Management of swamp buffalo farms in forest areas to preserve forest ecosystem and sustainability of community livelihoods

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Abstract. The swamp buffalo of Pampangan (swamp buffalo) is one of South Sumatran germplasm that has the potential to be developed as one of the livelihoods of the people in peat swamp land. Currently, its farming extends from the farm area of origin in Pampangan area to the development area in Riding Village, Pangkalan Lampam Subdistrict, Ogan Komering Ilir Regency. Its expansion is mostly located within production forest area which is adjacent to Wildlife Sanctuary (WS) of Padang Sugihan. In the last decade, its population has increased both by birth and displacement. This phenomenon may cause competition in obtaining food and trigger damage to Padang Sugihan WS ecosystem. In order to support the sustainability of its business and to maintain the preservation of Padang Sugihan WS ecosystem, the optimum management of buffalo farming is required. Biophysical analysis of optimum grazing area, optimization studies and livestock business analysis are the methods used in this study. The results show that the total area of grazing area outside Padang Sugihan WS area is 1,646 ha and optimum population per ha is 3 buffalos. Analysis of its business analysis showed that financial feasibility was feasible. They indicate that buffalo farm business is potential developed as an alternative to community livelihoods in peat lands. In order to maintain the preservation of forest ecosystems and sustainability of community livelihoods, it is necessary to improve the grazing pattern and management of grazing areas. Hence the fodder is fulfilled without damaging the area of Padang Sugihan WS.

1. Introduction
Swamp buffalo or known as Pampangan buffalo is one of the special germplasm of South Sumatra [1,2]. The original distribution area is found in villages in Pampangan Subdistrict, Ogan Komering Ilir District, namely Kuro, Bangsal, Pampangan, Menggeris, and Pulau Layang Villages. Like other swamp buffaloes, buffaloes are grazed in the swamp area. Although the condition of the grass is submerged, the buffalo can still eat it. Buffalo are known as buffalo species that have the ability to dive to grazing at the base of the swamp. However, because the number of grass species that can grow in flooding conditions is limited, there is competition among individual buffaloes to get available feed. These conditions are often complained by farmers, because it’s causing the buffalo to become thinner and even causing the death.
Puddles of swamp water that are too fast and last up to more than five months can also reduce the quantity of available grass for buffalo feed. In addition, the conversion of grazing areas into rice fields that occurred in several locations such as Kuro, Bangsal and Pulau Layang Villages also triggered a decrease in grazing area as well as a decrease in the quantity of feed. The problems faced by swamp buffaloes in the area of origin have triggered some farmers to move their buffaloes to new grazing areas, in Riding Village, Pangkalan Lampam District, Ogan Komering Ilir District. The new grazing area is known to farmers as the Sujihan area.

The transfer of buffalo to the Sujihan area has triggered new problems, because the area used as a buffalo grazing area is the Production Forest area and is adjacent to the Padang Sugihan Wildlife Sanctuary (WS). Even some farmers also feed their buffalo in the area of SM. Even though the laws and regulations (Law No. 41, 1999, Article 50, Paragraph 3, Item i) [3] prohibit grazing activities in the WS area. Although according to the rules there are legal violations committed by farmers, in the context of empowering communities around peatlands, swamp buffalo farms is an appropriate alternative livelihood to be developed around wet or moistened peatlands, because wet and submerged environments are ideal habitats for swamp buffalo.

These problems lead to the choice of grazing buffalo only in Production Forest areas that are legally permitted, because the area has been established in the Spatial Plan for Non-Timber Forest Product Utilization of Industrial Plantation Forests (IUPHHK HTI) PT. BMH as a living area designated as a grazing area. However, there needs to be a limitation on the number of buffalo so that the potential for available feed can meet the need for feed for the entire buffalo population throughout the year. The conditions that occur in the field become a topic worth looking for a solution in order to save biodiversity within the Wildlife Reserve area and ensure the sustainability of the livelihoods of the surrounding communities. Starting from this background, this paper presents the results of an optimal study of the carrying capacity of grazing areas in forest areas and financial analysis of swamp buffalo cultivation by the community.

2. Research method
Referring to the background and objectives described earlier, the studies have been conducted using survey methods and in-depth interviews. The interview was conducted to record the data needed to calculate the carrying capacity of the grazing area, which included data on grazing area, grass potential, feed needs per buffalo, as well as the number and dynamics of buffalo livestock populations. In addition, the data collection was also carried out to calculate the financial feasibility of swamp buffalo farming consisting of data on the buying price of a calf, the cost of building cages, cages maintenance costs and the selling price of mature buffalo.

The calculation of the carrying capacity of buffalo grazing areas within the forest area is based on the availability of grazing areas, the number of buffalo populations, availability of feed, and feed requirements per buffalo. The financial feasibility was analyzed using three indicators: Internal Rate of Return (IRR), Benefit Cost Ratio (BCR) and Net Present Value (NPV).

3. Result and discussion

3.1. General description of swamp buffalo farms in Sujihan area
Swamp buffalo farming in the Sujihan area began to develop about four decades ago. At the beginning of his arrival, the farmers built buffalo cages on the banks of the Air Sugihan River (local people called its as Sujihan River). To keep their buffalo livestock, they also build temporary houses nearby. Their main houses are in their original village (in the village). In the 2000s, the road connecting the Pangkalan Lampam Subdistrict and Air Sugihan Subdistricts was built by the Ogan Komering Ilir District Government. The flow of the road follows the Sugihan River flow and the road body is built by hoarding swamp land. As a result, some of the swamps where grazing is disturbed. The construction of the road also led to the removal of cattle breeding settlements and buffalo cages which were originally on the banks of the Air Sugihan River to the land that was closer to the road.
As a new grazing area, the Sujihan area is blessed with abundant fodder grasses, the area is relatively safe from theft of livestock, buffaloes are rarely affected by disease, and there has not been much conflict with other land users. Therefore, the number of swamp buffalo livestock populations in this area tends to increase. The increase was not only through birth, but also through the transfer of buffaloes from the swamp buffalo originating from the villages of Kuro, Bangsal, Menggeris, Pampangan and Pulau Layang, in Pampangan District, Ogan Komering Ilir Regency, South Sumatra Province.

The swamp buffalo farming pattern in the Sujihan area is carried out extensively, the buffaloes was released in the grazing area. There are no artificial boundaries that are intentionally made as a border between the grazing area of one hamlet and another. Figure 1 below shows the appearance of the swamp buffalo grazing area in the Sungai Damping village, which is located in the Sujihan area. In the picture it appears that the settlements and buffalo cages are located around the road which stretches along the flow of the Air Sugihan River. The area located on the right side of the photo is the Padang Sugihan WS area and the left part of the photo is the concession forest area of PT. BMH. Air Sugihan River is the natural boundary that separates the two regions.

![Figure 1. The view of swamp buffalo grazing area at Sungai Damping, Sujihan area](image)

3.2. Optimal carrying capacity of grazing area

Land use will be related to human activities to meet their needs. Because of limited land resource conditions, space planning is needed to get optimal benefits according to biophysical, socio-economic and cultural conditions and preferences. In order to preserve the biodiversity of forest ecosystems in the Padang Sugihan WS area and ensure the sustainability of community livelihood in and around forest areas, the people's swamp buffalo farms in the Sujihan area need to be managed appropriately. When linked to the ongoing peatland restoration efforts around the area, the swamp buffalo farms are actually a good alternative as one of the livelihoods of the communities around the flooded peatlands. Swamp buffalo has the advantage of being able to use low quality feed (grassland) and fire free.

Buffalo feed in the Sujihan area is available in large quantities. In terms of quality and quantity, it is still sufficient to be able to meet the needs of livestock that exist today. Based on the results of the
identification study, it was found that the potential for buffalo feed in several locations in the Sujihan region ranged from 4.28 to 16.20 tons per hectare. The number of buffalo population that currently reaches 1,873 tails in nine settlements (Lebak Simpanan, Penyajab, Sungai Damping, Sungai Setanjung, Penyabungan, Rengas Potong, Rengas Merah, Kampung Jawa, and Sungai Rasau).

Although the current amount of feed is not lacking, it is necessary to anticipate future food shortages by optimizing livestock grazing. To calculate the optimal carrying capacity of the grazing area in the Sujihan area, one location of the buffalo breeder group was taken in the Sungai Damping settlement. The results of the inventory of the potential of feed in this area obtained data that the availability of food in the dry season reached 7.36 tons / ha and in the flood season the potential for feed to shrink by half. This decrease is caused by a puddle that causes some grass species to die. Only a few grass species can live when flooded. These things are taken into consideration in calculating the optimal carrying capacity of the grazing area for swamp buffalo livestock.

Rotation of grazing areas is often carried out in the arrangement of providing feed for sustainable livestock. The preview study results show that the grazing area rotation system can increase feed stocking by up to 30% [5]. The following is the calculation of the carrying capacity of buffalo feed meadows in the Sujihan area during the dry season and the flood season. The grazing rotation period in one year is calculated by dividing the number of days in a year with the pasture of grazing in a pasture plot, namely: 365 days / 40 days = 9.125. In the dry season the potential feed is 7.63 tons / ha x 8 times rotation = 61.04 tons / ha / year.

In the rainy season, the potential for feed is reduced by about half (50%) from the potential available in the dry season because of inundation. Therefore, the potential feed in this season is estimated by multiplying the potential of feed in normal conditions multiplied by 50% and multiplied by the frequency of buffalo movement in the flood season (9.125-8 = 1.125), as the calculation is presented as follows: 7.63 tons / ha x 50% x 1.125 = 4.29 tons / ha / year.

Assuming the effective area of grazing is 50% (total area reduced by settlement, river, road and pool), then the potential for available feed is equal to the sum of potential feed in the dry season (61.04 tons / ha / year) with potential feed on during the flood season (4.29 tons / ha / year) then multiplied by 50%, or the details can be presented as follows: (61.04 + 4.29) x50% = 32.67 tons / ha / year.

Assuming buffalo feed needs per head per year is 35 Kg x 365 days = 12.775 tons / ha then in 1 ha the natural grazing area can accommodate 2.56 tails = 3 buffaloes or 3 livestock units.

Based on a partnership agreement between PT. BMH with the Sujihan community (Riding Village) that for the pasture area as buffalo feed forage provided by PT BMH around 1,863.4 ha. In the spatial layout of HTI is included in the area of living plants. If it is assumed that the land area can be effectively used as a pasture. With the available area, there are 2,795 buffaloes that can be accommodated in grazing fields.

To be able to realize the carrying capacity of the grazing area towards the optimal buffalo livestock population, it is necessary to change the livestock pattern that is currently practiced by the community into a more modern pattern of animal husbandry. To meet the needs of feed and roaming space buffalo can be arranged through the rotation of the paddock (grazing plots) which can be moved every 40 days. An example of a mock design of the grazing area setting is presented in Figure 2. Making paddock is intended to regulate alternating grazing of the land with the aim of preserving the feed supply and reducing damage to overgrazing grazing areas in certain areas [4-6]

Because the land is used as a grazing area for forest areas, it would be a good thing to maintain tree vegetation as one of the elements in the area. For example, by making the boundary between shepherding plot by using a live plant type gelam (Melaleuca cajuputi) which has been proven to be able to adapt to the flooded periodically. The purpose of the use of living plants is that the boundary plants can survive in the long term and the wood can be used by the community to build the construction of houses, buffalo cages and other purposes. Such a concept can also be known as silvopasture. The study in south-Florida, USA, silvopasture which combines trees, forages and livestock operations could improve environmental services and provided environmental benefits which can be consumed by community [7].
3.3. Financial feasibility of swamp buffalo farms
Swamp buffalo farms were produced meat, milk [8] and seedlings as seedlings. Swamp buffalo has good meat-producing potential. Swamp buffalo carcasses reach 40-47%. The Carcass is the main result of cattle slaughtering, namely the body parts of cattle without blood, head, internal organs, skin, tail, and lower legs. At the age of 2.5 - 3 years, the weight of male and female swamp buffalo can reach 305.17 ± 16.44 and 223.65 ± 16.28 Kg. While at 3.5 - 7 years, male and female swamp buffalo can reach up to 462.17 ± 43.67 Kg and 398.00 ± 38.46 Kg [9]. The average body weight of buffalo children aged 6-24 months can reach 201.58 ± 81.27 Kg. The sale of buffalo for meat production should be done at the age of 3 years, namely before puberty and approaching adulthood. At that age, the body's bipo growth rate has reached the optimal point [10].

The financial analysis of swamp buffalo farms in this study was conducted on two types of businesses, meat production and calf production. The meat production business was carried out by buying calf (generally male) and then maintaining it’s for eight months, after calf gone mature then the buffalo sold. The capital needed by farmers includes the cost of purchasing calf, the herd's wages and the cost of making a cage. For feed sources to rely solely on grass available in nature. The revenue is obtained by farmers from the sale of buffalo.

Swamp buffalo breeding business is done by buying an adult buffalo mother with the aim to produce saplings. The calves are then sold. Costs needed for the nursery business include the cost of purchasing buffalo broodstock, the cost of building a pen and the shepherd's wages. The revenue is obtained from the sale of calves.

The results of the financial analysis of the two swamp buffalo business types are illustrated in three business feasibility criteria consisting of BCR, IRR and NPV as presented in Table 1. The results of the analysis on the three indicators indicate that the swamp buffalo farm business is feasible. The community can choose one of the meat production or calf production, both of the patterns provide...
financial benefits. If you want to choose a business that produces a profit in the current value is higher, then a calf production business can be chosen. But if you want to choose a business that produces a higher rate of return, then choose a meat production business. Meat production business produces a higher rate of return, so choose a meat production business.

Table 1. Financial feasibility indicators of swamp buffalo farm business

| Indicators | Business type |
|------------|---------------|
|            | Meat production | Calf production |
| BCR        | 1.05           | 1.12            |
| IRR        | 20%            | 10%             |
| NPV        | 4,635,149.-    | 8,755,917.-     |

4. Conclusion and recommendation

The number of swamp buffalo populations in the area of the Timber Estate Company PT. BMH at the time this study was conducted was still within the carrying capacity that could be supported by available feed, both in the dry season and in the flood season. However, some farmers still graze their buffalos in the Padang Sugihan WS area. This certainly can disturb the stability of the ecosystem in Padang Sugihan WS and is legally not permitted. On the other hand, swamp buffalo cultivation is an alternative source of livelihood for communities around peatlands that are financially feasible to develop. Therefore, to preserve the ecosystem biodiversity of Padang Sugihan WS and ensure the sustainability of the livelihoods of the communities around the peatlands, the shepherd area and the grazing area restrictions need to be implemented immediately.

Acknowledgement

The authors would like to thank to Environment and Forestry Research, Development and Innovation Agency Leaders, swamp buffalo farmers, government of villages and local partners at Ogan Komering Ilir District. This research was made possible by the financial support from Peat Restoration Agency of Republic of Indonesia.

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