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Perceptions of Public Users on Forest Hydrological Services in South Korea

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Abstract

According to the valuation of the forest public function in 2020, the forest provides 65 percent(830t) of the number of domestic water resources in South Korea. This study investigated how Korean people appraise and perceive forest hydrological services through surveys. The surveyees were categorized into two groups: direct users and indirect users. Direct users are the people who use forest water for a living, such as water intake and meanwhile indirect users are the people who largely enjoy indirect benefits of forest hydrological services through the wide-area and local waterworks. We interviewed 759 residents living in upstream areas for direct users and 1,200 residents living in downstream areas for indirect users. As a result, 74 percent of direct users used only forest water resources for drinking and domestic water relying on forest water resources heavily. Direct users seem to be highly satisfied with low-cost service and clean water but dissatisfied with unstable water supply depending on seasonal changes and water quality contamination. 11 percent of indirect users used forest water resources as domestic water. In addition, 48.1 percent of direct users and 58.9 percent of indirect users were in favor of paying money regarding to the willingness to pay for enhancing forest water quality. The average value of the willingness to pay was 2,747 won for direct users and 2,307 won for indirect users, showing a similar level.

Keywords: forest hydrological services, willingness to pay, perception

Introduction, scope and main objectives

Forest offers a various kind of ecosystem services. Among them, forest hydrological services would be one of the most crucial benefits from the nature. As a ‘Green dam’, ‘flood control’ that reduces rainwater, ‘drought mediation’ that prevents dry valleys despite the lack of rain for a long time, and ‘water purification’ that provides clean water (Choi and Kim, 2004; Kojima et al, 2013). Research on the valuation of a forest benefits in 2020, the forest in Korea can store 19.53 billion tons of water which accounts for around 15 per cent of the whole volume of water and 58 per cent of the entire water use (Kim et al, 2020).

An effort to estimate the value of forest hydrological services which is of great relevance to the wellbeing and survival of human is one of the most crucial research fields as ‘Economic Evaluation of Ecosystem Service.’ Grizzetti et al. (2016) identified different types of evaluation method (Contingent valuation, Hedonic price, Market price, production function, Replacement Cost, Travel Cost) according to a different type of ecosystem services that forest hydrological service offers.

With respect to the economic value of forest hydrological service, there is a tendency that researchers use replacement cost method that estimates the value of a certain function by comparing the cost of other alternative function (Croitoru, 2007). Mainly, the cost of dam building and chemical coagulation to remove non-point pollutant sources are used to estimate the value of forest water resources. The advantage of replacement cost method is that it can be better for ensuring transparency and objectivity as its calculation is based on the engineering cost information.

On the other hands, some researchers adopted contingent valuation method that the value of goods is estimated by users to assess their preferences and Willingness-To-Pay (WTP). The estimated value or WTP has the potential pitfall of estimating the value to be bigger or smaller due to Hypothetical Bias (HB), but they can

offer the value that users are thinking of and assess the value of numerous kinds of non-market goods (Lee and Hwang, 2020).

Korean Forest Services also used to quantify the economic value of 12 forest ecosystem services (NIFoS, 2020). The economic value of forest hydrological services here is estimated by employing Replacement Cost from supply's perspective. However, it's not sufficient to grasp the social benefit and cost of forest hydrologic service, also the valuation from the viewpoint from users is necessary because they have first-hand experience of using services and forming their own perception towards the service. This research investigated the perception of users of forest hydrological services to better understand their perceived value of the services.

Methodology/approach

1-Definition of users

Users of forest hydrological services were categorized into two groups according to the way of forest hydrological services: direct users and indirect users. The definition of direct users is those who use forest water for a living, such as water intake and domestic water because of the absence of the public water supply. Indirect users are defined as the downstream residents of ordinary citizens who largely enjoys indirect benefits of forest hydrological services by using the wide-area and local waterworks or by visiting a valley for recreation purpose.

2-Survey Sites

This research conducted in-person interview for the direct users. They consist of 759 households living in upstream areas. They are residents of major river basins ranging from Han River (Northern Han: Inje county, Southern Han: Pyeongchang and Yeongwol county), Nakdong River (Yeongju city), and Geum River (Jinan county). This research excluded Yeongsan River Basin area because of low rate of water supply and water scarcity.

For surveying the indirect users, this research contacted 1,200 people whose address of downstream areas' residence are from Han River Basin (Seoul and 15 city and counties), Nakdong River Basin (Daegu and 9 cities and counties) to Geum River Basin (Daejeon and 6 cities and counties). Contrary to the case of the direct users' survey, this study conducted telephonic interview because the outbreak of COVID technically hampered in-person interview.

3- Survey questionnaires

The questionnaire of this study deals with the usage pattern and perception of forest hydrological services, the valuation of the service and willingness-to-pay, the management direction and authority in detail.

In addition, this study prepared a different survey questionnaire for each group because the direct and indirect users may differ in terms of the way that use the forest hydrological service. For example, the survey for the direct users delved into their usage pattern of forest water resources for water intake and domestic water and the degree of satisfaction.

Results

1- Characteristics of Forest Water Resource Use

The Usage Pattern of Direct Users and their Satisfaction Rate

74 per cent (n = 582) of the respondents relied solely on forest water resources for water intake and domestic water, whereas the rest of them (26 per cent, n = 197) used other kind of water sources such as tap water (14.5%), ground water (14.7%) and wells (3.7%), and other means (0.2%)

The direct users showed a high level of satisfaction. the most important factor was free or low cost for the service (69.6%), followed by clean water (51.4%), and rich in mineral (10.5%). However, some of them complained about the unstable water supply due to Korea's continental climate, which has frequent rainfall and typhoon in Summer (39.8%) and water quality contamination by flooding (17.0%). Moreover, the direct users pointed out poor water volume (16.2%) and Bacterial infection threat such as coliform bacteria (12.3%)

The Usage Pattern of Indirect Users and their Recognition of Forest Contribution

The indirect users largely rely on tap water as their main water source because wide-area and local waterworks are accessible to them. 11.6 percent of the indirect users (n =139) use forest water resources for their daily lives. It turns out that they use the forest water for drinking water (40.8 %), recreation (39.4%), domestic water (11.0%), agricultural water (8.6%), and others (0.2%). Asked if forest can enhance the quality and quantity of the wide-area and local waterworks, 87.1 percent answered 'Yes'.

2-Value Perception of Forest Water Resource

Importance of Forest Water Resources

The direct users placed 'Clean Water from Forest' at the forefront in terms of the benefits that forest can offer among 10 types of Forest Ecosystem Services like provision of forest products, clean water from forest, air purification by absorbing fine dust and air pollutant, alleviation of climate change by absorbing CO₂, controlling natural disaster, habitat for wildlife, biodiversity, scenic aesthetic, space for leisure and recreation, and education for nature. The indirect users attached significance to 'Alleviation of Climate Change by Absorbing CO₂ (1st)', 'Controlling Natural Disaster such as Landslide, Flood, Typhoon (2nd)', 'Air Purification by Absorbing Fine Dust and Air Pollutant(3rd)', 'Habitat for Wildlife(4th)', while 'Clean Water from Forest' ranked fifth. Compared to the indirect users, the direct users clearly manifested that they think highly of human survival issues in forest hydrological services.

Economic value of Forest hydrological services: Willingness-To-Pay

This survey asked, "Are you willing to contribute a certain amount of money for improving forest water resource as a form of tax or fund?". While 48.1 percent of the direct users answered "Yes", 58.3 percent of the indirect user did, which indicated a higher degree of willingness-to-pay than direct users.

The amount of money varies from 1,000 KRW to 5,000 KRW. The average of the willingness to pay showed insignificant difference between two groups (2,747 KRW, and 2,307 KRW respectively).

In terms of the reason for the willingness to pay, the direct users pinpointed 'more stable forest water source management and supply' (37.4%), 'and 'guarantee for clean and safe water' (32.4%), while the indirect users 'acceptable among of the charge' (29.4%), 'forest and environment protection' (32.4%), and 'investment for the future generation' (20.8%). On the contrary, those who refused to pay said "It is the government that should take the main charge of forest water management, not individuals."

The direct users were examined their valuation of forest water by asking "In your opinion, how much does 1 liter of forest water cost?". The average costed answered is 254 KRW, which is considerably higher than the cost of ordinary tap water (1 KRW) and an almost half of 500 KRW, the average market price of 1 liter bottle water.

The indirect users were examined their valuation of forest water by asking "Which one would you prefer between A (ordinary bottled water, 100KRW/100ml) and B (spring water from a primeval forest, 200 KRW/100ml)?" Around 44.5 per cent decided to choose B which is twice as much as A. It seems that is it due to their trust towards the quality of forest water resource.

3-Finance and Authority for Forest Water Resources

Water Use Charges as a Funding Source for Forest Management

Water Use Charge is a part of watershed management fund to support residents and improve water quality. Water works business operators levy and collect the charges from downstream residents in proportion to their water consumption (Act on the Improvement of Water Quality and Support for the Residents of Han River Basin, 1999). Specified by Presidential Decree, the charge of 170 KRW per resident per ton is imposed. The most of charge is invested in the construction of public sewage treatment facilities and environmental infrastructure facilities for livestock manure management (5~60%), and programs for supporting residence such as the provision of agricultural materials and village hall construction (15%).

44.1 percent of the direct users and 82.3 percent of the indirect users agreed to use water use charge as a financial source for the management of forest in upstream areas.

Authority for Forest hydrological Services

About the question "In your opinion, which organization bears the main responsibility for the provision of forest hydrological services?", the direct users mentioned local government such as city and county (58.6%), K-water (18.2%), and Korea Forest Agency (12.3%). Rather Korea Forest Service (39.5%) ranked the first among the indirect users.

Discussion

1- Financial Source of Forest hydrological Service Management

With regards to willingness-to-pay for the forest hydrological service management, the direct and indirect users said they would contribute 2,747 and 2,307 KRW per month respectively. It can therefore be assumed that Korean publics would pay roughly 2,500 KRW for better forest hydrological services. If the Korean government imposes roughly 2,500 KRW per household, it can create a budget up to 700 billion KRW for forest management as shown in Equation 1.

Annual Total Value of Willingness-To-Pay: about 700 billion KRW

$$700,290,000,000 \text{ KRW} = 23,343,000 \text{ households} \times 2,500 \text{ KRW/month/1 person} \times 12 \text{ months}, \quad <\text{Eq. 1}>$$

Where total number of household and average family size were based on 2019 population and housing census data

This result could be useful information for policymaking for creating a budget that improves forest hydrological services because it reflected the public opinion.

2- Public Awareness of Forest hydrological Service Authority

It is Korea Forest Service (KFS) and forest owners that provides forest hydrological services for creation and management of forest. However, as the survey result reveals, much of the public appears to have weak perception of the role of KFS for improving forest water resources.

This phenomenon can be interpreted in two ways. Firstly, it may evidence that KFS's role and contribution to the enhancement of forest hydrological services was not good enough to impress the general public even though KFS has been responsible for a lot of polices and has contributed to them. Probably, it would be time for self-questioning whether forest hydrological service-related policies have been on the right track. Secondly, the general public may lack the information about the role of KFS and forest owners because of the lack of promotion and outreach. It should consider the sharing information and active communication.

Conclusions/ wider implications of findings

Forest hydrological services would be one of the most crucial forest ecosystem services. This study has examined the perception of the general public as forest hydrological service users. Notably, it has conducted in-depth analysis by categorizing respondents into two groups (direct and indirect users) according to the route of use of forest hydrological services.

This study has shown that the direct user group heavily relies on forest water resources, and they requested stable water supply. Whereas the indirect users showed more open and positive attitude in terms of willingness to pay, the amount of money, and water use charge for forest management than the direct users.

It is expected that water issue would become more important because of climate change. Upstream forest water resource is the source and beginning point of water. It is required for forest hydrological service providers to gain a better understanding and empathy from the users, and to take a strategic approach that enables high quality and stable forest hydrological service provision.

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