

The Value of Jeju Island Biosphere Reserve as an Internationally Protected Area

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Abstract

This research analyzed the environmental, social, and economic value of Jeju Island BR. The findings from this research enable us to draw the following as conclusions in relation to the value of Jeju Island BR as an internationally protected area. First: The value of BR humans can receive through conservation as an indirect use depends on two factors. One is what sectors of BR are covered in examining its value. The other is the default factor which is substituted in the estimation of an economic value by sector of the BR. Second: Sustainable use of BR refers to its direct use. It is of course true that the direct use provides humans with many benefits in terms of improving material affluence and convenience in life. Third: Sustainable use does not mean there is no impact on the conservation of BR, but it means minimal impact on the entire BR or within the resilience of natural circulating ecosystem. Fourth: In the context of the above third conclusion, it would be necessary to conduct an empirical research on whether the current land-use in BR is within its carrying capacity. Fifth: In order to achieve the land-use within the carrying capacity of BR, there must be an explicit consideration of ecological implications of the existing social and economic decision as a cultural ethos in a way to environmentalism from consumerism. Sixth: Change in human perspective on the relation between humans and nature from anthropocentrism to ecocentrism is a necessary condition to establish environmentalism as a cultural ethos. Seventh: Nonetheless, nature and human activities toward nature have been in a conflicting relationship throughout the history of human civilization. The conflicting relationship may be termed a dialectic process through historical stages.

Key words :

the environmental, social, and economic value of Jeju Island Bio Sphere. An Internationally Protected Area

Objectives of the Research

Since the 18th century, industrialization has given us material and cultural affluence, as well as many of the conveniences in life we now enjoy. These benefits are achieved at enormous expense to nature, and produce worldwide environmental problems that threaten nature and human existence. In this sense, humans are beneficiaries and victims of industrialization. This is a self-contradiction that lies between industrialization and the preservation of nature. The self-contradiction is proved by the fact that nature can exist without humans, but humans can not survive without nature.

In such a context, UNESCO has launched remarkable programs designating internationally protected areas which receive protection because of their recognized natural, ecological or cultural values. They are designation of Biosphere Reserve from 1971, World Natural Heritage from 1972, and Global Geopark from 2001.

Among them, the major objectives of biosphere reserve (hereafter referred to as BR) are to conserve diversity and integrity of plants, animals and micro-organism, to promote research on ecological conservation and other environmental aspects, and to provide facilities for education, awareness and training (Jeong, 2016).

By the website of UNESCO Biosphere Reserve, there are 714 BRs in 129 countries all over the world as of June, 2021. BR has a wide range of functions, but the functions are categorized into environmental, social and economic value (Jeong et. al., 2021: 40–58). In a broad sense, these functions of BR as a unit of nature are termed ecosystem services. It was the 1980s when the ecosystem service became the standard, implying different terminologies such as nature's service or ecosystem goods in scientific literature (eg. Daily, 1997: 392; Daily et. al., 2000; Brown et. al., 2007; Kareiva et. al., 2011; Biggs et. al., 2015).

However, it is quite rare to conduct research on the value of BR as an internationally designated area. In this context, this paper aims at analyzing the value of Jeju Island BR in terms of environmental, social and economic function.

In order to achieve the objectives of this research,

this paper will introduce the basic profiles of Jeju Island BR for helping the readers understand about Jeju Island BR, and then will analyze the value of environmental, social and economic function that Jeju Island BR provides humans.

Introduction to Jeju Island Biosphere Reserve

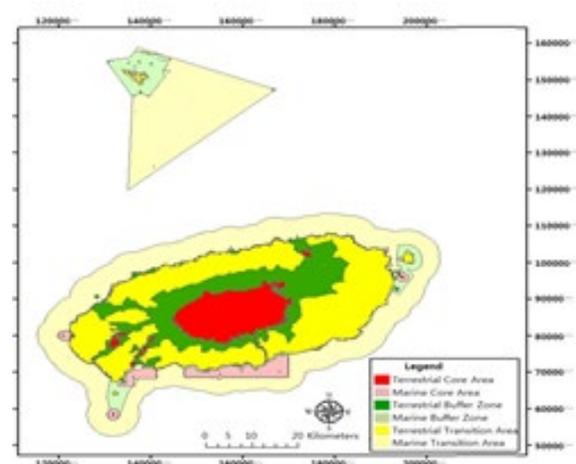
1. Geographic Location

South Korea is composed of nine provinces and six metropolitan cities. Jeju Island is a special self-governing province located in the southernmost part of the Korean peninsula (Map 1). It is 73km from east to west, 41km from south to north, and its total area is 1,847km², which is about 1.83% of South Korea.



Map 1) Geographic Location of Jeju Island

About 45% of the island was designated as a Biosphere Reserve site in 2002. In 2019, the designation was expanded to the entire Jeju Island and to 5km of the surrounding coast (Map 2).



Map 2) Geographic Location of Jeju Island Biosphere Reserve

Total area of Jeju Island BR is 3,871.94km² including terrestrial and marine area (Table 1). The proportion of each zone is 10.3% for core area, 18.7% for buffer zone, and 71.0% for transition area.

Table 1 Area of Jeju Island BR by Zone (Unit: Km²)

Category	Terrestrial	Marine	Total	Proportion
Core Area	289.75	109.76	399.51	10.3%
Buffer Zone	523.53	199.33	722.86	18.7%
Transition Area	1,032.87	1,716.70	2,749.57	71.0%
Total	1,846.15	2,025.79	3,871.94	100.0%

Source: JSSGP, 2018a: 33

2. Policies for Conservation

With the participation of Jeju citizens and community organizations, below are the major acts being applied for the conservation of Jeju Island BR (JSSGP, 2018b, 32–53).

For the conservation of core area, three acts are being launched. They are 'Designated as National Park by Natural Parks Act', 'Designated as Seogwipo Provincial Marine Park', and 'Application of Cultural Heritage Protection Act'. Meanwhile, for conserving buffer zone, 'Designated as Conservative Mountainous District', 'Management of Mountainous Districts Act', and 'Designated as Seogwipo Provincial Marine Park' are launched. 'Zonation of Relative/Absolute Conservation in Land-use' and 'Management Plan of Environment Resources as a Whole' are launched for conserving transition area.

3. Policy for Sustainable Use

Below are the major policies being launched for the sustainable use of Jeju Island BR (JSSGP, 2018b: 32–53).

Using the designated 6 tracking paths in Mt. Hallasan National Park, hiking, visiting, rest area, and academic monitoring and research, etc., are permitted in the core area. Shiitake mushrooms are cultivated in some areas.

The buffer zone is used as pasture, mountains and forests, and miscellaneous area, etc. Tourism activities in the buffer zone are done mostly in public tourism resorts, such as Natural Forest Resorts, Roe Deer Eco-Park, Saryeoni Forest Trail, and Seogwipo Provincial Marine Park, etc.

The majority of Jeju BR's economic activities are located in the transition area. There are 21 golf courses, 31 public and private facilities that are related to tourism, 26 accommodations, and 15 schools, etc. A brand new logo that symbolizes Jeju BR's designation by UNESCO has been designed. The following five products that are produced in the BR are using this new logo on their products to promote Jeju BR: shiitake mushroom, green tea, Sasa quelpaertensis, wood-cultivated ginseng, and pork.

Land-Use Based on Geographic Information System, Prior Location Review of Urban Management Plan, and research and monitoring on a periodic base, etc. are the management systems being employed for Jeju BR sustainability (JSSGP, 2012, 137–166).

4. Geological Characteristics

Jeju is a volcanic island, formed approximately two million years ago until historic times, by a volcanic eruption and shows the following characteristics (JSSGP, 2012: 10–15).

The lavas including the quality of trachyte as basalt are distributed widely in Jeju Island. The lavas form a wide range of volcanic topographies and about 360 small volcanoes called Oreum, including Mt. Hallasan (1,950m above sea level) is located in the center of Jeju Island. In relation to the conditions and time of the volcano, the mountain system, the water system, and the coastal topography show various characteristics. Approximately 120 small and large lava caves are distributed on the entire island. The representative cave is Geomunoreum lava tubes which were registered as a World Natural Heritage site in 2007.

Jeju Island has a radial water system with Mt. Hallasan as apex. This results in poor development of water system, forming mainly two streams towards north and south from the summit of Mt. Hallasan as the center of Jeju Island, but mostly are dry streams.

The total length of Jeju's coastline is 419.95km. Most of it is exposed to volcanic rocks. Small-scale pocket beaches and coastal sand dunes are developed along the coastline.

Most soils are of typical volcanic ash soil. The major parent material of the soil is basalt even though some ingredient includes tuff. Jeju Island was

formed by numerous volcanic activities for about 1.8 million years, which resulted in the parent materials of volcanic ash soil crumbling in different forms at different times.

5. Ecological Characteristics

Jeju Island BR holds various types of land cover that maintains biological diversity, and its ecological profiles of Jeju Island BR are characterized in terms of the geographic distribution of habitats and characteristic species (JSSGP, 2012: 15–27), habitats of special interest (JSSGP, 2012: 27–33), and endangered or threatened species (JSSGP, 2012: 33–38).

Geographic Distribution of Habitats and Characteristic Species: The distribution is divided into seven zones: Alpine Coniferous Forest, Shrubbery Zone, Temperate Deciduous Broadleaf Forest, Warm Temperate Evergreen Lucidophyll Forest, Wetland Vegetation, Mid–mountain Pasture Zone, and Coastal Habitat with Peculiar Landscape.

Habitats of Special Interest: The habitats include Gotjawal (lava stony forest), Oreum (monogenic volcano), inland wetland, and community of soft coral. Gotjawal was formed when lava with high viscosity gushed out from Mt. Hallasan and split into large and small rocky masses. The masses piled up and formed a rough and lumpy topography, Gotjawal that contributes to the recharging of underground water, and causes warm and moist effects. In this sense, Gotjawal is a rare and unique forest that exists in the world. Gotjawal's soil is poorly developed, with thick layers of small and large rocky masses.

Oreum is a monogenic volcano formed by volcanic ejections and is distributed throughout the whole area of Jeju Island, and is considered as an important element that forms Jeju Island's unique landscape. There are about 360 Oreums in total. Oreums are composed of grassland, natural forest, artificial forest, and wetland, etc., and is biologically diverse and scarce, has natural characteristics, and inhibits a diversity of species.

There are a total of 253 inland wetlands in Jeju Island. Five wetlands are registered with Ramsar Wetland. Endangered wild plants and animals inhabit in the inland wetlands. Vegetation shows a different distribution structure according to geography.

Collected insects around the wetlands are 11 Orders, 56 Families, and 149 Species. Jeju Island's endemic insects inhabiting in the wetlands are: 3 Orders, 5 Families, and 6 Species.

There are many rare and precious biological organisms in Jeju's sea that are not common in other seas in Korea. Seogwipo's soft coral communities (corals that do not produce calcium carbonate skeletons) form a beautiful underwater landscape. A variety of unique biological organisms inhabit in the many islands around Seogwipo. The beautiful underwater landscape connotes a rich biological diversity. Soft coral communities exist in areas where many encrust animals (biota that cling unto rock surfaces, mostly compound animals) inhabit.

In addition, many endangered or threatened species inhabit in Jeju Island BR (Jeong et al., 2015: 15–16). For example, a total of 103 species inhabit in Jeju Island BR among the animals listed in the IUCN Red List. By South Korea's criteria for classifying endangered wild animals and plants for the Wild Animal and Plant Protection Law, there are 31 plant species in Jeju Island BR among the total 77 endangered wild plants that are classified under this law. There are 87 endangered wild animals in Jeju Island BR among the total 165 species that are designated by this law.

The Value Jeju Island Biosphere Reserve

1. Environmental Value

Jeju Island BR has a wide range of environmental values. The representative values among them are water-related function, protection function of wild animals and plants, and others.

Water-related Function: This function is related to the forest. There are four main functions of forest as a green dam: recharge of underground water, purification of water quality, alleviation of drought, and flood control (Kim, J. H. et al., 2007).

Even though there are 11 human-constructed reservoirs, their sharing is about 2% (JD, 2018). This situation has led Jeju Island to rely almost exclusively on underground water for agricultural, industrial, commercial, and drinking water. The basement of underground water being recharged depends entirely

on the amount of rainfall as below (Ko and Park, 2016: 6-7).

The average precipitation during the past 10 years in Jeju Island is 1,872mm. The total annual precipitation to Jeju Island is 33.85 billion m³ to 35.16 billion m³. Among the total annual precipitation, 19-20% is direct run off to sea through stream and land surface, 33-37% is evaporated into the atmosphere, and 44-46% is recharged as underground water.

Regarding the purification of water quality, the function of the forests' water quality is to decrease the concentration of substances contained in precipitation when the precipitation passes through the forest ecosystem. Much of this work is done by forest soil. The examples include lowering the concentrations of substances such as nitrogen and phosphorus and bringing the pH of acid rain closer to neutrality, organic nitrogen and ammonia nitrogen being decomposed by the activity of soil microorganisms existing in forest soil, and the concentration of ammonia ion being dissolved as it passes through the soil layer (Kim, J. H. et al., 2007: 27-29). Such function of the terrestrial area of Jeju Island BR purifying water quality enables Jeju Island to maintain 100% pure water without any contaminant.

As explained below (Yun, 2001), alleviation of drought and flood control are conceptually distinct, but their functions exist as a reality. The two functions occur when the forest sinks rainwater in the soil and then flows it slowly through underground water. The structure and property of the forest soil in Jeju Island BR are characterized as a typical volcanic ash soil, and The major parent material of soil is basalt even though some ingredients include tuff (JSSGP, 2012: 14-15).

Protection Function of Wild Animals and Plants: Jeju Island BR is a site where a wide range of species inhabit. This implies Jeju Island BR has a function to protect wild animals and plants. The protection function includes inhabiting species, endangered species, and protected species.

Regarding animal (JSSPG, 2018a: 1), Jeju Island is known as an ecosystem treasure, with its approximately 6,300 species of terrestrial animals including about 2,000 species of tracheophyta insets inhabiting subtropical, temperate, cold and subalpine

regions. About 230 species of fish and 110 species of sea algae also inhabit. They are part of about 2,000 marine species including 800 species of fish and about 420 species of sea algae. A total of 103 species among the animals listed in IUCN Red List inhabit in Jeju Island (JSSPG, 2012: 36). These are the contribution of Jeju Island BR to the protection function of wild animals.

Regarding plant, Jeju Island BR shows a character of east coast climate and a vertical distribution of climate belt covering warm, temperate, and polar climate according to sea level. This type of climate belt maintains rich biological diversity through various types of land cover. The major types of land cover are alpine coniferous forest, shrubbery zone, temperate deciduous broadleaf forest, and warm temperate evergreen lucidophyll forest, etc. Such major types of land cover in the terrestrial area of Jeju Island BR protect a rich biological diversity as below (JSSPG, 2012: 30-33).

About 1,750 plant species inhabit in the terrestrial area of Jeju Island BR. Among them, 393 species are Jeju endemic plant, and 31 species are the 1st and 2nd grade endangered plants designated by Ministry of Environment of South Korean National Government. In particular, 157 and 536 species are listed in IUCN Red List at a District Level and Regional Level, respectively.

In addition, Jeju Island BR retains more than 550 species which can be utilized as medicinal and edible resource, among which about 210 species are medicinal plants (JSSGP, 2018a: 78).

Other Functions: The major other functions of Jeju Island BR are the prevention of soil runoff and landslide. Soil runoff is defined as water running over the surface of the earth. It is a common occurrence, and part of the water cycle. However, as runoff travels downhill towards a water source such as a lake or river, it transports chemicals, debris, or other pollutants it has collected from the soil with it. Surface runoff is a major component of the water cycle. It is the primary agent in soil erosion by water.

Soil runoff can cause soil erosion. Forests has an effect on water and soil conservation helping further ecological functions and improving vegetation reconstruction (Wu, 2014). No soil runoff has occurred in Jeju Island. This would imply that Jeju

Island BR being composed mostly of forest is conserved as it is.

Landslide refers to several forms of mass wasting that include a wide range of ground movements, such as rock falls, deep-seated slope, mudflows and debris flows. Almost every landslide has multiple causes including factors that increase the effects of down-slope forces and factors that contribute to low or reduced strength. There are several types of landslide. They are fall, slide, topple, spread, and flow, etc. The impact of landslide is very wide. Its example includes economic decline resulting in destruction of property, decimation of infrastructure, loss of life, destruction of landscape, and ecosystem, etc.

Jeju Island has experienced four heavy typhoons since 2003 as below (Jeong, 2015). The names of these heavy typhoons were Rusa (August 23 to September 1, 2002), Maemi (September 6 to 14, 2003), Nari (September 13 to 17, 2007), and Bolaven (August 20 to 29, 2012). Each of these heavy typhoons caused minor landslides in five or six sites in Jeju Island BR. All minor landslides in Jeju Island BR occurred because these typhoons were over the carrying capacity of Jeju Island BR.

When landslides in Jeju Island BR were restored, Jeju Government restored facilities such as shelter as soon as possible. However, natural ecosystems that were destroyed by landslides were not artificially restored if restoration were not urgently required; it is better for natural ecosystems to be restored on its own.

2. Social Value

There are a wide range of social values biosphere reserve provides to humans. However, only six social values Jeju Island BR provides will be examined as below.

As a Site of Tourism: There are 6 tracking paths in the core area of Jeju Island BR, while there are several tourism sites in the buffer zone and transition area. Tourism activities in the buffer zone are done mostly in public tourism resorts, such as Natural Forest Resorts, Roe Deer Eco-Park, Saryeoni Forest Trail, and Seogwipo Provincial Marine Park, etc. In particular (JSSGP, 2018a: 2-3), Jeju Island BR has three eco-tourism sites designated by the Ministry of

Environment of South Korean National Government.

On average, tourism revenue occupies 45.2% of gross regional domestic product during the past five years. These facts imply that Jeju Island BR has a significant part contributing to sustainable development of Jeju Island through sustainable use as a site of eco-tourism.

As a Site of Cultural Activity: The concept of culture is defined differently by academic fields such as anthropology and sociology and even by scholar, but is used as a recreational activity and traditional folk festival at its narrowest sense.

There are no recreational activities and traditional folk festivals perform in Jeju Island BR. However, there are some historical-cultural heritages in Mt. Hallasan National Park and around Yeongcheon Stream and Hyodoncheon Stream, all of which are the core areas of Jeju Island BR. Broadly, they can be grouped into two categories. One is a designated heritage by South Korean National Government or Jeju Provisional Government, while the other is a non-designated heritage.

The designated heritages by National Government include scenic sport, natural monument, and the designated heritages by Provincial Government include tangible cultural heritage, natural monument, and registered cultural heritage. Non-designated heritage includes tangible historical-cultural heritage. There are a total of 13 and 14 sites designated by National Government and Provincial Government, respectively, while there are a total of 53 non-designated sites (MHRI, 2012: 465, Ko et al., 2015)

As a Site of Religious Activity: Religious Activity is generally defined as any activity that primarily promotes or manifests a particular belief in or about a deity or an ultimate reality. There are four Buddhism temples in Jeju Island BR (MHRI, 2012: 448).

All of the four temples were constructed before Jeju Island BR was designated in 2012. Each temple areas are different, but the total area of the four temples is 372,494m². Number of regular Buddhists are different by temple, but their total number is 6,900.

The Buddhists visit their temple to participate in the collective Buddhism events being held at each temple, such as The Day of Buddha's Coming, which is once a year and Monk's sermon, which is

once a month. In addition, the Buddhists visit their temple for their personal worship on a regular or irregular basis. However, the four temples run no environmental program when their Buddhists visit their temples.

As a Site of Scientific Activity: Jeju Island BR is being used as an object of scientific activity. The scientific activity on Jeju Island BR can be classified into two categories. One is the research activity conducted by Jeju Government, and the other is the research activity conducted by academic scholars.

The research activity by Jeju Government has led and managed the research and monitoring on Jeju Island BR since 2002 when Jeju Island was designated as a biosphere reserve site. The representative researches and monitoring conducted include the value and change in natural ecosystems, various researches on deteriorated environment and visiting form for sustainable conservation, and a comprehensive survey on natural resources, etc. (JSSPG, 2012: 65–66). In addition, ‘Long-term Ecological Research on Mt. Hallasan for Responding to Climate Change’ is conducted every year since 2008. On the other hand, Jeju Government publishes the result of research and monitoring on the natural resilience of damaged areas due to human-induced causes for 10 years on Mt. Hallasan.

Research activity by academic scholars is being done on Jeju Island BR as a research site. According to the Jeju research database¹, 4,672 academic researches on Jeju Island BR were conducted and published since 1985. The research topics conducted on terrestrial BR are Diversity of Plant, Diversity of Animal, Insect, Vegetation, Exotic Plant Species, Plant Resources, Landscape, Soil, Wetland, Cave, and Geological and Topographical features, etc. Meanwhile, the research topics on marine area are Marine Environment, Fish Species, Marine Resources, Marine Plankton, and Marine Microorganism, etc.

As a Site of Environmental Education: School and social environmental education is being implemented in Jeju Island. The former is for primary, middle, and high school students, but is an optional subject. The latter is for Jeju citizens in general by 34

environment-related civil organizations under the financial support from Jeju Government or South Korean National Government, with a target of 180,000 educatees a year (Kim & Jeong, 2018: 29).

Jeju Island BR is being used as an environmental education site. The major sites that the educatees lead cover the areas of rich biodiversity, well-conserved landscape/vegetation/forest, human-induced damage, cave, Gotjawal (stony lava forest), world natural heritage, and global geopark, etc.

In addition, Jeju Government is using Jeju Island BR as an environmental education site in relation to the UNESCO Associate School Program. 22 primary, middle, and high schools in the proposed Jeju Island BR have joined the network of the UNESCO Associate School Program to implement the sustainable development education (JSSGP, 2018a: 115).

As a Site of Healing: Generally, healing is defined as the process of health restoration from an unbalanced, diseased, damaged or unvitalized organism (Hassen et. al., 2017). The result of healing can be to cure a health challenge, but one can grow without being cured or heal without ‘a cure’. Healing is also referred to in the context of the grieving process (Hassen et. al., 2017). In psychiatry and psychology, healing is the process by which neuroses and psychoses are resolved to the degree that the client is able to lead a normal or fulfilling existence without being overwhelmed by psychopathological phenomena. In this sense, it may be argued that healing is associated with the themes of wholeness, narrative, and spirituality, and is an intensely personal, subjective experience involving a reconciliation.

When forest is used as a healing site, it is called forest healing, forest bathing or nature therapy (Hassen et. al., 2017). The forest of Jeju Island BR, particularly, Mt. Hallasan National Park which is the core area of Jeju Island BR, is providing the hikers to Mt. Hallasan Nation Park with the function of forest healing. The number of hikers to Mt. Hallasan National Park, which is the core area of Jeju Island BR, was 1,001,437 in 2017, 891,817 in 2018, 848,279 in 2019, and 699,117 in 2020 (KNPS, 2021: 13).

Mt. Hallasan National Park allows hikers to pass through the assigned six tracking paths

1) <http://kiss.kstudy.com.lib.jejunu.ac.kr:8080/search/sch-result.asp>

that are protected by wool or stone to prevent soil loss vegetation damage from foot stamping (JSSGP, 2018a: 47). In addition, tracking paths are constructed by timber tech in order to minimize vegetation damage.

3. Economic Value

Jeju Island BR has a value as a site of residents' economic activity as below (JSSPG, 2012: 50–56, JSSPG, 2018a: 95).

Terrestrial area of Jeju Island BR is used for stockbreeding and agricultural production. The two categories of economic activity are done in the buffer zone and transition area. The stockbreeding industry is mainly composed of ranches such as cow, horse, dairy cattle, and pig.

Meanwhile, the marine area of Jeju Island BR is not used as a large-scale commercial fishing site, but is used for leisure and economic activity. They include amateur fishing, catching seafood and shellfish by Haenyeo (diving women) without any mechanical tools, and ocean floor sightseeing by submarine.

In particular, Jeju Government operates an institution for the usage of Jeju Island BR's logo for outstanding products of agriculture, fishery, livestock, and forestry that are produced in Jeju Island BR, natural resources, and manufactured products. This is to contribute to vitalization of local economy through enhancing the value of the products with a clean image and publicity of Jeju Island BR. As of 2021, 41 products produced and/or processed by 25 commercial companies are authorized as branded products using the logo of Jeju Island BR and are on sale in the market. These products are shiitake, bracken, wood-cultivated ginseng, cypress trees, pine trees, green tea, broad-leaf bamboo, port, yogurt, cheese, drinkable springwater, and beverage, etc.

In addition, the actual economic value of the sectors consisting of environmental value of Jeju Island BR can be estimated. Such economic value of Jeju Island BR as a unit of nature has two categories. They are use value and non-use (Baker and Ruting, 2014: 12; Hernández, 2014: 3; Jeong, 2018).

Use value refers to the tangible features of a commodity that can satisfy some human requirement, want or need, or that serves a useful

purpose. Use value is split into direct and indirect use value. Direct use is obtained through a removable product in nature, such as timber, fish, and water, etc., all of which are direct consumptive use. Indirect use is obtained through a non-removable product in nature, such as the sunset and waterfalls, etc. In this sense, use value refers to market value.

Non-use value is the value that people assign to economic goods, including public goods, even if they never have and never will be used. In other words, non-use value is the satisfaction of knowing that other people can benefit through conservation without being touched by humans, and future generations will be able to benefit from nature. In this sense, non-use value refers to the monetary value of nature which is not traded in market, thus is defined as a non-market price.

A group of scholars have developed the quantitative methodologies for estimating the value of nature as a non-market price in the 2000s (eg. Brown et. al., 2002; Philip and MacMillan, 2005; Brander et. al., 2008; Wegner and Pascual, 2011; Baker and Ruting, 2014; Barton et. al., 2016; Saarikoski et. al., 2016). The methodologies are applicable to the estimation of, in particular, economic value by the sector of nature or ecosystem. Another group of scholars have conducted empirical analyses of the economic value of nature or ecosystem, using the developed methodologies (eg. Acharya, 2000; Krieger, 2001; Verma, 2003; Heal et. al., 2005; World Bank, 2005; Mates, 2007; TFPL, 2009; Kumar and Wood, 2010; Wilson, 2010; KFRI, 2012; Nordhaus, 2017).

Among the sectors explained in the environmental value, this paper will estimate the economic value as a non-market price of underground water, preventing soil runoff, preventing soil landslide, and forest as a source of carbon sink.

The Economic Value of Underground Water: There are no creeks where water constantly flows in Jeju. This situation makes Jeju's underground water the main source for agricultural, industrial, and drinking water, etc. The forest is the major source for recharging water resources through conservation of precipitation. The economic value of underground water is estimated to be about US\$533 million as below (Jeong et al., 2021: 134–135).

(total quantity of available underground water as of

2020) *

(average market price of water per m³ including agricultural, industrial, and drinking water, etc. in Jeju Island) = 11,300,000,000m³ * US\$0.0471 = US\$532,230,000 ≈ US\$533 million

The Economic Value of Preventing Soil Runoff: This economic value can be estimated using two variables – quantity of soil runoff Jeju Island BR prevents a year and prevention cost of soil runoff per m³. The annual economic value of preventing soil runoff is estimated to be about US\$677 million as below (Jeong et al., 2021: 135).

(the quantity of preventing soil runoff) * (prevention cost of soil runoff per m³) = 90,026,596m³ * US\$7.52 = US\$677,000,001 ≈ US\$677 million

The Economic Value of Preventing Soil Landslide: This economic value can be estimated using two variables – the area (hectare) of soil landslide Jeju Island BR prevents a year and prevention cost of soil landslide per hectare. The annual economic value of preventing soil landslide is estimated to be about US\$318 million as below (Jeong et al., 2021: 135).

(the area of soil landslide) * (prevention cost of soil landslide per hectare) = 3,315 hectare x US\$95,940 = US\$318,041,100 ≈ US\$318 million

The Economic Value of Forest as a Source of Carbon Sink: Forest is sometimes a carbon source such as during a forest fire or when there are more dead trees than living trees. But in most other cases, forest absorbs carbon more than they release. The net balance of all of these carbon exchanges determines whether a forest is a carbon source or sink. Yet, the carbon source/sink balance is as dynamic as it is complex.

However, the quantity of carbon sink is different by the species and age of trees consisting in a forest (Pugh et. al., 2019). Each country and even each region in a country have different forest structures in terms of the species and age of trees. This means that in order to estimate the quantity of carbon sink by forest in a region, a field survey on the species and age of the trees should be conducted. Thus, it is inevitable to use the average quantity of carbon sink by forest per hectare in South Korea as a default factor applicable to Jeju Island BR.

According to KFRI (2012), the forests in South Korea, including all species and ages of trees, emit

1.34ton per hectare a year on average, and absorb 11.74 ton per hectare a year on average. This means the forests' average net carbon sink in South Korea is 10.40 ton per hectare a year, and 10.40 ton can be used as the default factor applicable to the area of the forest in Jeju Island BR.

Then, the economic value of forest as a source of carbon sink in Jeju Island BR is estimated to be approximately US\$3.663 billion in 2019 as below.

A: GRDP of Jeju in 2019: US\$20,101,100,000

B: Emission of CO₂-equivalent greenhouse gas in 2019: 4,944,538 ton

C: Carbon emission unit (carbon emission per US\$1.00 production of GRDP):

B/A = (4,944,538 ton)/US\$20,101,100,000 = 0.000246 ton

D: 0.000246 ton implies that 0.000246 ton of carbon is emitted per US\$1.00 production of GRDP, and implies that if the forest in Jeju Island BR absorbs 0.000246 ton of carbon per year, the economic value of Jeju Island BR is US\$1.00 a year.

E: Total quantity of carbon sink by the forest in Jeju Island BR a year: (Area of Forest)*(Quantity of Carbon Sink per hectare) = (86,630 hectare)*(10.40 ton) = 900,952 ton

F: The economic value of forest as a source of carbon sink: E/C = (900,952 ton)/(0.000246 ton) ≈ US\$3.663 billion

Summary and Conclusion

1. Summary

The objectives of BR which is one of the internationally protected areas being designated by UNESCO are to conserve diversity and integrity of plants, animals and micro-organism, to promote research on ecological conservation and other environmental aspects, and to provide facilities for education, awareness and training. However, it is quite rare to conduct research on the value of BR as an internationally designated area. In this context, this paper aimed at analyzing the value of Jeju Island BR in terms of environmental, social and economic function.

In order to achieve the objectives of this research, this paper introduced the basic profiles of Jeju

Island BR for helping the readers understand about Jeju Island BR, and then analyzed the value of environmental, social and economic function that Jeju Island BR provides humans.

Environmental Value: The representative environmental values are water-related function, protection function of wild animals and plants, and others. The water-related function is related to the forest as a green dam; recharge of underground water, purification of water quality, alleviation of drought, and flood control.

Protection function of wild animals and plants includes inhabiting species, endangered species, and protected species, with approximately 6,300 species of terrestrial animals including about 2,000 species of tracheophyta insets. About 230 species of fish and 110 species of sea algae also inhabit. A total of 103 species among the animals listed in IUCN Red List inhabit in Jeju Island (JSSPG, 2012: 36).

A character of east coast climate and a vertical distribution of climate belt maintains rich biological diversity through various types of land cover. About 1,750 plant species inhabit in the terrestrial area. Among them, 157 and 536 species are listed in IUCN Red List at a District Level and Regional Level, respectively. The major other functions are the prevention of soil runoff and landslide.

Social Value: Six social values among the wide range of social values Jeju Island BR provides to humans were examined. They were the site of tourism, cultural activity, religious activity, scientific activity, environmental education, and healing.

Tourism site: There are 6 tracking paths in the core area of Jeju Island BR, while there are several tourism sites in the buffer zone and transition area. Tourism activities in the buffer zone are done mostly in public tourism resorts.

Cultural activity site: There are no recreational activities and traditional folk festivals perform in Jeju Island BR. However, there are some historical-cultural heritages. One is a designated heritage by government, while the other is a non-designated heritage. The former includes scenic sport and natural monument, etc. Meanwhile, the latter includes tangible historical-cultural heritage.

Religious activity site: There are four Buddhism temples in Jeju Island BR, all of which were

constructed before Jeju Island BR was designated in 2012. Number of regular Buddhists are different by temple, but their total number is 6,900. The four temples run no environmental program when their Buddhists visit their temples.

Scientific activity site: Jeju Island BR is being used as an object of scientific activity by Jeju Government and academic scholars. The research activity by Jeju Government has led and managed the research and monitoring on Jeju Island BR, while 4,672 academic researches on Jeju Island BR were conducted and published since 1985.

Environmental education site: Jeju Island BR is being used as an environmental education site. The major sites that the educatees lead cover the areas of rich biodiversity, well-conserved landscape/vegetation/forest, human-induced damage, cave, Gotjawal (stony lava forest), world natural heritage, and global geopark, etc.

Healing site: The forest of Jeju Island BR, particularly, Mt. Hallasan National Park, is providing the hikers with the function of forest healing. Mt. Hallasan National Park allows hikers to pass through the assigned six tracking paths that are protected by wool or stone to prevent soil loss vegetation damage from foot stamping.

Economic Value: Terrestrial area of Jeju Island BR is used for stockbreeding and agricultural production, while the marine area is used for leisure and economic activity. Jeju Government operates an institution for the usage of Jeju Island BR's logo for outstanding products of agriculture, fishery, livestock, and forestry.

In addition, this paper estimated the economic value of underground water, preventing soil runoff, preventing soil landslide, and forest as a source of carbon sink, which Jeju Island BR provides as a non-market price. The estimated economic value as a non-market price of the four sectors per year were as below.

Underground water: US\$533 million

Preventing soil runoff: US\$677 million

Preventing soil landslide: US\$318 million

Forest as a source of carbon sink: US\$3.663 billion

2. Conclusion

The history of human civilization began from

the hunting-gathering society, followed by the agricultural society, and the industrial society emerged about 300 years ago. Humans were economically poor, but enjoyed the original quality of nature in the hunting-gathering and agricultural society. Meanwhile, humans enjoy material affluence, however it is not provided with the original quality of nature. This is because economic development has been achieved by nature's sacrifice. This means that improvement of material affluence is inversely proportional to nature's conservation.

Empirically proven through the history of human life, nature can exist without humans, but humans can't survive without nature. In this context, the crisis of nature caused by economic development through the use of nature directly is linked to the crisis of human existence. In this sense, it is argued that humans are the beneficiaries and victims of industrialization and has committed a self-contradiction.

In order to solve the self-contradiction, a wide range of human activities have been launched. One of them is the designation of internationally protected areas such as biosphere reserves, world natural heritages, and world geoparks.

There are two categories of access to BR. One is sustainable use, and the other is conservation. Sustainable use is the direct use of nature. Meanwhile, conservation provides humans with at least two benefits. One is the benefit that humans can receive the original quality of ecosystem services from nature while conserved without human intervention. The other is the benefit as an indirect use of nature gained from conserving nature. The latter can be categorized into environmental, social, and economic value.

This research analyzed the environmental, social, and economic value of Jeju Island BR. The findings from this research enable us to draw the following as conclusions in relation to the value of Jeju Island BR as an internationally protected area.

First: The value of BR humans can receive through conservation as an indirect use depends on two factors. One is what sectors of BR are covered in examining its value. The other is the default factor which is substituted in the estimation of an economic value by sector of the BR. For the latter case, the default factor is different depending on the level

of technology development and socio-economic development in the region where the BR is located.

Second: Sustainable use of BR refers to its direct use. It is of course true that the direct use provides humans with many benefits in terms of improving material affluence and convenience in life. However, it would be necessary to compare which is more beneficial between direct use and conservation. Particularly, this comparison is necessary in the transition area with central functions, which may contain a variety of agricultural activities, settlements and other uses.

Third: Sustainable use does not mean there is no impact on the conservation of BR, but it means minimal impact on the entire BR or within the resilience of natural circulating ecosystem. This would mean that the sustainable use of BR should be promoted within the carrying capacity of BR.

Fourth: In the context of the above third conclusion, it would be necessary to conduct an empirical research on whether the current land-use in BR is within its carrying capacity. In other words, the empirical research is an examination of whether the land-use of BR is really a sustainable use.

Fifth: In order to achieve the land-use within the carrying capacity of BR, there must be an explicit consideration of ecological implications of the existing social and economic decision as a cultural ethos in a way to environmentalism from consumerism. Consumerism is defined as a lifestyle to purchase and consume goods and services more than we need, while environmentalism is a lifestyle to purchase and consume goods and services as much as we need. In this sense, the cultural ethos of environmentalism would contribute to reducing consumption and resulting in less production of goods and services that cause nature to have less pollution and less destruction.

Sixth: Change in human perspective on the relation between humans and nature from anthropocentrism to ecocentrism is a necessary condition to establish environmentalism as a cultural ethos. Because environmentalism is drawn from the perception that nature can exist without humans, but humans can't survive without nature, and that the crisis of nature is the crisis of human existence.

Seventh: Nonetheless, nature and human activities

toward nature have been in a conflicting relationship throughout the history of human civilization. The conflicting relationship may be termed a dialectic process through historical stages. The dialectic process has resulted in an ecological synthesis in agricultural society, economic synthesis before the 1960s when the seriousness of the destruction of nature was recognized, and ecological synthesis again since the 1970s.

The ecological synthesis in an agricultural society is defined as a society without serious nature destructions because human activities (thesis) were within the carrying capacity of nature (anti-thesis). The economic synthesis in the early industrial society from the eighteenth century to the 1960s is defined as a society whose goal were to improve material affluence and convenience in life. In this historical stage, human activities (thesis) have been characterized as 'human domination over nature', as a result, nature exceeded its carrying capacities (anti-thesis), which has made humans recognize that the crisis of nature is the crisis of human existence.

In accordance with this recognition since the 1970s, even though human activities (thesis) are still continuing to exploit nature (anti-thesis) for improving material affluence and convenience (thesis), many institutional efforts have been launched to reduce this destruction of nature (ecological synthesis). Examples are environmental policies by governments, international environmental conventions by international organizations, green managements by business corporations, environmental movements by NGOs, and environmentally friendly behaviors by general citizens in everyday life. In academic areas, many green social theories have also emerged, such as risk society theory, deep ecology, social ecology, new environmental paradigm, and environmentalism.

Such dialectic processes throughout historical stages can be applied to the process before and after BRs are designated in the relation between conservation and sustainable development in terms of the framework of thesis-antithesis-synthesis.

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