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# Current Status and Problems of the Management of Javan Deer Captive Breeding in Java Island, Indonesia

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**ABSTRACT**

The current Javan deer breeding development has shown encouraging results. Some obstacles are still encountered in developing captive Javan deer. Information about the management and the problem of Javan deer captive breeding still needs to be improved. This research is aimed to provide the variations in the management of captive Javan deer and to obtain various problems encountered in managing captive Javan deer. The research will be carried out in several captive Javan deer, namely the Javan deer captivity Maliran, KPH Blitar, and KPH Ngawi (Perhutani). Bunder Javan deer captive breeding (BKSDA Yogyakarta) and CV. Bahtera Satwa (Private javan deer captive breeding). The data collection method used a triangulation method which collects secondary data, interviews, and field observations. Secondary data includes documents related to deer population regulation and management. The interview was conducted using a semi-structured questionnaire. Field Observation is intended to verify and obtain more detailed information about the verifier to be assessed. The result showed captive design and breeding facilities already have the appropriate equipment. Recording of logbook/studbook data has been done. Population management indicates the development of the population, which has increased from the initial population. The feed given, on average, is already a combination of forage and supplementary feed. Only one captive Javan deer has utilized the results of captive breeding. The constraints and problems faced are the population problems such as frequent deaths, low productivity, and the sex ratio that is close to not ideal. Human resources and the new system still need to improve digitization efforts in recording and reporting. The permit application system must adapt to the newly introduced One Single Submission (OSS). Management operational costs are still limited. There are variations in the management of captive Javan deer that have been carried out. Some constraints and problems are often encountered in managing captive Javan deer. Some problems can then be sought for solutions through innovations in captive management.

***Key words*** *: Captive breeding, Javan deer, Management, Problems, Triangulation method*

## Introduction

Anthropogenic influences are increasingly demonstrating negative impacts on global biodiversity. Nearly a quarter of extant mammals are currently classified as threatened, and for certain species, this threat level has been exacerbated by their status as extinct in the wild (IUCN, 2018). However, conservation efforts have successfully reduced extinction status (Barongi *et al.*, 2015). It is estimated that with-

out both in-situ and ex-situ conservation measures, the IUCN status of the ungulate species will be eight times worse than it is today (Hoffman et al., 2015). Conservation breeding and reintroduction schemes seem to be more helpful in conservation efforts for mammals and improve their conservation status than other conservation measures (Barongi *et al.,* 2015).

The Javan deer is also one of the wild animals that have a potential economic or commercial value which has been widely used for various purposes such as utilization in the form of meat for animal protein needs, as pets, tourism objects, and as biomedical and medicinal experimental animals (Takandjandji *et al.,* 2020). The Javan deer population in nature has decreased due to uncontrolled poaching and habitat destruction (Krisna *et al*., 2020). Efforts to conserve natural resources can be made to protect endangered species under pressure from humans or experiencing changes in their habitat. To avoid extinction and, at the same time, optimally and sustainably utilize deer can be done through captive breeding (Rasyidi et al., 2020).

Captive breeding is a form of ex-situ conservation with a strong foundation in existing international and national regulations. Nationally, several regulations in the forestry sector regulate captive breeding, namely Law No. 5 of 1990, PP No. 7 of 1999, PP no. 8 of 1999, Minister of Forestry No. 19 of 2005 jo Permenhut No. 69 of 2013 (Latuputty, 2017). At the same time, regulations at the international level are through the 1992 Convention on Biological Diversity (CBD) and CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna) (Latuputty, 2017).

Recently, Javan deer captive breeding development has shown encouraging results because it cannot be utilized to conserve Javan deer in nature and provide brood stock. The existence of captive Javan deer in West Java, such as in Ranca Upas Bandung, Cariu, and Darmaga (Krisna *et al.,* 2020), in Central Java, such as in Baturraden (Azwar *et al.,* 2019), Cilacap and Dawe, Kudus (Samsudewa *et al.,* 2016) as well as in East Java, such as Tahura Suryo Ngawi, Pasuruan and Maliran Blitar (Rianti *et al.,* 2018) tend to be used as tourism facilities. Meanwhile, the function of reintroduction support for the Javan deer population in the wild has yet to be carried out.

Some of the obstacles encountered in the development of captive Javan deer, namely data collection on the development of captive breeding in the form of births and deaths, mutations, and animal health, have not been carried out optimally. The origins and filial status of Javan deer in various captive units and conservation institutions need to be better monitored (Anugrah, 2018). Licensing and bureaucracy, sometimes the information still needs to be opened to parties who want to carry out deer breeding activities. The high cost of breeding deer, especially on a commercial scale, still makes adopting this system an obstacle (Santosa *et al*., 2012; De Vuyst, 2013).

Information about the management and the problem of Javan deer captive breeding still needs to be improved. The information available is in the form of an evaluation that only collects data on the number of captive breeders, the types of deer in captivity, the number of populations, and the ratio of males and females in captivity (Santosa *et al*., 2012; Semiadi and Jamal, 2015). Then another study is studies on captive breeding of this species on their roles to climate change mitigation (Krisna *et al.,* 2020). These study aspects have yet to describe the achievements of deer captive breeding in efforts to conserve these animals. Therefore, it is necessary to study the variations in the management of captive Javan deer that have been carried out so far and obtain information on various constraints and problems often encountered in managing captive Javan deer. Obstacles and problems often found in the management of captive Javan deer so far can then be sought for solutions or solutions through research and innovations in captive management that align the needs and developments of the times.

## Materials and Methods

### Research Location

The research was conducted in several captive Javan deer managed by different institutions, namely BUMN (A state-own enterprise), Government, and Private. Java deer breeding locations managed by BUMN are the Java deer captivity in Maliran, Blitar KPH Blitar, and KPH Ngawi (Perhutani/A state-own forest enterprise). Bunder Java deer breeding (managed by BKSDA Yogyakarta) and CV. Bahtera Satwa (A private Java deer captive breeding) in Dawe, Margorejo, Kudus, Central Java. Kesatuan Pemangkuan Hutan (KPH) is forest management area according to its main function and designation, which manager can manage it efficiently and

sustainably. Balai Konservasi Sumberdaya Alam (BKSDA) is the technical implementing unit under the Directorate General of Conservation of Natural Resources and Ecosystems of the Ministry of Environment and Forestry which responsible for supervising and monitoring protected plants and animals in their territory, including monitoring efforts to breed and care for protected plants and animals by individuals, companies and related conservation institutions.

### Data Collection

The data collection method uses a triangulation approach. A triangulation method collects secondary data (documents), interviews, and field observations (Hopf *et al.*, 2016; Moleong, 2018; Shin *et al.*, 2022). Secondary data includes captive licensing documents, documents related to deer population regulation and management, captive management institutional documents, and captive assessment documents by the authorized institution (BKSDA). The interview was conducted using semi-structured questionnaire with the management and staff of the deer breeding management, which was guided by questions as the topic of conversation and a control direction. Key persons were chosen by purposive sampling (Etikan *et al.*, 2016). Field Observation was intended to verify secondary data/document information and interview results and obtain more detailed information about the verifier to be assessed (Natow, 2020). Direct observation was conducted to see captive facilities and infrastructure, supporting facilities built in the cage area, forage planting areas, supporting buildings. This triangulation method is applied to each verifier so that the information obtained can be accurate.

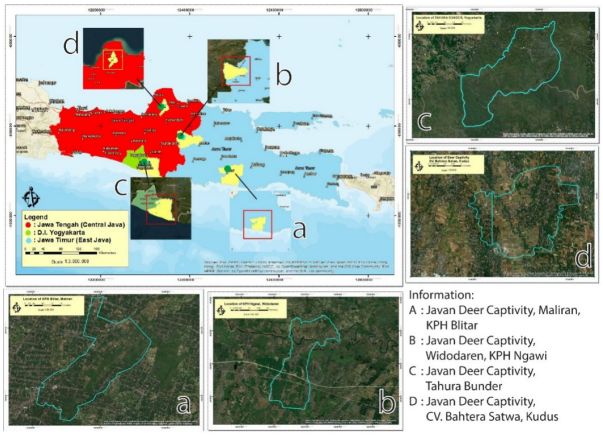


**Fig. 1.** Study area. **A**. Javan deer captive breeding at Maliran, KPH Blitar, East Java; **B**. Javan deer captive breeding at Widodaren, KPH Ngawi, East Java; **C**. Javan deer captive breeding at Bunder, BKSDA Yogyakarta, and **D**. Javan deer captive breeding at CV. Bahtera Satwa, Kudus, Central Java, Indonesia

### Data Analysis

The data that has been collected is then carried out by a comparative analysis of the aspects that have been determined such as general condition, administrative management, population management, feeding management, and utilization of Java deer breeding results. After that, a qualitative descriptive analysis was carried out on the management that has been carried out so far to obtain the constraints faced.

## Results

### Variations in the management of captive Javan deer from several aspects

Based on searching important documents, interviews, and field observations on the management of captive Javan deer at the research location, various aspects of the management of captive Javan deer can be presented as follows:

The general condition of the existing captives, three captives have an area of less than or equal to one hectare, while one captive has an area of more than 5 ha. Captive design, breeding facilities, and shelter vegetation already have the appropriate equipment. The average condition of the cage is still good; only one captive breeding needs repair because since it was built in 1994, there has yet to be any improvement.

All own all captive breeding permits except for the BKSDA Yogyakarta, which focuses on the interests of being a stock centre. Overall the Javan deer captive breeding under study has met the administrative requirements needed in captive management, namely captive permits, making a logbook/studbook, and making inspection reports when mutations, deaths, and births of Javan deer occur in captivity. The Log Book must be open to officers in the context of coaching and control and to the auditor or the team assessing the success of captive breeding in assessing compliance with qualification standards. Every wild plant and animal breeding business unit with a captive breeding business li-

cense must submit a report. Reports consist of monthly and annual reports regarding the development of all species breeding in the captive unit Only captive CV. Bahtera Satwa already has permits for the distribution of animals.

This table indicates the development of the Javan deer population, which has increased from its initial population. Progeny tagging by tagging and routine health checks have been carried out. Almost all of them have been tagged for the tagging of individual

**Table 1.** General Conditions of Captive Javan Deer (*Rusa timorensis*)

| No | Aspects | Locations | | | | |
|---|---|---|---|---|---|---|
| | | KPH Blitar | KPH Ngawi | BKSDA Yogyakarta | CV. Bahtera Satwa | Requirement standard |
| 1 | Size | 7.8 ha (located in compartment 39g of RPH Sumberingin BKPH Rejotangen) | 1.0 ha (adjacent to Tahura Soeryo Ngawi) | 0.34 ha (located within the Flora Fauna Bunder Station area) | 0,66 ha | Deer captivity does not require large areas, it is most popular with small, and mid-size (De Vuys, 2013) |
| 2 | Design | The cage is surrounded by a 2.75 m high wire mesh fence. There are 3 cages. | Expanse of land surrounded by a 1.5 m high harmonica wire fence | The cage is surrounded by a 2.75 m high wire fence, divided into 2 separate areas. | The cages are separated between generations and gangways are available. | Enclosure and barrier design, construction and maintenance must be such to fully ensure the safety of the animals (Blacket *et al.*, 2019) |
| 3 | Facilities | Tub drinking water, Puddle, Shelter, Feeding tank, Water tank, Tower, Warehouse, Office, and Drilled wells 3 units | Rearing cage, bulkhead cages, clip cages, shelters, drinking water tub, and wallow pool | The shelter uses a light steel roof, drinking water tub, wallowing tub, drainage channels, the clip cage has been damaged or non-functional for a long time | Communal enclosure, cage shelters, isolation cage, feeding place, drinking places, the puddle, and gangways | Required drinking water, shelters, tower, warehouse (Adam *et al.*, 2016; Ismail *et al.*, 2020) |
| 4 | Tree stand/ shade | Bushes dominate the enclosure of the bulkhead. In the rearing cage, the shade of the lac tree is very dominant. There is also *Ficus benjamina* | Shade trees in the form of kesambi and ploso. | There are bushes and several trees, such as strawberry tree, tropical almond tree, and coast cottonwood. 75% exposed to sunlight | There is at least one tree in each cage. | Required woody vegetation if natural vegetation was inadequate (Adam *et al.*, 2016) Availability of shade (Bombal *et al.*, 2023) |
| 5 | Captive breding conditions | Still good | Cages made in 1994 need repair on the fence | The condition of the cage is good, but during the rainy season, it is wet, and there are puddles. | Still good | Required 50% of the area be suitable deer habitat (Adam *et al.*, 2016) |

deer in captivity. Tagging is done by installing ear tags with a predetermined code number. The addition of deer from other sources to enrich genetic diversity has yet to be carried out. The sex ratio in captive Javan deer shows an average sex ratio of 1:1. Population management in animal captivity includes: selecting deer seeds, grouping deer, developing deer populations, monitoring sex ratios, maintaining health, and preventing inbreeding (Takandjandji, 2015; Bayne *et al*., 2023). Overall, the four captive Javan deer carry out routine checks on animal health every year, carried out two times using their veterinary medical personnel or brought in from other agencies. Of the four captive Javan deer,

**Table 2.** Administrative Management of Java Deer Captive Breeding

| No | Aspects | Locations | | | | |
|---|---|---|---|---|---|---|
| | | KPH Blitar | KPH Ngawi | BKSDA Yogyakarta | CV. Bahtera Satwa | Requirement standard |
| 1 | Captive breeding license | SK 109/K.2/BIDTE K.1/KSA/B/2019 on 20 August 2019. Valid until 20 August 2024. | SK.100/K.2/BID TEK.1/KSA/11/ 2019 Valid for five years (2019-2024) | Captive Breeding in BKSDA Yogyakarta is a stock center | SK.229/IV-K.11/KKH/ 2016, and is currently in the process of being extended | a captive permit is needed as a form of legality and recognition of the management of protected animals (Prayoga *et al.*, 2021) |
| 2 | Data logging | Mutation reports of the addition of new deer (births) and reductions (deaths) are reported per occurrence. Reports on the development of the deer population are reported monthly | Done through the logbook (daily recording) and reported every month | | It already exists, but it is still manual, the website has been tried, but it still needs improvement. | making studbook, logbook regarding the recording of the development of all existing stock species in captivity (Anugrah, 2018) |
| 3 | Investigation report (BAP) | Every time a birth or death occurs, the manager makes an investigation report (BAP) and reports to the East Java BKSDA. If there isa mutation or delivery to other breeders, the manager makes and reports to the East Java BKSDA | Birth investigation report (every time there is a birth) Death investigation report (every time there is a death) RKT (Annual Report) | | Already available | Make data collection on the development of captive breeding in the form of births, deaths, and mutation of animals (Anugrah, 2018) |
| 4 | Animal distribution permit. | Do not yet have a distribution permit for animals (just in the process of applying for a distribution permit) | There are not any yet | | It already exists under the name of PT. Kudus Media Multisarana. | Captive deer to be distributed, with permitting distribution licence (Adam *et al*., 2016) |

it shows that each captive breeder has a clear origin.

The feed given, on average, is a combination of forage and concentrate (supplementary feed). Feeding is done there two times a day, and there are also 3-4 times a day. The feeding amount is sufficient for the number of Javan deer in captivity. Some feed sources rely on forage availability from the surrounding environment, and some make their forage locations. One crucial component in managing captive animals is the availability of forage plants inside and outside the captive area, which determines the habitat's carrying capacity. The importance of quality and quantity of feed for animals kept in captivity is because feed is a limiting factor. Low quality and quantity of feed is often the main obstacle in captivity for production purposes (Ceacero *et al.*, 2012; Birnie-Gauvin *et al.*, 2017).

Only one captive Javan deer has utilized the results of captive breeding, namely the sale of living forms and their parts, namely the captive breeding of Javan deer CV. Bahtera Satwa. Other uses for tourism facilities have also been carried out by the captive Javan deer KPH Blitar, CV. Bahtera Satwa and KPH Ngawi. Meanwhile, the BKSDA Yogyakarta's Java deer captivity focuses more on providing broodstock for parties who will develop Javan deer breeding.

**b. Constraints/Problems in the Management of Javan Deer Breeding**

Based on searching important documents, interviews, and field observations on the management of captive Javan deer at the research location, the constraints and problems in managing captive Javan deer can be presented as follows:

The population problem is frequent deaths due to fights and disease and low productivity; the sex ratio of males and females is close to not ideal, caused by higher male birth rates. Digitization efforts in recording and reporting still need to be improved by human resources and the new system being implemented. Some of the facilities and infrastructure are

**Table 3.** Population Management of the Javan Deer Captive Breeding

| No | Aspects | Locations | | | | |
|---|---|---|---|---|---|---|
| | | KPH Blitar | KPH Ngawi | BKSDA Yogyakarta | CV. Bahtera Satwa | Requirement standard |
| 1 | Origin of breeders and initial numbers | It is derived from captive Javan deer in compartment 70, which is part of the construction of the Karangkates Reservoir with details of 10 males and 8 females | Origin of KPH Blitar deer breeding in 1994. A total of 4 individuals (1 male and 3 females) | In early 2000, the initial broodstock came from Gembira Loka Zoo, with as many as 10 individuals | Javan deer breeders came from West Nusa Tenggara with a total of 5 consisting of 1 male and 4 females in 2006. | Should have the origins of breeder and initial amount of deer (Ismail *et al.*, 2020) |
| 2 | Population Development | The number of Javan deer in 2014 was 77, and now in 2022, there are 97 individu. | The number of Javan deer in 2014 was 22, and now in 2022, there are 43 individu | The number of Javan deer in 2010 was 24, and now in 2022, there are 43 individu. | The number of Javan deer in 2011 was 43, and in 2022 there were 107 individu. | Population should increase form initial numbers (Ismail *et al.*, 2020) |
| 3 | Tagging | 75 individuals have been tagged until 2016 After that, no one was tagged | New tagging was done on 20 out of 43 (almost 50% of the population) | Tagging is usually given when the deer is at least four months old with ear tags | Tagging is done by placing an ear tag with a specific code number | External tagging was required (Adam *et al.*, 2016) |
| 4 | Health check | It can be two times in 1 year | It can be two times in 1 year | Every year routine health checks are carried out. | Every year routine health checks are carried out | Need health monitoring of animals (Blacket *et al.*, 2020) |

starting to need repairs. There is no distribution permit and digitization of the distribution permit application system, which still needs to be improved to adapt to the newly introduced OSS (One Single Submission) system. Management operational costs are still limited, although some can be overcome through the collaboration for tourism development and selling live animals and their parts. Permits for the distribution of animals still need to be able to sell live animals and their parts. Meanwhile, those already obtaining a distribution permit still need vigorous promotion and an easy and fast administrative process. Not all captive breeding sites under study have carried out their release obligations except for Javan deer captive breeding by the BKSDA Yogyakarta.

## Discussion

### Variations in the management of captive Javan deer from several aspects

The facilities and infrastructure used in captive Javan deer are cage buildings, fences (outside and in), areas for planting feed, captive facilities (shelters, places to eat, drinking places, water channels, water towers) and control roads (Takandjandji, 2015). According to SEAZA (2019), management of captive breeding in an intensive way requires facilities and infrastructure such as cages consisting of quarantine cages, mothers, males, fawns, and terminal cages. Supporting facilities that need to be built in the enclosure area are water installations, shading, fencing along the enclosure's confines, and cor-

**Table 4.** Feed Management of Java Deer Captive Breeding

| No | Aspects | Locations | | | | |
|---|---|---|---|---|---|---|
| | | KPH Blitar | KPH Ngawi | BKSDA Yogyakarta | CV. Bahtera Satwa | Requirement standard |
| 1 | Type of feed (forage feed, and additional feed) | Forages: Para grass, leaves of mahogany, pigweed, white albizia, and white-veined Fig. Additional feed: concentrate, bran, or rice bran | Forages: Dwarf Elephant Grass and leaves Additional food: Polar, Vitamin B complex, and minerals | Forage: Para grass or corn stalks. Additional feed: rice bran and polar | Forage : Elephant Grass and Additional food : Concentrate | Mixed between grazer and browser (Syed & Ilyas, 2015). Required supplemental feed if natural vegetation was inadequate (Adam *et al.,* 2016; Bombal *et al.,* 2023). |
| 2 | Frequency of feeding | 3-4 times/day | Forage food 3 x a day, Complementary food every 2 days | During the day, use concentrate feed, and in the afternoon, forage feed | 2 times feeding (morning and evening) | 2 or 3 times a day (Ismail *et al.,* 2020) |
| 3 | Number of feeding | Each feeding reaches almost 200 kg | 70 kg (3 times a day), 2 kg per individu | Concentrate feed daily of about 20 kg and forage feed of about 10 bunches @ 15 kg (150 kg). | Elephant grass forage 4-5 kg/day/ individu Concentrate 0.5-1 kg/day/ individu | 3.75 – 10 kg grass & bran per individu (Ismail *et al.,* 2020) |
| 4 | Feed source | Grass and leaves that come from around the area | Forage and fodder land with an area of 1.5 ha andgrass that grows around the breeding area | Concentrate or corn husks buy at the feed kiosk. Grass and leaves that come from around the area | Forage elephant grass from the Forage and fodder land itself Concentrate from feed supplier | Usually from the open grass land (Kabeer *et al.,* 2018) |

ridors connecting the cages for the calves, females, and males.

**The government** regulation also regulates the obligations of breeders in carrying out their breeding activities, namely: (a) make a master book of wild plants or animals that are bred, (b) carry out a marking and/or certification system for the individual species being bred, and (c) Prepare and submit periodic reports to the government. Based on the regulation, each plant and animal captive unit must make the stud book and a log book for recording the development of all stock species in captivity.

Meanwhile, for the ownership of permits for the distribution of animals, only one captive Javan deer, namely CV. Bahtera Satwa. This condition is because of the orientation of captive Java deer CV. Bahtera Satwa is already leading to commercial interests, so a permit to distribute animals, one of the requirements to sell animals, must be owned first. The three other captive Javan deer breeders still need to get a permit for the distribution of animals, usually due to the non-fulfilment of the requirements needed to obtain a permit for the distribution of animals (Anugrah, 2018).

**Management** of deer in captive captivity includes grouping, weaning, and tagging. Deer grouping helps facilitate mating arrangements, avoid inbreeding, keep males from disturbing other deer, ensure the safety of pregnant males in the birth process, calm breastfeeding mothers in caring for fawns, and avoid early marriages (Takandjandji, 2015). Of the four captive Javan deer, on average, they already have two cages, namely the main cage and the weaning cage, which is used to separate the female who are giving birth and breastfeeding their fawns. Tagging is usually given when the deer is four months old using a tag on the ear. It is an essential thing in the management of deer captivity. The purpose of tagging or numbering is to know the pedigree, to know the age, to facilitate control, to facilitate the identification of individuals, and to facilitate marriage arrangements (Setiawan *et al.*, 2021; Takandjandji, 2015).

Breeding or reproducing animals in a captive business is very important because the success of a captive business can be seen in managers' success in breeding the animal they hold captive. Of the four captive Javan deer, on average, the population has grown significantly from its initial numbers. Inbreeding, it is necessary to pay attention to the lineage of the animals to be bred. Do not let inbreeding mating occur because the offspring produced from

**Table 5.** Utilization of Java Deer Breeding Results

| No | Aspects | Locations | | | | |
|---|---|---|---|---|---|---|
| | | KPH Blitar | KPH Ngawi | BKSDA Yogyakarta | CV. Bahtera Satwa | Requirement standard |
| 1 | Sale of deer/live animal parts | It does not exist yet because it does not have a distribution permit yet | It does not exist yet because it does not have a distribution permit yet | Not yet, because the focus is on a stock center | Sales and utilization of live animals, meat, skin, and antlers have been carried out | Producers will generally sell deer until their third year of operation (De Vuys, 2013) |
| 2 | The use of deer so far | Initially used for captive tourism (Deer Maliran Feeding). Starting in 2017, in collaboration with the area around the deer captivity, it has begun to be utilized for tourism services (Kesambi Trees Park) managed by CV. Sumber Intan Persada | Not yet; just starting in 2020, it will be developed as part of the Tahura Soeryo Ngawi tourist facility | As a source of breeding deer (stock center) | • Utilization of live animals and their parts<br>• Tourist facilities | Finding and developing high-value markets and market their products (De Vuys, 2013) |

**Table 6**. Constraints/Problems of Java Deer Breeding Management

| No | Aspects | Locations | | | |
|---|---|---|---|---|---|
| | | KPH Blitar | KPH Ngawi Yogyakarta | BKSDA Bahtera Satwa | CV. |
| 1 | Population aspect | • Males die due to fighting during the mating season<br>• Adult deer suffer from bloating, which can result in death<br>• The composition of the population tends to be predominantly male | • Many children die because they are attacked by other males or suffer from bloating<br>• The composition of the population is still primarily male | The productivity of old breeders is low. | Population record management requires precision and persistence. This condition is complicated because of limited human resources. |
| 2 | Management Aspect | When it was still purely held by the Forest Management Unit, the management staff was still limited, but after the collaboration with CV. Sumber Intan Persada, the management staff, is very helpful | • Deer health checks are still incidental<br>• Lack of undergrowth in rearing cages | • Need to exchange or refresh brood deer to avoid inbreeding<br>• Better sanitation management to prevent disease | Administrative management of captive breeding, which has begun to be digitized, must be carried out correctly. |
| 3 | Aspects of facilities or infrastructure | • There is one leaking drinking water tub.<br>• The condition of some of the wood on the observation tower stairs has started to break down | • No bulkhead cage<br>• The condition of the fence has not been updated since it was first built in 1994 | Handling cage (clips) that is not working | Limited infrastructure, especially the condition of the cage that needs repair |
| 4 | Licensing aspect | Do not have distribution permit yet | Do not have distribution permit yet | - | Licensing is constrained by the presence of OSS |
| 5 | Financial aspect | It has been resolved after collaboration with CV. Sumber Intan Persada. But the existence of covid caused income to drop dramatically | • Availability of little operational management costs<br>• Other sources of income cannot be optimized | Operational costs for management still rely on the budget from the BKSDA Yogyakarta | Financially it started to be healthy after 2013; it started selling |
| 6 | Sales aspect | There has been no sale of deer or parts of their lives because there is no distribution permit | There has been no sale of deer or parts of their lives because there is no distribution permit | As a stock center, we never carry out sales activities | Sales require faster promotions and ease of administrative processes |

these marriages are generally vulnerable in their reproductive abilities, the animal's strength is not good, and the appearance of the seeds is also not good.

Several steps can be taken to reduce the occurrence of inbreeding in captivity (Gooley *et al.*, 2020; Moreno *et al.,* 2015): (1) collection of animal seeds from different populations, (2) conduct heterozygosity tests on animals to be used as seeds. The higher the degree of heterozygosity, the better the value of the animal as a breed, (3) carry out regular genealogical records for each individual in captivity, (4) periodically introduce new individuals who are not inbred animals or do not have a family relationship with existing animals. These new individuals can come from natural populations or other captive sites.

Of the four captive Javan deer, there was no activity to introduce new individuals who were not inbred animals or had no family relationship with existing animals. So it can raise suspicions that the offspring produced have started to experience inbreeding. This suspicion can be answered by carrying out a heterozygosity test/genetic test to prove whether inbreeding has occurred. Deer health is something that needs serious attention so that deer productivity increases. Factors that influence disease include climate or season, sanitation or hygiene (cages, feed, and equipment), environmental disturbances (stress), and physical trauma (clamped, wire scratches, fighting). In principle, sick deer are handled by bringing in a veterinarian or health paramedic (Rahmawan, 2018).

**Deer breeding** will succeed if the feed is of good quality, quantity, and continuity. This success is because feed is closely related to deer breeding. As ruminants, deer generally consume feed consisting of grasses, leaf shoots, young plants, and concentrates. The quality and quantity of feed required varies according to sex, age, physiological status, and season (Felton et al., 2018).

The need for forage will increase according to the number of animal populations owned. The main obstacle in the supply of forage for animals, especially production, cannot be constant throughout the year. During the rainy season, forage production will be abundant, whereas, during the dry season, the production level will be low or even reduced altogether (Hutapea *et al.,* 2021). The additional feed includes concentrates (corn, bran, and livestock pellets), sweet potatoes, cassava, banana peels, soybeans, coconut cake, and carrots (Darnoto, 2018; Takandjandji, 2015). The feeding frequency is 2 or 3 times a day (morning, afternoon, and evening), with more feeding in the afternoon because deer are ruminant animals. Additional feed in rice bran is given thrice a week, as much as 0.5 kg per individual (Takandjandji, 2015). Overall, the four captive Java deer have carried out feed management following the recommended provisions.

**The benefits** obtained from captive breeding, in addition to the conservation aspect, are eco-tourism objects (uniqueness and beauty) and meeting the needs for animal protein and other by-products (2nd offspring/F2 and next generation.). The use of captive-bred antlers for production includes meat products as a source of animal protein, hard antlers, and velvet antlers for the craft and medicine industries, leather for the craft industry, and feces/dung for organic fertilizers. Other uses are for further captive breeding, pleasure (hobby), demonstration (tourism), as well as education and research (Takandjandji, 2015; William and Sas-Rolfes, 2019; Bansiddhi *et al.,* 2020; Keulartz, 2015).

Java deer captivity CV. Bahtera Satwa, which is commercially oriented, has succeeded in developing captive breeding products to sell live animals and their parts because they already have an animal distribution permit and are developing tourism services. Java deer captive breeding in KPH Blitar and KPH Ngawi tends to use tourism services to gain economic income. They cannot take advantage of the sale of life and parts because they still need a distribution permit for the animals. Meanwhile, the Yogyakarta BKSDA Java deer captive breeding focuses on being a stock center, so it does not take advantage of these two opportunities.

**b. Mitigation problems**

In the deer group, it is known that in the mating season, males will compete with other males to dominate the group of females they can mating (Giarat Ali *et al.,* 2021). One main activity related to adult males' breeding behavior is fighting with fellow males or simply sharpening the insects on tree trunks (Dahlan and Dawend, 2013). The risk of fighting between males during the struggle or competition in mating a female deer in heat can result in death.

More adult deer deaths are caused by fights between males, the environment, and stress due to handling (Takandjandji, 2015). The risk of death due

to fights between males can be reduced by adjusting the ideal male and female sex ratio, namely 1: 4. Another way to do this is to reduce the large number of males by reducing sales or placing them in new enclosures so that there is no accumulation of numbers of male in the same cage.

More deaths occurred during the rainy season during deer captivity, namely in young deer (27%) and adult deer (9%). Common diseases that often attack Javan deer in captivity are bloating, pneumonia, gastrointestinal infections (including intestinal worms), skin and wound infections, and physical trauma. Most deer deaths occur during the rainy season, and the disease that often attacks is pneumonia (pneumonia) due to muddy and damp stables. Prevention and eradication of the disease in deer in captivity included sanitation of the enclosure environment, feeding according to nutritional standards, improvement of handling techniques, vaccination, and administration of drugs according to the type of disease and veterinary medical recommendations. Deer health checks are routinely performed at least once a year, especially during the rainy season (Darnoto, 2018; Takandjandji, 2015).

The older the animal, the lower its productivity, which will impact the low breeding of the deer population in captivity. It is necessary to refresh the old population with younger and more productive individuals so that breeding can be maintained well. For this reason, it is essential to periodically introduce new individuals who are not inbred animals or unrelated to existing animals. These new individuals can come from natural populations or other captive sites.

In this modern era, efforts have emerged to simplify administration with a digitalization system. So far, the recording activities carried out in captivity are still manual, so they must adapt to the new system when they are converted into a digital system. This activity sometimes impacts the inability of existing human resources to follow the new system introduced. It is crucial to upgrade human resource capabilities so that they can adjust and follow the new system through specific training.

Some obstacles in managing captive Javan deer, especially the aspects of facilities and infrastructure, are the condition of the pens, which are starting to need repairs, and some supporting facilities starting to break down. Fences and cages must always be regularly maintained so that deer do not come out of the cage due to damage to the fence. Fence damage is more common during the breeding season when the antlers feel itchy, so the wire is one of the targets for the horns. The environment and sanitation in the cage are warm, especially during the rainy season (Takandjandji, 2015). The solution that must be done is to repair the breeding cage and gradually make repairs to the damaged supporting facilities, and complete the necessary breeding support facilities.

Some obstacles in managing captive Javan deer, especially the licensing aspect, are the need for distribution permits and adjustments to the OSS (One Single Submission) system in applying for or extending new permits. A distribution permit is required to commercially use captive wild plants and animals. It is essential to complete the requirements needed to obtain a distribution permit and carry out intensive communication with the authorized agency (BKSDA) so that they can assist in obtaining a distribution permit. A distribution permit is crucial in utilizing captive-bred animals, which can also be a source of income for captive management. The government recently rolled out the OSS system to help facilitate the administration of captive management, including applying for/extending permits for distribution permits for captive breeding. Given that this system is still new, there is a possibility that breeders are not used to adapting to this system, so there is a need for assistance from the competent authority (BKSDA) regarding the use of this application so that this system will assist breeders and the goal of facilitating management administration can be achieved.

Some obstacles in managing captive Javan deer, especially the financial aspect, are the few operational costs available because the budget depends on the agency overseeing them. Captive management depends on the availability of funds or costs (Takandjandji, 2015). These funds are vital for the initial investment and management of operational costs. Sustainability of the availability of funds is also fundamental to ensure the sustainability of captive breeding. Exploring sources of funds can be done by accelerating opportunities to obtain funds through the sale of captive breeding products by obtaining a distribution permit for the animals. This condition can be seen in the Java deer captivity CV. Bahtera Satwa was able to overcome financial problems after being able to sell captive breeding products starting in 2013. It can also be done by cooperating with partners to develop deer captivity as one of the icons of Edu-ecotourism development. This

condition can be seen in the KPH Blitar Java deer captivity, which took advantage of the opportunity because there was no permit to distribute animals by cooperating with a partner, CV. Sumber Intan Persada (a business group whose members are KPH Blitar employees) is developing a deer farm as part of the Kesambi Trees Park tourism service business. The profit obtained from this business before the covid pandemic was huge, which could be used for captive management costs, providing sufficient income for managers and the surrounding community.

Several obstacles in managing captive Javan deer, especially the sales aspect, are being unable to sell captive products because they still need to get a wildlife distribution permit and lack of promotion and administrative facilities to help ease the sale of captive products. A distribution permit is one of the requirements to use captive TSL (Tumbuhan dan Satwa Dilindungi=protected plant and animal) for trading purposes. For this reason, it is essential to complete the requirements needed to obtain a distribution permit and carry out intensive communication with the authorized agency (BKSDA) so that they can obtain assistance in obtaining a distribution permit. Concerning promotion and ease of administration, until now, the regulation can only accommodate captive deer (meat, antlers, and other parts), including guarantees for controlling their distribution. The government needs to be encouraged to prepare the necessary regulations to assist in promoting captive-bred products and ease of administration.

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### Conflict of Interest

The authors declare that there are no conflicts of interest

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