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Study of Utilization of Hydrological Services and Economic Value of Humboe Water Resources by Ermera Community

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A R T I C L E I N F O

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A B S T R A C T

This study aims to determine the volume of water use of the community of Humboe Village, Ermera Municipality for household needs and to determine the economic value of hydrological environmental services in the Forest Area in Humboe Villag. This research was carried out in Ermera, taking place from January to March 2023. The variables observed in this study are the volume of water used for household needs, namely the need for clean water (m^3/month), the economic value of water based on the price applicable to household needs (U$) and the willingness to pay (WTP) by the water user community (Rp. Sample determination is carried out by *Simple Random Sampling*, with the number of samples taken as much as 10% or 40 families out of a total of 140 household's members of pipe-based management. The data collection method is carried out by taking secondary data and direct interviews with the public using structured questionnaires. The results of the study show that the average water volume over the past year in Humboe Village is 41.38541667 m3/year with 140 households using Humboe springs

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INTRODUCTION

Forests are invaluable natural resources because they contain biodiversity as a source of germplasm, sources of timber and non-timber forest products, water system regulation, preventing floods and erosion as well as soil fertility, protecting biological nature for the benefit of science, culture, recreation, tourism and so on. The division of forest areas based on their functions with certain criteria and considerations is stipulated in Government Regulation of the Republic of Indonesia No. 34 of 2002 concerning Forest Management and Use of Forest Areas Article 5 paragraph (2), which is clarified with the functions of forest areas in Law of the Republic of Indonesia No. 41 of 1999 concerning Forestry, namely Protected Forests, Conservation Forests and Production Forests.

Production Forest is a forest area that has the main function of producing forest products, both timber forest products and non-timber forest products to meet the needs of the community. The existence of forests is very important for humans to continue their lives. Production forest management is an effort to utilize production forests whose activities consist of harvesting or logging, planting, processing and marketing timber forest products in production forests. The goal of forest management is to achieve the dual benefits of producing timber, regulating water systems, wildlife habitats, food sources for livestock and humans, and recreational areas.

Environmental services are defined as services provided by the functions of natural and artificial ecosystems whose value and benefits can be felt directly or indirectly by stakeholders in order to help maintain and/or improve the quality of the environment and people's lives in realizing sustainable ecosystem management (Suprayitno, 2008). The existence of production forests provides benefits for village communities around forest areas because they use water sources for their daily needs.

Humboe Village is one of the villages located in Ermera District, Ermera Regency, Mady Gleno City. Humboe Village is close to the capital city of Gleno, which can be reached by motorized vehicle. The boundaries of the Humboe Village area are to the west bordering Estado and Leguime Village Villages, to the east bordering Talimoro Village, to the north bordering Mirtuto Village, to the south of Ponilala with Poetete Village. The number of residents of Humboe village in 2015 was 2481 people with a total of 435 families. There are four hamlets in Humboe Village and of the four hamlets, Poeana Hamlet has the largest population, namely 164 people. Then the second is Boro Hei Hamlet with a population of 134 people. Furthermore, Hatali and Dirlau Hamlet with a population of 95 people and 42 people, respectively. The majority of the people of Humboe Village work as farmers and coffee plantations.

According to local government information, Humboe Village is one of the villages that received the Drinking Water Supply System (SPAM) project by the Ministry of Public Works and Public Housing during the Indonesian government era, Communities in several villages use water for their needs in the form of water management institutions managed by the village government. Most of the people take advantage of the existence of water sources from the production forest area to meet their daily needs, such as bathing, washing and other clean water needs, by installing pipes directly at the water source in the

production forest area and then storing the water in a reservoir located at the village hall and then flowing to residents' houses. To accommodate the water, residents use storage containers such as reservoirs, buckets, and basins to be ready to be used as household clean water needs.

The benefits of hydrological environmental services as a source of water are very important for the community. However, the community of water environment service users in Humboe Village has not contributed to maintaining the sustainability of the Forest Area in Humboe Village.

LITERATURE REVIEW

Forests are one of the national natural resources that are a buffer for people's lives and a source of prosperity, which must be maintained optimally by maintaining their carrying capacity in a sustainable manner. Forestry development is a shared responsibility and is carried out responsibly and transparently so as to provide the greatest benefits for the prosperity of the Indonesian people (Nurfatriani, 2010).

According to Law Number 41 of 1999 concerning Forestry, a forest is a unified ecosystem in the form of an expanse of land containing biological natural resources dominated by trees in the communion of nature and its environment, which cannot be separated from each other. From the definition of forest mentioned, there are elements that include: A unity of ecosystem in the form of a stretch of land Contains biological natural resources along with nature and the environment that cannot be separated from each other Able to provide benefits in a sustainable manner.

Environmental services are products of biological natural resources and their ecosystems in the form of direct benefits (*tangible*) and indirect benefits (*intangible*) which include, among others, natural tourism services (recreation), water protection services (hydrological), soil fertility, erosion and flood control, beauty, uniqueness of biodiversity, carbon absorption and storage (Merryna, 2009).

Hydrology is the science that studies water in all its forms (liquid, gas, solid) on, in, and above the ground level. This includes its distribution, cycle and behavior, physical and chemical properties, and its relationship with the living elements in water itself (Asdak, 2002).

The hydrological benefits of a forest are very important, because water is a vital human need and its existence cannot be substituted. Some studies have shown that the hydrological benefits of forests are significant, for example the 7,500-hectare La Tigra National Park in Honduras supports more than 40% of the water supply in Tegucigalpa (the capital of Honduras) and agricultural irrigation is able to generate a net profit of US$ 500 per week. In Indonesia, the hydrological benefits of Gunung Gede Pangrango National Park are more than Rp 4.341 billion per year (Darusman, 1993 *in* Ramdan *et al.*, 2003). Another example, Mount Ciremai provides hydrological benefits for the household and agricultural sectors worth Rp 33.5 trillion (Ramdan *et al.*, 2003).

Economic assessment is a reliable and logical technical tool to be used as input for decision-makers in natural resource management. Monetary value or calculation can show a strong concern for natural resource assets and the environment, can be used to determine the quality of the environment, as a

basis for quantitative comparison in monetary form against several alternative options in deciding on a policy or the use of funds (Tampubolon, 2008).

Gustami, *et al.*, (2002) define the economic value of forests as the characteristics or quality of goods and services from forests that cause these goods and services to be exchanged for something else to determine their benefits or usefulness. For some profits and services, the market provides a good price and raises the value of social placement that the goods have a price in society. However, for impermanent goods, only a small part of the total value, which is often the value of the environment, is not included in the value of individual components. One approach that can be used to this problem is total economic value.

METHODOLOGY

Population is the entire object of research. The population in this study is the entire community of Humboe Village which totals 435 families, which are divided into 2 categories. The first category is people who use springs from Forest Areas with a piping system, which is as much as ..... head of family (KK), the second category is people who use as much river water..... head of family (KK).

Sample is a part or representative of the population members who are the object of research. The sample in this study was determined by simple random sampling with a sampling intensity of 10%. So, the number of selected samples for users of the piping system is (KK,) and those who use river water are (KK.) According to Arikunto (2011), if the population is less than 100, then the sample is the entire population, and if the population is more than 100 people or in large numbers, then a sample of between 10-15% or 20-25% of the population can be taken.

There are two types of data in this study, namely primary data and secondary data. Primary data is data obtained directly from the target/individual, for example data from interviews or questionnaires, while secondary data is data obtained from related agencies, local village governments in the form of notes, books, reports, tables or diagrams about the research area (Sugiarto et al., 2001).

The data collection techniques used in this study are as follows: 1. Field research techniques, namely data collection is carried out through field orientation, structured interview methods (questionnaires) and observation. Data is obtained by means of observation and interviews with communities around the forest area to obtain data on the use of water from the forest area. The data taken are as follows:

a. Volume of water used for daily necessities such as cooking and toilets (m^3)
b. The number of family members, as users of water needs and the costs incurred to obtain water.
c. The price applies to forest service users as water providers.
d. Willingness to pay (WTP) by the water user community.

1. The water value is calculated based on household needs (eating, drinking, bathing, washing). It can be calculated with the following formula:

TPA = VPA (month 1 + month 2 + month 3 + ... + month 12)

Information:

a. **LANDFILL = Total water use for households (m3/year)**
b. **VPA = Volume of water usage (MCK)**

2. The economic value of clean water for household purposes using the Prevailing Price method

NART = TPA x HB

Information:

c. **NART** = Household water value (U$)
d. **LANDFILL** = Total water use for households (m3/year)
e. **HB** = Applicable price (U$/m3)

(Sudinta and Antara (2008) *in* Soemarno, 2010).

3. The water value is calculated based on WTP (*Willingness To Pay)* by following the following formula:

$$\mathbf{WTP} = \sum_{\mathbf{i=1}}^{\mathbf{7}} \mathbf{AWP_i} \left(\frac{\mathbf{n_i}}{\mathbf{N}}\right) \times \mathbf{Populasi}$$

Information:

- WTP = Willingness to pay total
- AWPi = Average willingness to pay, amount 1 to 7
- Ni = The number of respondents who are willing to pay AWPi
- N = Number of people interviewed as a sample

(Sudinta and Antara, 2008)

RESULT AND DISCUSSION

1. **Volume of Household Water Use of Humboe Village Community Originating from Humboe Spring**
2.

Table 1. Volume of Household Water Use of Humboe Village Communities Coming from Humboe Production Forest

It	User	Total Water Usage Volume (m3)
1	**Pipingization**	**41.38541667**
Sum		**41.38541667**

Source: Primary Data processed in May 2023

Number of Users = 40 families
Population = 140KK
Deal Price = U$. 5 /month

$$HB = \sum_{i=1}^{40} (HK \text{ x } IP \text{ x } JP)$$

With:

- HB = Prevailing Price
- HK = Deal Price (U$/Month)
- JP = Number of Users (Soul)
- IP = Payout Index (Year)

$$HB = \sum_{i=1}^{32} (HK \times IP \times JP)$$

= 5 x 12 x 40
= U$.2400 dollar

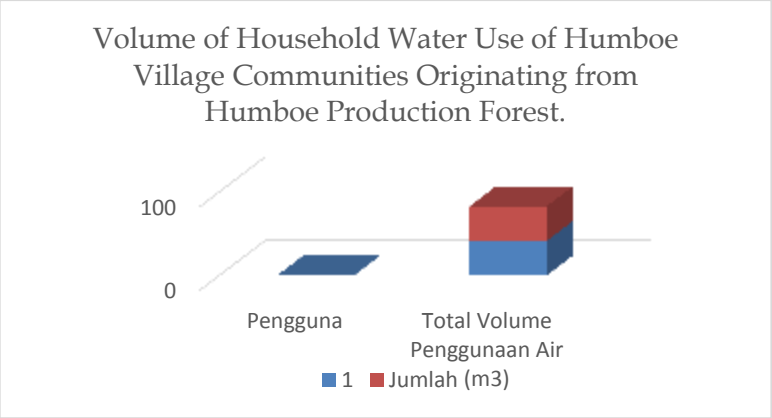


Figure 1. Volume of Household Water Use of Humboe Village Communities Originating from Humboe Production Forest

2. Economic Value of Hydrological Environmental Services in the Production Forest Area of Humboe Village

Table 2. Economic Value of Hydrological Environmental Services in the Production Forest Area of Humboe Village

It	User	Total Economic Value of Water Environmental Services (U$)
1	**Pipingization**	**4.591666667**
Sum		**4.591666667**
Average		4.591666667

Source: Primary Data Processed in May 2023

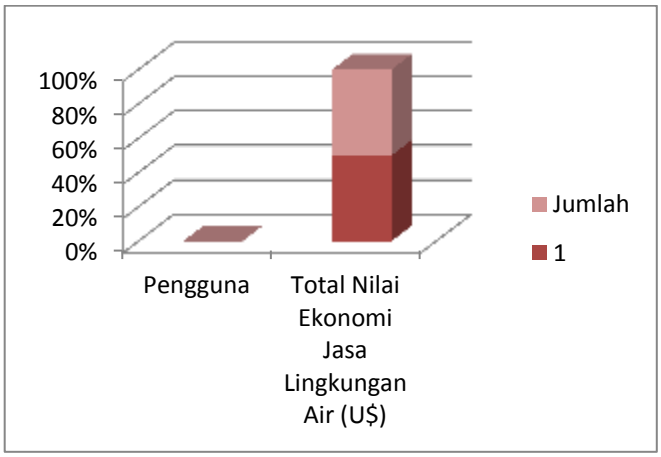
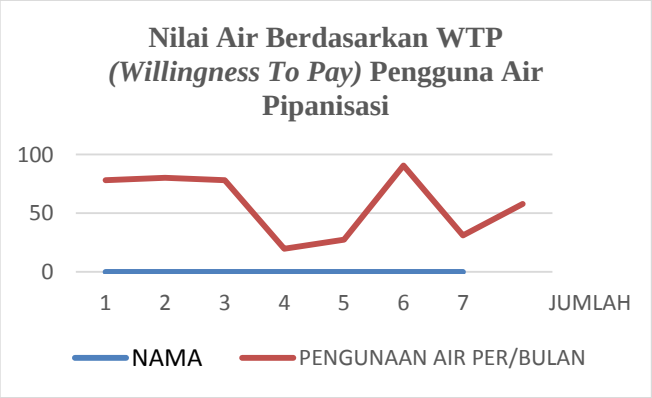


Figure 2. Economic Value of Hydrological Environmental Services in the Production Forest Area of Humboe Village

3. Water Value Based on WTP *(Willingness To Pay)* of Piped Water Users

TOTAL: 57.81493506



Graph 3. WTP *(Willingness to Pay)* Piped Water Users

$$\textbf{Rata} - \textbf{rata pemanfaatan/bulan} = \frac{\sum_{i=1}^{7} \textbf{total penggunaan/bulan}}{\textbf{jumlah responden}}$$

$$= \frac{57.9}{7}$$

$$= 8.29 \text{ m3/month}$$

$$-\textbf{WTP} = \sum_{i=1}^{7} \textbf{AWP}_i \left(\frac{n_i}{N}\right) \times \textbf{Populasi x } 12$$

$$= 57.9x1x140x12$$

$$= 97{,}272/\text{ year}$$

Water is a natural resource that is absolutely necessary for human life and in the environmental system, water is an element of the environment. Human needs for water are always increasing from time to time, not only because of the increase in the number of people who need water, but also because of the increasing intensity and variety of water needs, (Silalahi. M.D., 2002). Human daily activities are never separated from water. Starting from bathing, washing, cooking to elements of the human body, one of which also consists of water. The volume of water use by the people of Humboe Village is the total water demand used to meet their respective needs.

The volume of water utilization in Humboe Village is the amount of water used by the community to meet their daily needs. The total volume of water used by the people of Humboe Village is the total volume flowing from the Production Forest Area around the village. This is because when the water flows and fills several reservoirs located at the Humboe Village Hall, the water then flows through pipes to people's homes.

The water source located in the Production Forest Area around Humboe Village is the water supplier of Humboe Village water management which has begun its management during the Indonesian colonial era until now. The lack and adequacy of the water needs of the people of Humboe Village is highly dependent on the discharge of water sourced in the Production Forest Area and whether there is damage to the connecting pipes between the water source and several reservoirs that have been available at the Humboe Village Hall. The following volume of water use for the needs of community households that

utilize water sources managed by the Humboe Village Government from the production forest area is presented in Table 7.

According to Linsey (1985), household use is water used in private residential places or houses and so on for drinking, bathing, watering gardens and other purposes. Water needs are not always the same for all time, it all depends on a water use activity in daily life by the community. Household water needs will also be influenced by the consumption pattern, namely the larger the population of an area, the more water use will be.

From the results of the research that has been carried out by the Humboe Village community, the total volume of water uses of the Humboe Village community using pipes as many as 140 households is 41.38541667 m3/year and the price applies to annual payments of U$. 2400/year. This causes the volume of water use used by the people of Humboe Village for household needs to be relatively large.

CONCLUSION

Based on the results of the research that has been carried out, it can be concluded as follows:

1. The total volume of water use for household needs of the people of Humboe Village, Ermera District, Ermera Regency, in the category of 140 households of piped users, is 8.29 m3/month which comes from production forests. So that the total volume of household water use of the Humboe Village community is 97,272 m3/year.
2. The economic value for water environmental services managed by the Humboe Village Government using pipes with a total of 140 households based on the manager's effective price for the past year in 2015 is U$. 4.591666667/year.

Declaration of Conflicting Interest

The authors declare that there is no conflict of interest in this work.

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