



## **Economic valuation of Sun bear (*Helarctos malayanus*) and Sumatran elephant (*Elephas maximus sumatrensis*) based on maintenance cost approach**

Audelia Thalita Ramadhanti, Yanto Santosa, Arzyana Sunkar

Study program of Tropical Biodiversity Conservation, Post Graduate School, IPB University, 16680, Indonesia

### **Article Info:**

Received: 19 - 09 - 2022

Accepted: 05 - 10 - 2022

### **Keywords:**

Economic valuation, maintenance cost, Sumatran elephant, Sun bear

### **Corresponding Author:**

Audelia Thalita Ramadhanti  
Study Program of Tropical  
Biodiversity Conservation, Post  
Graduate School, IPB  
University;  
Phone: +6281290947749  
Email:  
[audeliathalita@gmail.com](mailto:audeliathalita@gmail.com)

**Abstract.** *Sun bear (*Helarctos malayanus*) and Sumatran elephant (*Elephas maximus sumatranus*) are two species with high population decline due to poaching and illegal wildlife trade. It is still difficult to enforce hunting and wildlife trade laws due to legal standardization that can be used as an economic basis for lawsuits. One method of quantifying the economic value of animals can be done through an economic valuation process. This study aims to examine the economic value of sun bears and Sumatran elephants based on a maintenance cost approach. The research was conducted at the conservation institutions of Medan Zoo, Siantar Zoo, and PPS Tashikoki from February – May 2021. The method used in the study was to manage conservation institutions to obtain the amount of cost allocation for animal care that refers to the five principles of animal welfare. The results showed that the sun bear's economic value based on its two-year maintenance cost reached Rp 76,760,000.00 and for the Sumatran elephant, it reached Rp 621,730,000.00. The feed allocation is the highest maintenance cost allocation for these two species. This high economic value indicates a disproportionate amount of fines given to the perpetrators of hunting and illegal wildlife trade, which has implications for weak legal products and does not cause a deterrent effect.*

### **How to cite (CSE Style 8<sup>th</sup> Edition):**

Ramadhanti AT, Santosa Y, Sunkar A. 2023. Economic valuation of Sun bear (*Helarctos malayanus*) and Sumatran elephant (*Elephas maximus sumatrensis*). JPSL 13(1): 49–56. <http://dx.doi.org/10.29244/jpsl.13.1.49-56>.

## **INTRODUCTION**

Illegal wildlife trade is a form of environmental crime and has become a global issue (Nellemann 2016). The increase in animal trade activities, especially wild animals, is influenced by the potential for economic gain (Rajagukguk 2014). During the 2015 – 2018 period, there have been more than 609 arrests of poachers and distributors of illegal wildlife trade in Indonesia (Ditjen Gakkum KLHK 2019). Meanwhile, from 2017 to mid-2019, the police arrested 796 illegal animal sellers with confiscated goods totaling 15.640 animals (Moses 2019). This condition indicates the alarm of urgency in wildlife conservation, which indirectly impacts state losses. State losses due to the illegal wildlife trade are estimated at IDR13 trillion annually and continue to increase (Khoirunnisa and Pricille 2019).

Efforts to prosecute cases of illegal trade are still challenging to do. This condition is caused by the lack of information related to the value of illegal trade, which tends to vary and does not have an expected value; even the prices circulating in the market are generally only formed based on agreements between actors. The absence of standard guidelines for determining prices in illegal trade schemes indicates that the value of the wild animal is artificial, making it difficult to quantify. In other words, the standard of animal value

quantification is not yet available (Chardonnet et al. 2002). In this regard, it is necessary to have a process of quantifying the economic value of the relevant wildlife used in determining the amount of the lawsuit/ fine. This can be done through the process of economic valuation of natural resources. An economic valuation is an approach to quantifying goods and services produced by natural resources, which can be categorized as the basis for market value and non-market value (Hasibuan 2014).

The process of economic valuation to quantify the value of animals can be carried out using a maintenance cost approach. Maintenance costs are the allocation of costs used to ensure the preservation of these species in conservation institutions, which refers to the five principles of animal welfare (Bahrani et al. 2020). This research will analyze the economic value of the sun bear (*Helarctos malayanus*) and the Sumatran elephant (*Elephas maximus sumatranus*). Sun bear and Sumatran elephant are often the targets of illegal trade, which is carried out alive and dead with the body condition intact or divided into specific parts (specimens) such as meat, skin, and ivory. In the context of this research, the high cost that conservation institutions must allocate for the maintenance of sun bears and Sumatran elephants is indirectly assumed as the number of estimated losses when both species die due to poaching and illegal wildlife trade.

## **METHODS**

### **Location and Time of Research**

Data collection was carried out from January – March 2020 and February – May 2021. Data collection related to the economic valuation of the sun bear and Sumatran elephant was carried out in several conservation institutions, including Medan Zoo, Siantar Zoo, and Tasikoki Manado Animal Rescue Center (PPS).

### **Data Collection**

Maintenance cost calculation data was obtained through structured interviews with conservation institution managers to determine the maintenance costs consisting of infrastructure/enclosure costs, feed, health, and minimum wages for the keeper. The maintenance cost component refers to the main aspects of ensuring animal survival, life, and welfare. Collecting the economic value of sun bear and Sumatran elephant data is carried out using in-depth and structured interviews with conservation institution managers. Interviews with managers were conducted to obtain information related to the allocation of costs incurred for maintaining sun bears and Sumatran elephants, which refers to five principles of animal welfare, including: (1) freedom from hunger and thirst, which is manifested in the availability of food and drinking water; (2) freedom from discomfort, as indicated by the availability of enclosure infrastructure and equipment or other rearing facilities, (3) freedom from pain, injury, or disease, as indicated by the availability of health care and treatment facilities for illness and disease; (4) freedom from the fear and distress, shown by the management and control of disturbing environmental factors, and (5) freedom to express natural behavior, marked by the creation and control of a cage environment that allows animals to carry out their natural behavior and habits (Yohanna et al. 2014).

### **Data Analysis**

#### ***The Economic Value Based on the Maintenance Cost Approach***

The cost approach in this study uses the protection cost approach (BK), which is carried out in conservation institutions. Estimation of the economic value of sun bears and Sumatran elephants with a mathematical cost approach can be formulated as follows (Bahrani et al. 2020):

$$PC_i = a + b + c + d + \dots + \text{etc}$$

$$PC_r = \frac{\sum_{i=0}^n PC_i}{n}$$

$$WEV = PCr \times nY$$

Descriptions:

a,b,c,d = Investment costs (infrastructure/ enclosures) and operational costs (feed, health care, and keeper's minimum wages)

PCr = Average maintenance cost

PCi = The cost of maintaining animals at the i-th conservation institution

n = Number of conservation institutions

WEV = The economic value of wildlife

Y = Length of maintenance of wild animals (years)

The principle of the approach used in calculating sun bear maintenance costs based on each cost component:

- a. The cost of making/ providing infrastructure/ enclosure is calculated with the assumption that the service life of the enclosure for animal rearing is ten years, so the annual cost is calculated by dividing the total cost of making/ procuring enclosures by ten years of enclosure life. In addition, for the management unit that allocates the cost of maintaining/maintaining enclosures and maintenance equipment, the total cost of animal care enclosures is calculated from the total cost (value) of procurement/construction of enclosures per year plus the cost of maintenance/care for one year;
- b. The cost of animal feed is calculated from purchasing feed cost for the needs per animal per day for one year of maintenance;
- c. The animal health and treatment maintenance cost is calculated from the allocation and use of costs for maintenance and health checks, including for the purchase of vitamins and medicines;
- d. The cost of animal care workers is calculated from the wages for one animal keeper per month for one year (12 months) and then divided by the number of individual animals or enclosure units that are technically economically feasible. The basic assumption is that each worker (animal keeper) whose wages are calculated is tasked with maintaining a minimum number of animals according to animal species that are technically economically feasible.
- e. Determination of the final economic value of each type of animal is calculated for the maintenance period of one year and two years.

## **RESULTS AND DISCUSSION**

### **The Economic Value of Sun Bears Based on the Maintenance Cost Approach**

The existence of sun bears in Indonesia has been officially protected through the Decree of the Minister of Agriculture No. 66/Kpts/Um/2/1973 concerning violations of the trade in sun bears, both alive and dead, including their body parts. However, the existence of this protected status is not strong enough to reduce the high number of hunting and trading of sun bears in Indonesia. According to Sasmita (2018), sun bears are also often found dead, either intact or have taken certain parts such as claws/nails, skin, gall, and meat to be traded illegally.

The increasing threat to the sustainability of sun bears requires conservation efforts that are carried out in-situ and ex-situ conservation. According to Ngabekti (2013), ex-situ conservation is the process of protecting (rare) plant and animal species by taking them from unsafe or threatened habitats and placing them under human protection. Examples of ex-situ conservation forms include zoos, animal rehabilitation centers, animal rescue centers, and safari parks. In the context of ex-situ conservation, several costs are required to ensure the sustainability and welfare of the animal's life. The following are maintenance costs incurred by conservation agencies for sun bears (Table 1).

Table 1 Allocation of sun bear's maintenance cost in conservation institutions

No	Maintenance cost component	Maintenance cost per animal per year at the Institute (Rp x 1000)		
		Medan Zoo	Siantar Zoo	PPS Tasikoki Manado
1	Infrastructure	20,000	17,500	-
2	Feed	21,600	19,800	23,400
3	Health care	400	600	1,200
4	Keeper's minimum wage	3,600	4,200	3,840
	Total	44,600	42,100	28,440
	Average			38,380
Economic value based on total maintenance cost for two years				76,760

Conservation institutions have four components of maintenance costs to support animal welfare, including infrastructure costs (providing/building enclosure maintenance), feed, health care, and minimum wages for the keeper. The highest costs for maintaining sun bears at Medan Zoo, Siantar Zoo, and PPS Tasikoki Manado were allocated for feed needs, namely Rp 21,600,000.00, Rp 19,800,000.00, and Rp 23,400,000.00, respectively. The composition of sun bear feed per day per individual is 4,000 - 6,000 grams of fruits (papaya and banana muli) and 200 - 500 grams of tubers such as sweet potatoes (Firdilasari *et al.* 2016). In addition, sun bears eat honey and plants' soft parts (Indarwati 2007). The variety of feed on sun bears is important to meet all their nutritional needs. Prijono and Handini (1998) stated that a rich nutrient feed is needed to maintain health and long life. The difference in the allocation of sun bear feed costs in each conservation institution can be caused by many factors, including the type of feed provided and the price of feed at the location.

The maintenance costs for the sun bear enclosure infrastructure at the Medan Zoo and Siantar Zoo conservation institutions are Rp 20,000,000.00 and Rp 17,500,000.00, respectively. The sun bear is an arboreal nocturnal animal that likes heights and is skilled at climbing trees compared to other Ursidae families (Astuti 2006). In other words, an artificial sun bear enclosure must provide tree trunks that they can climb on and sharpen their hooves.

The cost of health care for sun bears at Medan Zoo, Siantar Zoo, and PPS Tashikoki reached Rp 400,000.00, Rp 600,000.00, and Rp 1,200,000.00, respectively. Based on the results of interviews, one of the sun bears health care routine is the provision of regular deworming medicine twice a year. This is explained by Nugroho and Purwaningsih (2015), that the most significant factor affecting sun bear health is enclosure biosecurity, which is not considered and has the potential for gastrointestinal parasite infestation. Furthermore, Jenantika *et al.* (2019) stated that the gastrointestinal parasites that infest sun bears are helminths (worms) and digestive protozoa. Therefore, in addition to increasing the biosecurity of the enclosure, another form of anticipation is to administer deworming medicine regularly (twice a year) for sun bears.

The components of the keeper's minimum wage cost for sun bears at the Medan Zoo, Siantar Zoo, and PPS Tasikoki Medan conservation institutions reached Rp 3,600,000.00, Rp 4,200,000.00, and Rp 3,840,000.00. Vionna (2015) states that the quality of animal keepers will indirectly determine the success of various conservation programs, which are the vision and mission of a conservation institution. Yanitri (2021) states that the animal keeper is in charge of bathing animals, trimming nails, shaving hair, checking and controlling animals regularly, caring for sick animals until they recover, and being responsible for whatever happens to animals or animal enclosures that are being treated. Even though they have the same basic duties and functions, the different levels of difficulty of the types of animals handled by each keeper can affect the difference in wages received.

The costs of maintaining sun bear at Medan Zoo, Siantar Zoo, and PPS Tasikoki Manado for one year in a row reached Rp 44,600,000.00, Rp 42,100,000.00, and Rp 28,440,000.00. If the calculation of economic value is assumed by using the animal productive age approach, namely the ability of animals to produce offspring; able to guarantee the sustainability of their species; and of economic age to be used commercially, then at least two years of sun bear maintenance are required. Thus, the total maintenance cost for two years is estimated at Rp 76,760,000.00 (Table 1).

**The Economic Value of Sumatran Elephant Based on the Maintenance Cost Approach**

Similar to the sun bear, the Sumatran elephant is also a vulnerable species to hunting and illegal trade. Bangun (2017) states that Sumatran elephants are hunted for their ivory trade, then processed into various products, such as cigarette pipes, amulets, accessories such as necklaces, bracelets, souvenirs, furniture, and others. The high demand for Sumatran elephant body parts has implications for the decline in its population. This condition can be one of the justifications for the urgency of Sumatran elephant conservation not only in its natural habitat (in-situ), such as GPS collars installment and providing rewards for forest rangers who have succeeded in preventing poaching but also in ex-situ.

In the principle of ex-situ conservation, animal welfare must be the priority focus of conservation institutions. Referring to the Regulation of the Director General of Forest Protection and Nature Conservation (Dirjen PHKA) of 2011, animal welfare is defined as the survival of animals that need to be considered by managers so that animals live healthily, have enough food, can express normal behavior, and grow and reproduce well in a safe and comfortable environment. The following are Sumatran elephant maintenance cost components at the Medan Zoo (Table 2).

Table 2 Allocation of Sumatran elephant's maintenance cost in conservation institutions

No	Maintenance cost component	Maintenance cost per animal per year at the Institute (Rp x1000)
		Medan Zoo
1	Infrastructure	18,200
2	Feed	233,400
3	Health care	50,265
4	Keeper's minimum wage	9,000
Total		310,865
Economic value based on total maintenance cost for two years		310,865 x 2 = 621,730

The calculation of the Sumatran elephant's economic value, estimated from the maintenance cost at the Medan Zoo conservation institute, obtained a fantastic value of Rp 621,730,000.00 (Table 2). The highest allocation of maintenance costs lies in need for food for Sumatran elephants, which is Rp 233,400,000.00. Based on the results of interviews, Sumatran elephants at Medan Zoo get abundant feed; this is because apart from being given standard food such as forage and fruit, Sumatran elephants also get food from their enclosure. According to Sitompul et al. (2013), the Sumatran elephant is a megaherbivorous species that can spend 60 - 82.2% of its daily time eating and requires large amounts of forage, which ranges from 200 - 300 kg of biomass per day for an adult elephant or 5 - 10% of its body weight. In addition, Sumatran elephants consume 250 kg of natural food per day for adult elephants weighing 3,000 - 4,000 kg (Eltringham 1982).

Meanwhile, the maintenance cost for the Sumatran elephant enclosure at Medan Zoo is estimated at Rp 18,200,000.00. The Sumatran elephant enclosure at Medan Zoo is constructed to resemble its natural habitat with an open area so that the elephants have enough space to move. This is in accordance with Prahara's (1999) statement that at least 70% of the enclosure must be open and can be penetrated by sunlight. On the other hand,

Phuangkum et al. (2005) also stated that enclosure is an essential element in elephant care. The minimum area of open enclosure for each male elephant is 500 m<sup>2</sup>, and for a female elephant is 200 m<sup>2</sup> (BIAZA 2006). The elephant enclosure is generally a wide expanse and is open to provide free space for elephants to move.

The component of Sumatran elephant care cost reaches Rp 50,265,000.00. In the context of maintaining the health of the Sumatran elephant at Medan Zoo, there are at least 1-2 veterinarians for regular treatment, which is carried out twice a year. This is in accordance with BIAZA's (2006) statement that for elephants, examinations by doctors are generally carried out every six months, and medical treatment is carried out if the elephant is very seriously ill; in addition, blood tests are carried out by a veterinarian once a year. Based on the results of interviews, the condition of Sumatran elephant at Medan Zoo is in excellent and healthy condition, and it has never experienced a severe disease. In addition to checking their health and disease conditions, the Sumatran elephants at Medan Zoo also receive special attention related to nutritional intake.

Regarding the keeper, the keeper's minimum wage for Sumatran elephants at Medan Zoo is estimated at Rp 9,000,000.00. Based on the results of interviews, Sumatran elephant keepers have high demands for expertise in creating a comfortable and calm atmosphere for Sumatran elephants. This is because Sumatran elephants have a high level of sensitivity. Not only providing feed and sanitizing the enclosure but the keeper at this conservation institution is also tasked with monitoring the elephant's condition and caring for sick elephants. At Medan Zoo, the Sumatran elephant is one of the attractions for visitors who want to get around by riding an elephant, so a keeper is needed to handle this task.

Based on the analysis results, the cost of maintaining sumatran elephants for one year at the Medan Zoo conservation institution is Rp 310,865,000.00. Same with sun bears, if the calculation of the economic value of the Sumatran elephant is based on the productive age to produce offspring, the ability to guarantee the sustainability of its species, and the economic age to be used commercially; then the economic value of the Sumatran elephant for at least two years of maintenance is Rp 621,730,000.00.

The economic value of the sun bear and the Sumatran elephant calculation was estimated based on the maintenance cost approach, resulting in a relatively high number; this represents the high economic value of the two species. Unfortunately, when viewed from the number of fines listed in the Directory of Decisions of the Supreme Court of the Republic of Indonesia, the length of imprisonment and the nominal fines received by the perpetrators are considered low. For example, in the case of trafficking in 1 (whole) sun bear in East Kalimantan in 2020, the perpetrator was only subject to 18 months in prison with a material fine of Rp 2,000,000.00. Meanwhile, the trade in 1 elephant tusk that occurred in Lampung in 2020 was only subject to 9 months imprisonment and a fine of Rp 2,000,000.00.

If a comparison is made based on the approach to maintenance costs incurred for these two species, it can be said that the fines imposed for the illegal trade of sun bears and Sumatran elephants have not been maximized. The implication is that legal products are considered weak and do not cause a deterrent effect. This representation can be seen in the rampant illegal wildlife trade cases.

## CONCLUSION

The calculation of the economic value based on the maintenance cost approach for sun bears and Sumatran elephants by considering their productive age is Rp 76,760,000.00 and Rp 621,730,000.00, respectively. The magnitude of this economic value is assumed to represent the state losses that must be borne if these two species die due to illegal hunting and trade. This condition can be justified that the number of fines filed by perpetrators in cases of illegal wildlife hunting and trade in Indonesia is disproportionate and has not been able to create a deterrent effect.

## ACKNOWLEDGEMENT

Researchers express their gratitude to LPPM IPB, UNDP, and GAKKUM KLHK as research fund providers. Researchers are also thankful to Medan Zoo, Siantar Zoo, and PPS Tashikoki conservation institutions as research data collection sites for the information provided during this research.

## REFERENCES

- [BIAZA] British and Irish Association of Zoos and Aquariums. 2006. *Management Guidelines for The Welfare of BIAZAoo Animals*. London: Regent's Park.
- [Ditjen Gakkum KLHK] Direktorat Jendral GAKKUM Kementerian Lingkungan Hidup dan Kehutanan. 2019. *Laporan Kasus Tindak Pidana Kejahatan Terhadap Satwa Liar*. Jakarta: KLHK Republik Indonesia.
- Astuti D. 2006. Konsumsi dan pencernaan pakan pada beruang madu (*Helarctos malayanus*) di Taman Margasatwa Ragunan Jakarta [thesis]. Bogor: Institut Pertanian Bogor.
- Bahruni, Masy'ud B, Hidayat A, Sunkar A, Rahman DA, Purnamasari I. 2020. Valuasi ekonomi satwaliar dilindungi untuk kepentingan proses hukum [research final report]. Bogor: Institut Pertanian Bogor.
- Bangun P. 2017. Efektivitas Kerjasama WWF Indonesia – BBKSDA Riau dalam memerangi perdagangan ilegal gading gajah sumatera di Provinsi Riau 2010 – 2015 [thesis]. Semarang: Universitas Diponegoro.
- Chardonnet PH, Clers BD, Fischer J, Gerhold R, Jori F, Lamarque F. 2002. The value of wildlife. *Rev Sci Tech Int Epiz.* 2(1):15–51.
- Eltringham SK. 1982. *Elephants*. Dorset: Blandford Press.
- Firdilasari I, Harianto SP, Widodo Y. 2016. Kajian perilaku dan analisis kandungan gizi pakan drop in beruang madu (*Helarctos malayanus*) di Taman Agro Satwa dan Wisata Bumi Kedaton. *Jurnal Sylva Lestari.* 4(1):97–106.
- Hasibuan B. 2014. Valuasi ekonomi lingkungan nilai guna langsung dan tidak langsung komoditas ekonomi. *Signifikan.* 3(2):113–126.
- Indarwati I. 2007. Pemilihan pakan dan aktivitas makan beruang madu (*Helarctos malayanus*) pada siang hari di pusat penyelamatan satwa Gadog Ciawi [thesis]. Bogor: Institut Pertanian Bogor.
- Jenantika PU, Fahrimal Y, Sayuti A. 2019. Identifikasi parasite gastrointestinal pada beruang madu (*Helarctos malayanus*) di Taman Margasatwa Medan. *JIMVET.* 3(3):142–148.
- Khoirunnisa A, Pricille P. 2019. Upaya penanganan tingkat perdagangan satwa liar oleh pemerintah Indonesia pada tahun 2013 – 2016. *Global Insight Journal.* 4(1):80–101.
- Moses M. 2019. Jejak transaksi di Taman Safari. *Tempo Majalah Berita Mingguan*. [accessed 2020 Dec 2]. <https://majalah.tempo.co/read/157438/jejak-transaksi-di-taman-safari>.
- Nellemann C, Henriksen R, Kreilhuber A, Stewart D, Kotsovou M, Raxter P, Mrema E, Barrat S. 2016. *The Rise of Environmental Crime – A Growing Threat To Natural Resources Peace, Development And Security*. Kenya: UNEP-INTERPOL.
- Ngabekti S. 2013. Konservasi beruang madu di KWPLH Balikpapan. *Biosaintifika.* 5(2):115–120.
- Nugroho HA, Purwaningsih E. 2015. Nematoda parasite gastrointestinal pada satwa mamalia di penangkaran pusat penelitian biologi LIPI Cibinong. *Pros Sem Nas Masy Biodiv Indon.* 8(1):1785–1789.
- Phuangkum P, Lair RC, Angkawanith T. 2005. *Elephant Care for Mahout and Camp Managers*. Bangkok: FAO.
- Prahara W. 1999. *Pemeliharaan, Penangkaran, dan Penjinakan Kakatua*. Jakarta: Penebar Swadaya.
- Prijono SN, Handini S. 1998. *Memelihara, Menangkar, dan Melatih Nuri*. Jakarta: Swadaya Buku.
- Rajagukguk EV. 2014. Efektivitas peraturan perdagangan satwaliar di Indonesia. *Jurnal Wawasan Hukum.* 31(2):216–228.
- Sasmita YK. 2018. Implementasi peraturan menteri kehutanan No. P. 32/Menhut/2011 dalam menanggulangi penurunan populasi beruang madu di Kalimantan Timur. *EJournal Ilmu Hubungan Internasional.* 6(4):1871–1886.

- Sitompul AF, Griffin CR, Rayl ND, Fuller T. 2013. Spatial and temporal habitat use of an asian elephant in sumatra. *Animals*. 3(3):670–679.
- Vionna A. 2015. Studi deskriptif mengenai work management pada animal keeper di Taman Safari Indonesia I [thesis]. Bandung: Universitas Kristen Maranatha.
- Yanitri NLA. 2021. Pengukuran beban kerja mental dengan menggunakan metode NASA – TLX studi kasus: zookeeper di Bali Zoo [thesis]. Surabaya: Universitas Surabaya.
- Yohanna, Masy'ud B, Mardiasuti A. 2014. Tingkat kesejahteraan dan status kesiapan owa jawa di Pusat Penyelamatan dan Rehabilitasi Satwa untuk dilepasliarkan. *Jurnal Media Konservasi*. 19(3):183–197.