



ASSESSING VALUE OF WATER PURIFICATION SERVICES BY ULU MUDA FOREST RESERVES

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Introduction

- Water purification is considered benefits obtained by regulating ecosystem processes, which contribute to human well-being by securing access to and availability of clean water.
- It also explains the role and function of the ecosystem to life, whereas these services have a strong relationship to the balance of human well-being specially to issues of safety (safety of clean water).
- Forest are recognized as an important source of water supply for industry, agriculture, households and recreational purposes.
- Most of clean water supply comes from rain that is filtered through forests and ends up in rivers. Forest helps prevent contaminants from entering rivers, lakes and groundwater in a number of ways. This process called "water purification" but naturally.
- Ulu Muda catchments main in Ulu Muda Forest Reserves (FR) plays an important role as it serves the demand of water for the state of Kedah, Penang and Perlis intended for domestic, agricultural and industrial used.
- Hence, the aim of this paper is to assess the value of purification services by Ulu Muda FR for domestic uses.

Materials & Methods

Data

- Data of WTPs and coordinates of intakes. Information on the treatments cost covered all operational costs in treatments include chemical, electrical were gathered from local water agency, Syarikat Air Darul Aman (SADA), Kedah. Some of the example chemicals used in treatment are lime, liquid chlorine, sodium fluoride and liquid alum.
- National Forest Inventory V (NFI V) was gathered from Forestry Department of Peninsular Malaysia and Digital Elevation Model (DEM) was obtained by downloading from the website <https://earthexplorer.usgs.gov>

Approach

- The catchment boundaries for each WTPs were generated using the DEM input and water intake point processed by ArcSWAT module installed on ArcGIS software.
- A GIS analysis was conducted to determine the percentage of forest land use within each water catchment from 12 WTPs, using the NFI V data. We simplified the categories of NFI V data as virgin and logged forest. Each virgin and logged forest have a different impact in the model developed.
- The assessment of economic benefit of Ulu Muda FR for water purification services is based on the study of benefit transfer approach of economic model that was conducted and developed in Perak (Vincent et al., 2015). The approach of the analysis was to use the constant values from the study in Perak to the analysis using treatment cost data in Ulu Muda basin WTPs. This analysis is guided by the theory of using cost functions for environmental input values (McConnell and Bockstael 2006, pp. 647; Vincent 2011, pp. 46-54; Freeman et al., 2014, pp. 240-244).

Results

- Total of 12 WTPs in which each of them were mapped based on the location of the water intake. The source of water intake were from Sungai Muda (originally from Ulu Muda FR).
 - The delineation of catchments for each WTP's intake as in Figure 1 and catchments boundaries are larger as the WTPs located at the downstream of the Sungai Muda basin. The list of WTPs catchments area as in Table 1.
 - Forest land use representing by the NFI V were assessed for each of WTPs catchment. This is an important phase as it reflects the impact of forest land uses in the catchments site to the cost of water treatment in respective WTPs. The size of catchments, percentages of forest land use and the value of treatment cost were used to calculate the marginal value of water purification services.
 - The economic assessment for water purification used model that intended to calculate the annual fee that the WTPs must pay for water purification services by forest.
- The average marginal value for Ulu Muda basin is RM17.33/ha/year. The total marginal value is RM26,719,329.84/year. This value can be considered the operating cost implications of the WTPs to pay for water purification services by FR, similar to paying for other operating costs (chemical, electricity and labor) by the WTP.

No	WTP	Catchment Area (ha)
1	Jenert	157,466.57
2	Kuala Nerang	98,703.15
3	Nam	123,707.23
4	Lubuk Merbau	128,092.06
5	Kulm Hi-Tech	410,080.17
6	Bukit Selambau	220,494.40
7	Jeniang/Sg. Pau	172,732.99
8	Jeniang Baru	172,732.99
9	Penang Tunggal (Sungai petani)	410,080.17
10	Teloi Karan	218,069.80
11	Kuala Ketil Lama	373,691.33
12	Kuala Ketil Baru	373,691.33

Table 1. The list of WTPs and the area of catchments.



Figure 1 The map of WTPs water intake location and the catchments extent.

Conclusions

- Forest acts as natural water purification agent that is very effective in providing clean water resources to consumer, especially for domestic use.
- The results of marginal value of water purification services by Ulu Muda FR shows that areas with a higher percentage of virgin forest will produce lower marginal value (lower treatment cost).
- To ensure lower water treatment costs and reduce the burden of consumers on higher charges to obtain clean water from water treatment, areas of water supply catchments need to be protected and maintained. It is not only benefitted water supply but also on other important services such as reducing the risk of floods, sedimentation and nutrient exports.

References

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