Database system	Medium

This brief review is part of the USAID SEA Project on exploring how Allen Coral Atlas Data is being used to inform the stakeholders, researchers and managers to advance coral reef management and sustainable biodiversity protection particularly in Indonesia. In summary, the Allen Coral Atlas would be a welcome addition to the arsenal of support needed to adequately plan for and implement coral reef conservation in Indonesia. And, as noted, such efforts will involve multiple institutions and thus a challenge for the Allen Coral Atlas is to provide a user friendly interface that can truly serve the needs of Indonesia and its many institutions.

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