

Research article

# Modelling Resource Extractions: Way Forward to Sustainable Development of Layawan River, Northern Mindanao, Philippines

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## Abstract

Unregulated extraction of resources might lead to degradation and unsustainability. Thus, it is imperative that projections of an economic value in the future might help resource-users for future sustainable development. Data were extracted from survey questionnaires, key informant interviews and focused group discussions. The values derived were analyzed using Stella model version 9.0.2. Results showed that economic value projections of 10 years for sand and gravel quarry would have an estimated value of PhP3,946,188,000,000, for fishery resources it would be PhP394,619,425,000.00, extraction of water for domestic use and other agricultural purpose is estimated at PhP394,350,000,000.00, for the two major recreation and ecotourism activities, swimming and zipline adventure were estimated at PhP394, 615,000,000.00, and lastly, for the existence and bequest values were estimated to be at PhP394, 675,000,000.00. These values were considered as economic reserves for future utilization of the resources, and yet might project utilization patterns that would make these resources sustainable. This would entail conservative efforts of various stakeholders to sustain the resources for the future generations. **Copyright © AJSSAL, all rights reserved.**

**Keywords:** STELLA model, natural resources, riverine ecosystem, Layawan River

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## INTRODUCTION

Water bodies have been used as sinks for human and industrial wastes due to their ability to help break down wastes and return them into their natural environments. Increasingly, however, the natural capacities of water bodies for waste processing have been exceeded and eventually reduced by excessive pollution loads (Padilla, 1995). The benefits provided by natural ecosystems are both widely recognized and poorly understood (Daily, 1997). Though, putting values of the services that can be derived from the river is quite difficult but this can often effectively influence policy formulation and decision-making, thus the present study generally aims to project the values of the natural resources extracted from the Layawan River for 10 years.

Layawan River is one of the two major rivers of Mt. Malindang located in the municipality of Oroquieta, Misamis Occidental (Gorospe-Villarino, et. al. 2006 and Bacaltos, et. al. 2006). Its headwater is located in Barangay Sebuca, a remote area of Oroquieta City located at the crater valley of Mt. Malindang, with elevation ranging from 700-1,400 meters above sea level (masl). (Bacaltos, et. al. 2006). Water from Layawan watershed is mainly used for domestic and agricultural activities among the 33 barangays covered and serves 158 hectares of ricefield (Bongcayao, et. al. 2015).

The river is one of the main sources of sand and gravel in Zamboang del Norte. It was also a recipient of cleanest and greenest river award in the Philippines (Bongcayao, et. al. 2015 and Bacaltos, et. al. 2006) which may imply good management (Bacaltos, et. al. 2006). However, continuing threats of water quality deterioration was prevalent particularly the liquid wastes that were freely draining into the river system. Hence, this study was conducted to help the local government and other concerned stakeholders to do holistic and concerted efforts on conservation, protection and management of the river system. The economic estimates (in Philippine Peso) of the river system (Paler et al. 2016) could be an added significant information needed to immediately address this issue.

## METHODS

Data gathering employed household survey using survey questionnaires, key informant interviews and focused group discussions. Available secondary data were obtained from the City Planning and Development Office, City Environment and Natural Resources Office, Barangay Profile and from other reliable sources to evaluate the numbers of policies and conservation efforts being done in Layawan River. Purposive sampling was carried out wherein representatives from various stakeholders were chosen as respondents in the survey. Respondents include representative from upland, midland and lowland area of the river, barangay officials whose location are besides the Layawan River, selected residents who are knowledgeable about the river, local government unit particularly the environment officer and the indigenous people (Subanen) who are the main actor in Layawan watershed. A Stella model version 9.0.2 was used to project estimated economic value of the resources considered.

## RESULTS AND DISCUSSION

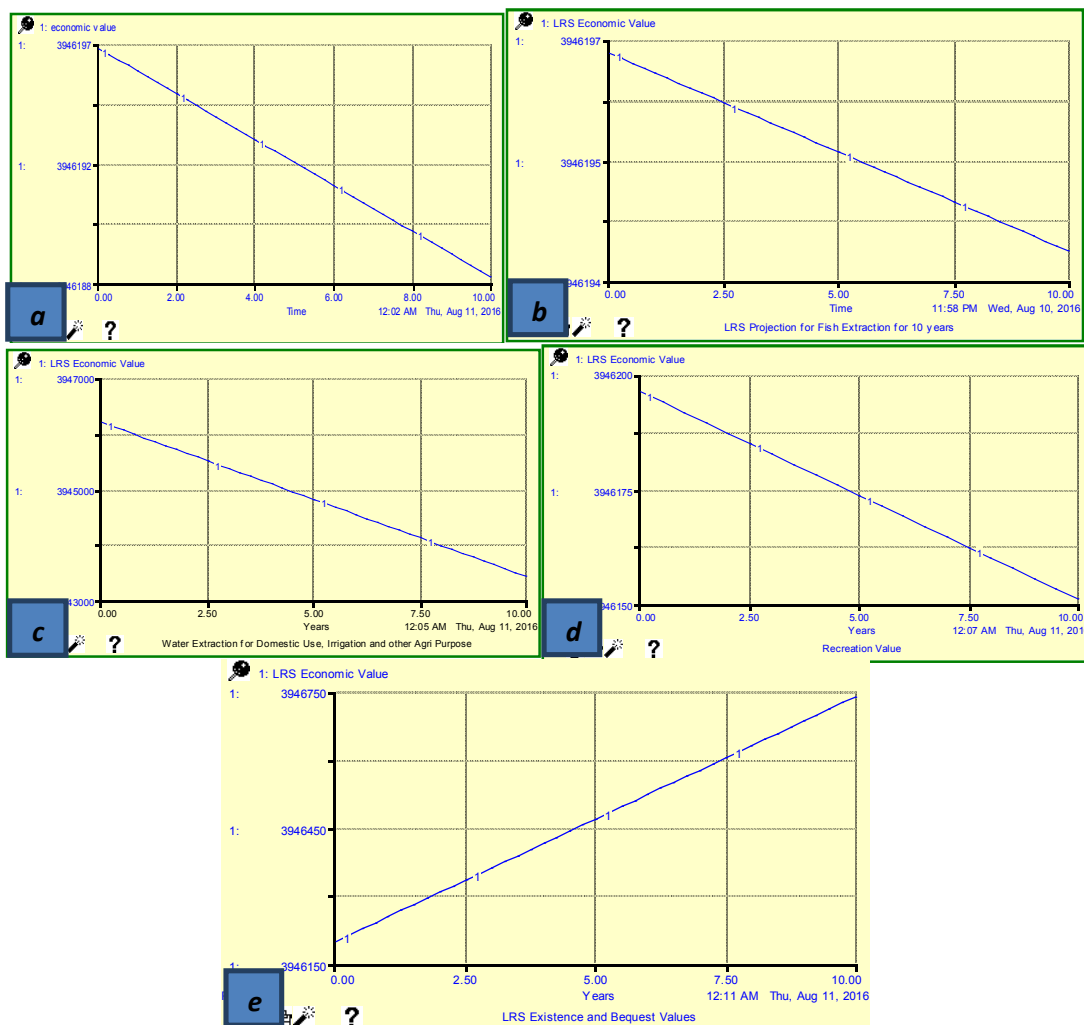
The extraction of sand and gravel through quarrying could provide the residents an income of PhP 86,400.00 per year. This contributes the total economic value of Layawan River System of PhP 394,619,633,933.24 (Paler et al 2016). The projection of these extraction income from sand and gravel within 10 years would simply affect the Layawan River system economic value of nearly PhP 3,946,188,000,000. This income projected an income which could be used for various stakeholders, and therefore demands some political interventions of the city government (Figure 1a).

Fishing in the rivers was done for food, while those species at higher market values were sold in the market like freshwater eels. Some fishes were used as food items as substitute for marine fishes. Fishing and the fishes caught were affected by the turbidity of the water and its reduction in numbers. This in turn, reduced their added income and the benefit they derived from the fishes (Vedra and Ocampo, 2014). In Layawan River system, the estimated income for fishes alone, was around PhP 24,840.00 per year based on prevailing market price of the city (Paler et. al. 2016). In 10 years' time, this could have an estimated economic value of PhP 394,619,425,000.00 (Figure 1b).

Extraction of water for domestic use and other agricultural purpose had an estimated value of PhP10,128.24per year. In terms of irrigation waters, it has PhP27,797,370.00. This would account a total of PhP27,807,498.24per year. In this case, the projection was estimated to be at PhP 394,350,000,000.00 for 10 years (Figure 1c).

In terms of tourism activities like swimming and zipline adventure, both had an estimated value of PhP 96,000.00, and PhP 360,000.00 per year, respectively. Visitors were coming from nearby places and some were around the country. When further developments be considered in the future, value of the river would increase (Paler et al, 2016). The projected value of these tourism activities for 10 years wasPhP394, 615,000,000.00 (Figure 1d).

The resources were considered to have their non-use values that included the existence and bequest values. In case of Layawan River system, it had an estimated economic value of PhP 3,946,750.00, and being projected in 10 years at PhP 394, 675,000,000.00 (Figure 1e).



**Figure 1.** Modelling economic values of the resources within the Layawan River system for 10 years using Stella model 9.0.2.



## CONCLUSION AND RECOMMENDATIONS

Natural environment qualities are commonly undervalued or not included at all in decision making. For instance, conversion of natural areas to agricultural uses or logging concessions is done even when the net effect on society is negative. The benefits provided by natural ecosystems are both widely recognized and poorly understood. What is increasingly clear, however, is that natural ecosystems are under enormous pressure around the world from the growing demands placed on them by human economies. Projections made in terms of economic benefits would allow the resource-users and decision-makers to analyze and use the present resources in sustainable manner for the future generations.

The present study projected some implications to present a more informed choices even when economic considerations are not the primary criterion for decision making. It is rarely feasible or desirable to estimate every environmental benefit or cost. Even where valuation provides only partial results, however, it can help to structure how we think about conservation, identify critical information gaps, and clarify the relation between ecosystem processes and human welfare. Indeed, an important benefit of attempting to undertake economic analysis is that it forces us to grapple with our limited understanding of ecosystem processes and the way they affect human welfare.

It is imperative therefore, that the city government, and all possible stakeholders would increase their vigilance on resource conservation and sustainable use of these resources. These can be done through improved implementation of the national and local legislation through appropriate penalties among the violators. Likewise, improved non-regulatory measures in the form of enhanced IEC materials might be of great help.

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