ECOSYSTEM-BASED MANAGEMENT TOOLKIT FOR PHILIPPINE COASTAL RESOURCE MANAGEMENT:

3D RELIEF MAP

RESOURCES, ENVIRONMENT, LIVELIHOODS, ECOSYSTEMS AND FISHERIES MAP

MSI

FindFishSup

MERF

the David & Lucile Packard FOUNDATION

Coral Reef Targeted Research & Capacity Building for Management

The 3D RELIEF (Resources, Environment, Livelihoods, Ecosystems and Fisheries) Map: An Ecosystem-based Management Tool for Philippine Coastal Resources Management

Richard N. Muallil and Rollan C. Geronimo

Published by the Marine Environment & Resources Foundation, Inc., University of the Philippines Diliman, Quezon City, Philippines through the David and Lucile Packard Foundation.

Suggested Citation:
Muallil, R.N. and Geronimo, R.C. 2010. The 3D RELIEF (Resources, Environment, Livelihoods, Ecosystems and Fisheries) Map: An Ecosystem-based Management Tool for Philippine Coastal Resources Management. *In:* Marine Environment & Resources Foundation, Inc. *Ecosystem-Based Management Toolkit for Philippine Coastal Resource Management.* Marine Environment & Resources Foundation, Inc., Marine Science Institute, UP Diliman, Quezon City, Philippines. 25 p.

ISBN 978-971-94898-3-2

Credits:
Editor: Rhia Odessa M. Gonzales
Graphic Design/Layout artists: Reina Marie C. Gastardo and Johann Nicolas S. Rivera
Cover Photograph: Riovie Ramos
Printed and bound in the Philippines by Printon Press
Web reference: www.philcrm.org/EBMtools/

The 3D RELIEF (Resources, Environment, Livelihoods, Ecosystems and Fisheries) Map: An Ecosystem-based Management Tool for Philippine Coastal Resources Management

Richard N. Muallil[1,2] and Rollan C. Geronimo[1,2]

[1] Marine Environment and Resources Foundation, Inc.,
c/o The Marine Science Institute, University of the Philippines
Diliman, Quezon City 1101

[2] The Marine Science Institute, University of the Philippines
Diliman, Quezon City 1101

INTRODUCTION

The Philippines is endowed with diverse and very productive coastal ecosystems that provide countless benefits to coastal communities. However, these ecosystems have been threatened to collapse due to destructive and unsustainable human activities. Degradation of coastal ecosystems poses a serious impact on food security and economy not just of the local communities but for the whole country as well. Thus, there is an urgent need for effective coastal resource management to secure the future of the next generations. A management approach that could address the declining status of coastal resources is ecosystem-based management (EBM). This approach considers the importance of collaboration among stakeholders as key in the development of comprehensive and integrated resource management plans. Through the Ecosystem-based Management Tools Demonstration Project entitled "Finding a way out for depleted subsistence fisheries in the Philippines (FindFishSup)", three EBM tools were introduced (Table 1) to 10 partner coastal municipalities to aid them in decision-making. One of these tools is the "3D Relief Map" which was constructed and demonstrated for most of our partner municipalities. A 3D Relief Map is a 3-Dimensional (3D) scaled and georeferenced rendering or representation of a given area that can be used for compiling, collating, and presenting spatial data (Figure 1). It is a geographic information technology made easy to use for everyone including those who lack the capacity to relate to other more

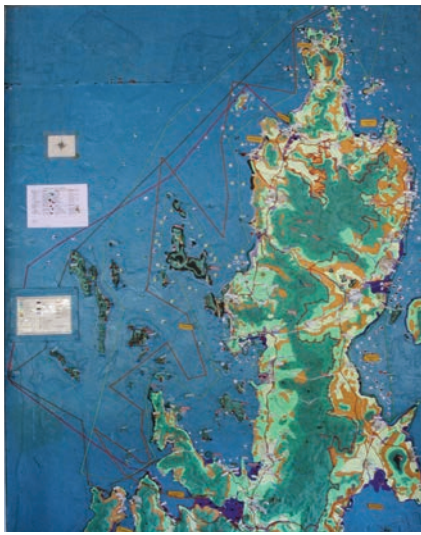

Figure 1: The 3D map of El Nido, Palawan.

technical and more scientific geographic information devices such as geographic information system (GIS) software. This concept was first introduced in the Philippines through the National Integrated Protected Areas Program (NIPAP) in the 1990s to facilitate engagement of local communities in biodiversity conservation. It was primarily used to help communicate management concerns in protected areas and ancestral domains. In the FindFishSup project, we explored the utility of the 3D map as a basic coastal resource management (CRM) tool in conjunction with other EBM tools such as ReefGame.

The 3D relief mapping activities were conducted with the following objectives in mind:

1. To produce a community-generated 3D graphic representation to facilitate visualization of the coastal and marine resources in each site
2. To engage community-based stakeholders including fisherfolks in the coastal and marine resource state, pressure, response, use and issues assessment through a collaborative and participatory approach linked to other tools.
3. To assist participants in learning to spatially orient and link with other resource use and information.
4. To introduce the importance of rationalizing spatial uses vis-à-vis governance, ecological and social-economic attributes.

Table 1. The 3 EBM tools demonstrated through "FindFishSup" project.

EBM TOOL	DESCRIPTION
ReefGame	A linked board game and computer model that can be used to explore alternative and supplemental livelihoods and coral reef conservation in fishing communities.
FISH-BE/FISHDA	A Fisheries Information for Sustainable Harvest Bio-Economic model used as managerial and communication tool to assess, test, and demonstrate various management strategies in the fishery.
Relief Map	A 3-Dimensional (3D) scaled and georeferenced representation of an area of interest that can be used for compiling, collating, and presenting spatial data.

CONSTRUCTING THE 3D RELIEF MAPS

Constructing a 3D relief map is fun and easy! However, it requires lots of hands working together as there will be lots of tracing, cutting and pasting to be done to build the map. The 3D maps produced in the EBM project were constructed by groups of 15 to 30 high school students from the local community. It only took a 30-minute orientation for the students to be ready to construct the 3D map of their municipality and to finish it in just 2 to 3 days with minimal supervision!

The manual written by Rambaldi and Callosa-Tarr (2002) was used as guide in constructing the map. Below are some notes and tips in constructing a 3D relief map.

Materials

The basic material needed for the construction of a 3D map is a topographic map (Figure 2) of the area of interest. This map can be procured from the National Mapping and Resources Information Authority (NAMRIA). Other materials needed, which are cheap and readily available, are: corrugated cardboards, carbon papers, crepe papers, glue, pencils, scissors, cutters, tapes, rulers, strings, chalks, paint brushes and plywood as a base.

Topographic map

A topographic map shows the surface shape and features of an area on a two-dimensional plane with elevations represented by contour lines (Figure 2). Each contour line represents a specific elevation, usually set in meters. Normally, not all contour lines are labeled with elevation. When only two contour lines are labeled, it is assumed that the lines between the labeled lines represent elevations increasing at

equal intervals from the lower value to the higher value. For example, if the 2 contour lines are labeled 100 m and 200 m and there are 4 unlabeled contour lines between them, it is estimated that the lines starting from the one adjacent to the 100-m contour line represent 20-meter intervals from 100 m to 200 m (see Figure 3). Steeper slopes are represented by more closely spaced contour lines than gentler slopes. Mountains are represented by series of loops with the innermost loop representing the highest elevation (Figure 2 & 4).

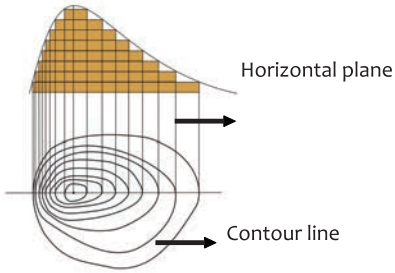

Figure 2.
Contour lines in a simple topographic map.

Contour lines are curved or straight lines on a map describing the intersection of a real or hypothetical surface with one or more horizontal planes. The configuration of these contours allows map readers to infer relative gradient of a parameter and estimate that parameter at specific places.

Source:
http://en.wikipedia.org/wiki/Contour_line

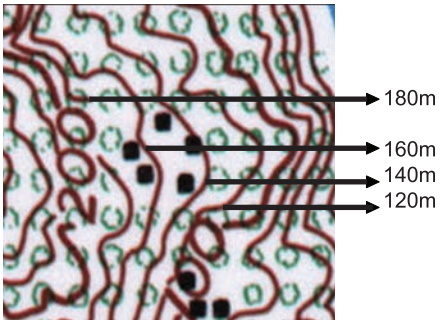

Figure 3. Contour lines on a topographic map showing only 2 labels.

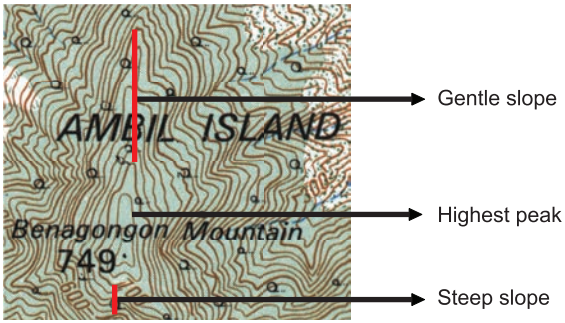

Figure 4. Closely spaced contour lines indicate steep slope. The highest peak on a mountain is represented by the innermost loop.

Grids and scales on a topographic map are necessary pieces of information for constructing 3D maps (Figure 5). The grid represents parts of the map coordinates and determines the geographic location of the area while the scale is the proportion or ratio of the measurement on the map relative to the actual ground measurements. For example, a map with a scale of 1:10,000 indicates that one meter on the map is equivalent to 10,000 meters or 10 km on actual ground measurements. The higher the ratio, the more detailed the map is (e.g., map scale of 1:1000 is more detailed than 1:10,000). It is advantageous to use a digital topographic map because it allows the user to adjust the size of the maps into the desired size. For example, the digital topographic maps from the NAMRIA were scaled 1:50,000 but we were able to magnify the scale to twice or thrice its original size when the maps were printed. The final size of the printed maps were adjusted so as not to exceed the size of plywood (4 ft x 8 ft) which was used as a base to support the 3D map.

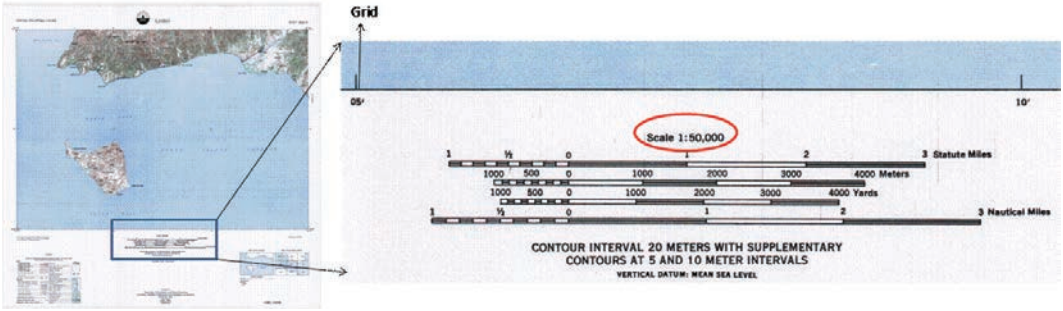

Figure 5. The scale and grid on a topographic map.

TIPS:

As a rule of thumb, the size of the 3D relief map should be small enough to make the entire area visible but large enough to pinpoint, with some accuracy, the spatial location of important landmarks, resources and other structures of interest. While a larger 3D map has the advantage of depicting more intricate details of the area, it is more difficult to move bigger maps from place to place compared to smaller maps. A 1:10,000 scale map, for example, provides resolution that enables stakeholders to locate important details, with high accuracy, even to the household level. This scale is ideal for municipal-level maps. For maps of provinces, a 1:10,000 scale will make a very large 3D map which is no longer suitable for collaborative discussions. For example, mainland Palawan which has a length of 430 km (estimated from ArcView 3.2©) will make a 43-m long 3D map!

Preparing the base of the map

The base of the map provides support for the 3D map which is mainly composed of layers of consolidated corrugated cardboards. Therefore, the base should be strong enough to support the weight of the map and does not easily bend as the glued cardboards dry up. A wooden table may be necessary for a large 3D map. For smaller 3D maps like those constructed in the EBM project, a ½-inch thick marine plywood made a good base. However, cardboards will not readily stick to the surface of plywood using ordinary glue. Therefore, a layer of 1/8 -inch thick paper chipboard needs to be affixed on top of the plywood using Epoxy or rugby adhesive (Figure 6). Cardboards can then be easily glued on top of the paper chipboard layer.

Figure 6. A layer of chipboard is being affixed on the surface of a ½ -inch thick marine plywood.

Using the printed topographic map as a reference, grids can be placed on the base which will serve as a guide in placing the layers of pre-cut cardboards later.

TIPS:

The tracers need to be thoroughly familiar with the contour lines of the map prior to tracing, especially when the map contains broken contour lines (e.g., when only part of the land is captured on the map). The tracers should therefore be careful in identifying and tracing the contour lines correctly. The facilitator may need to closely supervise this activity. Highlighting different contour lines with different markers (e.g., blue and red for 20-m and 40-m contour lines, respectively) prior to tracing will help avoid errors. For every contour line traced, the cardboard will be passed on to the carvers. It is also good to label each traced cardboard with rough location and contour reference (e.g., 20-m lower right) so it is easier for the gluers to find the exact position of the cardboard on the 3D map.

Tracing, Cutting and Pasting

Once the base of the map is ready and the topographic map printed, the succeeding activities will require several rounds of tracing, cutting and pasting. Therefore, it is important to divide the participants in the map-making activity into three groups: the tracers, carvers, and gluers. All the participants can be supervised and guided by a facilitator who is most knowledgeable about the 3D map construction and the topography of the map to be constructed. The facilitator must see to it that each participant is doing his/her job correctly.

The job of the tracers is to trace each of the contour lines from the topographic map to the corrugated cardboards using carbon papers (Figure 7). The tracers need to tape together sheets of carbon papers to a size just a little bigger than the printed topographic map. The resulting large sheet of carbon paper is then attached at the back of the topographic map. The topographic map with attached carbon paper is then used to trace each of the contour lines on top of the cardboards.

The role of the carvers is to cut the cardboards along the traced lines (Figure 8). Sharp scissors or cutters can be used. Very sharp cutters can help ensure that edges of the corrugated board are cut finely and smoothly.

Figure 7. The students tracing the contour lines onto the cardboard beneath the topographic map.

Figure 8. The carvers cutting cardboards along the traced contour lines.

TIPS:

2 separate mountain structures

Mountain structures being attached and consolidated on the map.

During the cutting, it might be difficult to locate where the cut cardboards go in the map. It is thus recommended to divide the carvers into small groups based on location or structure (e.g., mountain) of the cardboards to be cut. For example, if there are 2 mountains on the map, one group will focus on cutting the cardboards making up one mountain so that the gluers can immediately paste the layers together to avoid misplacing or losing cardboard pieces, especially the small parts.

Layers of the two mountain structures in this image were cut by two groups of carvers. The layers were immediately glued together by the gluers before the whole mountains were attached to the base map.

TIPS:

Glue must be spread out evenly to prevent parts of the cardboard from bulging as a result of air pockets formed while gluing the layers and crepe papers. It is also recommended that each layer be added and glued at 10 to 15 minute interval to allow the previous layers to stick together and the glue to partially dry. Bulging will result from a very wet cardboard.

The gluers are in charge of consolidating the cut cardboards into layers by placing one board on top of another (Figure 9). The grid placed on the base will serve as a reference for the proper placement of each cardboard on the base map. Other reference points such as borders of the map or cliffs where layers overlap may also be helpful. Glue can be used to paste the layers together. The layers can be consolidated further by paper-mâché created from crepe paper cut to about 5cm x 5cm size and glued to the 3D map using water based glue (i.e., 1 part glue and 5 parts water mixture). Paint brush is used to glue crepe papers to make the surface smooth (Figure 9). This process can be repeated for every layer added. Layers of small cardboards can be attached together before being consolidated with paper-mâché. After all the layers have been attached and consolidated, the end-product will be a white 3D relief map (Figure 10).

Figure 9. The gluers affixing the 40-m cardboard.

Figure 10. The white 3D relief map of Batangas City.

USES AND APPLICATIONS IMPORTANT FOR CRM

Monitoring and Evaluation

The 3D map is an excellent field-based tool that can be used for a snapshot assessment of the spatial location of available resources vis-à-vis the status and threats to resources. Basic geological and resource information can be placed on the map. Data are simply plotted on the 3D map (Figure 10) using various markers (Figure 11). Data could be important landmarks, establishments, resources, other structures of interest and may include activities and threats to resources.

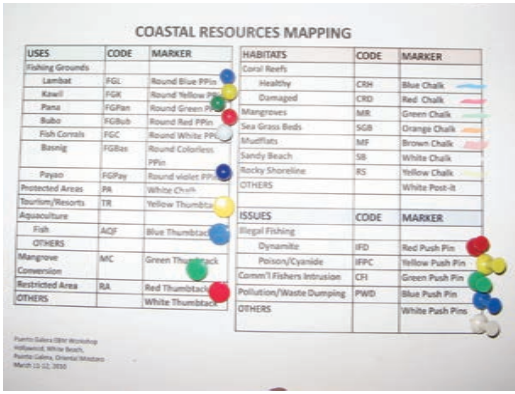

Figure 11. The markers (e.g., thumb tacks, pins, colored chalk) used during the 3D relief mapping activity in Puerto Galera, Oriental Mindoro.

TIPS:

To have a comprehensive and accurate data, a good mix of participants/stakeholders is key. Participants must be knowledgeable on both the ecological and socio-economic condition of the area. For coastal resource management, fisherfolks are the most important participants. Fisherfolks are often entirely dependent on coastal resources and their day-to-day livelihood activities within coastal ecosystems make them one of the most knowledgeable in terms of the status and threats to this resource. Local government units (LGU), non-government organizations (NGO), academe and other stakeholders should also be invited as they can provide technical assistance and other important information specifically on legislations and laws pertaining to resource use.

However, a 3D map is NOT capable of storing past data once the map is revised and updated. Hence, the 3D map as a monitoring and evaluation tool is efficient when used together with other geographic information technologies like Geographic Information System (GIS) which can handle, store, analyze and communicate the information better.

Collaborative Planning

When all the needed information are plotted on the map, the 3D map can be used for extended discussion among stakeholders regarding spatial planning. The visual knowledge of the landscape and resources provided by a 3D map makes it an excellent communication tool for collaborative planning among stakeholders. Thus, various issues important for the stakeholders such as resource use, development and threats can be conveniently addressed and discussed through a participatory and collaborative approach.

Education, Raising Awareness and Tourism Promotion

A 3D map is simply a miniature replica or representation of an area. It is simple and easy-to-understand which makes it a valuable tool in educating the youth to increase their awareness about the geography of the area and its resources. It is also a convenient way of introducing the area to tourists and other visitors thus enhancing the tourism potential of the area.

Caution:

Users must be aware of the inherent risks of exposing critical information to the public. Outsiders may take advantage of the information for their personal interest endangering the resources and the community as a whole.

3D RELIEF MAPPING ACTIVITY: THE "FINDFISHSUP" PROJECT EXPERIENCE.

The FindFishSup project conducted a series of workshops with 10 partner municipalities to determine alternative opportunities for fisherfolks affected by declining coastal resource. Except in the first workshop that involved Bolinao and Alaminos City, coastal resource mapping using the 3D relief map was one of the major activities undertaken during the workshops. In Subic, Zambales, a topographic map was used for the resource mapping in lieu of the 3D map which was not completed in time due to damaged materials. In El Nido, Palawan, the pre-existing 3D map (which was constructed through the NIPAP) was updated in the mapping activity.

The participants in the mapping activity workshops were composed largely of fisherfolks. Representatives from the LGU, NGOs, national government agencies (NGAs), tourism and industry sectors were invited to the workshop also participated in the activity. Prior to the workshop, the 3D maps were painted blue and green to indicate sea and land, respectively. Lines painted on the map represent national roads. During the workshop, participants gathered around the 3D map and were initially asked to identify and mark important landmarks (e.g., ports, barangay centers, etc.) and to be familiar with areas that serve as spatial reference points. Afterwards, participants plotted the following information:

a. Resources (e.g., location of healthy and damaged corals, mangroves, seagrass beds, mud flats, sandy beach and rocky shoreline).
b. Uses (e.g., location of fishing grounds for each gear type, protected and/or restricted areas, mariculture activities, industry and tourism activities, etc.)
c. Issues (e.g., location of illegal and destructive fishing activities, commercial fishers' intrusion, pollution and waste dumping, etc.)

Pins of various colors and shapes were used as markers to label the location of each point. Colored chalks or strings were used to indicate areas covered by certain resources (see Figure 11 for sample).

Aside from data plotting, the facilitator should encourage participants to discuss, in more detail, the pieces of information that have been plotted on the 3D map. Among the important discussion points commonly raised during the mapping activities were the following:

a. Status and threats to coastal resources (e.g., coral reefs).
b. Assessment of the economic, ecological and biological sustainability of resource use.
c. Evaluation of the current intervention efforts to counter the threats undermining the health of coastal resources.
d. Suggestions and recommendations for a strategic and integrated CRM programs.

In some of the workshops, data plotting was completed first before a representative would present the data-filled map to the group followed by a discussion on issues and other matters. In other workshops, discussions were simultaneously done with data plotting. The latter case proved to be a better

method in enhancing collective participation of the participants in the discussion which were more spontaneous and genuine. However, this should to be well facilitated. Poorly facilitated discussion could be time-consuming and pointless at times. The facilitator must be able to recognize which issues need particular and immediate action and focus the discussion on such matters. The facilitator should also try to calm or moderate discussions among the players as much as possible to avoid conflicts among the stakeholders. Facilitators should also ensure that everyone participates especially when some participants tend to dominate and monopolize the discussion while others might feel out of place.

IMPORTANT ISSUES THAT SURFACED DURING THE 3D RELIEF MAPPING ACTIVITIES:

Threats to coastal resources

Almost everywhere, **illegal** and **unsustainable fishing** practices are still rampant despite efforts of the LGU to combat these activities. Blast fishing, cyanide fishing and poaching by commercial fishers are among the major problems reported. Among our partner municipalities, Puerto Galera reported the least problems in terms of illegal fishing practices except for a few isolated cyanide fishing activities by some fishers. Lubang has been successful in mitigating blast fishing in their area. In Mabini, poaching by commercial fishers is their main problem. In El Nido, destructive fishing practices are reported to be rampant outside the Bacuit Bay where law enforcement is less or weak. Looc municipal waters appeared to be the most

threatened from all these illegal fishing practices. Threats from overfishing came out in Masinloc resource mapping activity when fisherfolks commented that their municipal waters may be too small to support the current number of fishers.

Siltation was also a major threat to coastal resources in Puerto Galera, Looc and El Nido. Using the 3D relief maps, the participants were able to demonstrate how corals are affected by mining and illegal logging activities from the adjacent mountains. Damaged corals due to Crown-of-thorns starfish (COTS) infestation were also reported. In Mabini, COTS infestation occurred in 2006 but the corals have recently recovered. In El Nido, the latest infestation was in 2009 which affected corals in the entire municipal waters especially within the Bacuit Bay.

Need to empower fish wardens ("Bantay Dagat")

All the partner municipalities have organized and trained fish wardens primarily to control illegal fishing activities within their municipal waters. Municipalities like Puerto Galera and El Nido have established bases, for fish wardens, strategically located to guard marine protected areas (MPAs). However, during the mapping activities, it appeared that fish wardens are undermanned, underpaid and underequipped altogether. Normally, fish wardens are composed of volunteers whose incentives are mainly from commissions they get out of the fines from apprehensions. Lack of patrol boats is also a major problem because patrolling could not be done on a regular basis due to such logistics problem. Patrol boats are usually used by authority only to respond to violations reported by Bantay Dagat volunteers. The volunteers could not apprehend the violators who are often armed and well-equipped. For example, fish wardens in Looc reported that poaching by commercial fishers in their municipal waters is occurring almost daily but they could not do anything about it.

Need for more IEC campaigns by the LGU on CRM programs

Some of the workshops revealed that Information, Education Communication (IEC) campaigns should be strengthened. It became apparent during the mapping activities that some participants were not aware or uninformed of some important CRM programs. For example, some fisherfolks were unaware of the locations of MPAs. CRM programs must be well disseminated for proper compliance and to enhance cooperation of the stakeholders and the general public. For example, fisherfolks in Puerto Galera seemed to be unreceptive to the idea of putting up more MPAs. Generally, their impression was that the LGU continued to reduce their fishing grounds. *"Halos wala ng pwedeng pangisdaan ang mga mangigisda dahil lahat bawal na"* (Almost all the waters have already been closed from fishing). However, the LGU explained that the only "no-take" zone (core zone) are areas within the Muelle Bay. Other areas are still open for fishing as long as the fishers do not use destructive and other prohibited gears. In all the workshops, the LGU were able to explain to fisherfolks the important regulations regarding MPAs. Delineation of MPA boundaries were also conveniently done on the 3D maps.

Need for livelihood support if fishers are to exit the fishery or if fishing grounds are closed

The LGU representatives of Puerto Galera, during the activity, was determined to minimize, if not totally ban, fishing activities in areas with high tourism potential. They argued that fishing undermines the status of the reefs, which draws tourists, whilst the presence of fisherfolks in these areas simply distracts tourism activities. One particular fishing ground that the LGU wanted to close from fishing is the reef area just off Brgy. Minolo where numerous fishers reside. According to the LGU, the area will be closed for 5 years only to give enough time for the damaged corals to recover. This idea was simply unacceptable for fishers since for most of them, fishing was their only source of livelihood and the area that will be closed

is their normal and closest fishing ground. For fishers, what the LGU proposed is practically denying them of their livelihood. The LGU explained the importance of protecting the resources and the jobs it will potentially bring to the community in the long run. Fishers were further encouraged to engage in tourism-related occupations such as boat operators and tourist guides. The fishers expressed their sentiments regarding their desire to be boat operators but expensive monetary investment is a major hindrance. Fishers seemed to agree with the plans of the LGU if they are provided with boats and offered opportunities to engage in tourism occupations and/or other livelihoods that pay enough to support their families.

SUMMARY

The "FindFishSup" project was able to demonstrate that a 3D relief map is promising tool for coastal resource management and for capacitating knowledge-based and learning communities where the following lessons and insights were derived. 3D relief mapping interactive engagements during our EBM tools demonstration workshops with partner municipalities highlighted that:

1. **3D Relief map** stimulates participation, interaction and collaboration among stakeholders.

   Generally, mapping activities in all our workshops were very interactive. Participants interacted with each other well. They also worked collaboratively in the data plotting and in addressing important issues. Some participants looked very proud and enthusiastic for being able to identify locations familiar to them.

2. **3D Relief map** is a good monitoring and evaluation tool.

The detailed intricacy of the land and seascape provided by the 3D map makes information plotting including various resources and habitats convenient and covers a large area depending on the capacity of the participants using the 3D map. By regularly updating the information on the map, it can make a good monitoring and evaluation tool. For example, the effectiveness of employing fish wardens to mitigate commercial fishing encroachment can be monitored and assessed through participatory consultation with local communities using a 3D map. The prevalence and range of commercial fishing encroachment through time can be conveniently depicted on the map. The same can be done with other issues related to resource status, use and management. But since the 3D map does not have the capacity to store past data, its function as a monitoring and evaluation tool can be best achieved when reinforced with GIS or GPS.

3. **3D Relief map** is an excellent tool for IECs.

The mapping activities showed that a 3D map is a promising tool for IECs of CRM programs especially for delineation of MPAs, zonation and resource use regulations. In some of the workshops conducted, some fisherfolks were unaware of the boundaries of MPAs and fishing regulations in their areas. The LGU had a chance to explain to the fishers about their existing MPAs. The discussion was not limited to boundary delineation but extended to the importance of MPAs in protecting coastal resources and how the community could benefit from MPAs.

4. **3D Relief mapping** activities can bring out issues important for the stakeholders.

The mapping activities were able to bring out issues important for the

stakeholders, especially when threats to resources were plotted on the map. For example, when occurrence of mining discharge were pointed on the map, stakeholders raised the issue about pollution from such industry. Some of the issues raised in the workshops are listed in the previous section.

5. **3D Relief map** provides a good venue for management and development planning.

The rationale behind the 3D map as an excellent strategic planning tool is based on two main reasons. First, the 3D map can expose important issues that need to be addressed. Second, participants in the mapping activities are composed of representatives from different sectors in the community. Hence collaboration among planners having different expertise should make planning easy and worthwhile.

6. **3D Relief map** is a tool that can be readily and conveniently used by many people and for many situations!

Among the three EBM tools demonstrated during our workshops, the 3D map was the most user-friendly tool which could be easily understood, used and communicated even by ordinary fisherfolks. In fact, a fisherfolk in El Nido commented that the 3D map is the best CRM tool primarily due to its user-friendly nature. This is very important since, in most cases, CRM programs involve collaboration with local communities. In addition, the 3D map does not require electricity to operate, making it an ideal field-based tool that can be used for remote areas with limited or no access to electric power.

ACKNOWLEDGEMENTS

We would like to thank Dr. Porfirio Aliño for his invaluable inputs and suggestions. We are grateful to all our partner municipalities and the schools and students who helped in the construction of the 3D relief maps in the project sites.

APPENDICES

Appendix 1. Data plotting on the 3D relief map of Masinloc, Zambales.

Appendix 2. Presentation of the map after the data has been plotted, Batangas City.

Appendix 3. A fisher sharing his views during discussions with other stakeholders in Puerto Galera, Oriental Mindoro.

Appendix 4. Students of Colegio de San Jose de Alaminos who participated in the Alaminos City 3D map-making activity.

Appendix 5. The happy faces of the freshmen high school students of the University of Batangas after succesfully constructing the 3D map of Batangas City.

Appendix 6. Students of Balingasay National High School working on the 3D map of Bolinao, Pangasinan.

Appendix 7. High school students in Looc, Occidental Mindoro finalizing their 3D map.

Appendix 8. Participants of the 3D map making in Masinloc posed with their mayor, Hon. Jessu E. Edora (standing in red).

Appendix 9. The students of School of the Nation in Puerto Galera after successfully constructing their 3D map.

Appendix 10. Students and teachers from 4 high schools in Lubang, Occidental Mindoro together with some LGU representatives after completing the construction of their 3D map.

REFERENCES:

Deguit, E.T., R.P. Smith, W.P. Jatulan and A.T. White. 2004. Participatory coastal resource assessment training guide. Coastal Resource Management Project of the Department of Environment and Natural Resources, Cebu City, Philippines. 134 p.

http://en.wikipedia.org/wiki/Contour_line

Rambaldi, G., Callosa-Tarr, J. 2000. Manual on Participatory 3-Dimensional Modeling for Natural Resource Management. Essentials of Protected Area Management in the Philippines. Vol. 7; National Integrated Protected Areas Programme. European Commission, DENR, Quezon City, Philippines

Rambaldi, G., Callosa-Tarr, J. 2002. Participatory 3-Dimensional Modeling: Guiding Principles and Applications. ASEAN Regional Centre for Biodiversity Conservation (ARCBC), Los Baños, Philippines.

About the authors:

Richard Muallil is the fisheries/ecology Research Assistant of the FindFishSup Project from Sibutu, Tawi-Tawi. He earned his BS Zoology degree from the Mindanao State University Marawi City in 2002 and MS Biology from the University of the Philippines Diliman in 2008. He is currently pursuing his PhD degree in Marine Science at Marine Science Institute, University of the Philippines Diliman. He is particularly interested in the ecology and population genetics of coastal ecosystems and the interplay between these ecosystems and the Philippine fisheries.

Email address: rm14prince@gmail.com

Rollan C. Geronimo is a graduate of MS Marine Science at the University of the Philippines Diliman, and is currently a Marine Policy Consultant for Conservation International - Philippines. He is the Assistant Project Supervisor of the EBM Project.