Sustainability studies of smallholder livestock based on climatological conditions, land resources and farmer profile

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Abstract. Bali Island is one of the islands in Indonesia that is vulnerable to climate change. To support mitigation and adaptation efforts, information on climate change in Bali is needed. Sustainability in the field of animal husbandry is of course very important. Especially for beef cattle. The aim is to assess the sustainability of smallholder livestock based on climatological conditions, land resources, and farmer profiles. The research was conducted in Bangli and Gianyar Regencies, Bali Province. The material used is 200 farmers with direct interviews. The method used was the Participating Rural Appraisal (PRA) survey. The results of the research on land resources in Bangli Regency were 42,502 ha of plantation land (29.92%) with the type of coffee plantation, while in Gianyar Regency using an area of 14,790 ha (40.19%). From the breeder profile. The results showed that most of the farmers were old, had low education, had low main jobs as breeders and livestock. The positive thing is that farming takes a long time and has good detection capabilities so that it can be detrimental to the experience that climatological conditions, land resources, and farmer profiles can continue for small farmers in Bali.

1. Introduction
As an archipelago, Indonesia is more vulnerable to the impacts of climate change. The potential impacts of climate change are changes in rainfall patterns, rising temperatures, and rising sea levels. One of the islands in Indonesia that is vulnerable to climate change is Bali Island. To support mitigation and adaptation efforts, hence information is needed about climate change in Bali. Sectors that will receive the impact of climate change seriously are the forestry, agriculture, and livestock sectors. Sustainable in the livestock sector is of course very concerned. Especially for cattle, beef cattle are a commodity in the livestock sub-sector as a meat producer, job creation, and a source of income for farmers. The contribution of cattle farms to farmers' income is 24–34% of the total farmer income. The high interest of farmers in raising livestock, both as a main and secondary source of income, is influenced by the level of demand for cattle. The demand for cattle is predicted to increase continuously in line with the improvement in people's income and the high awareness of the community to consume nutritious food [1]. The province of Bali has varying climatological conditions in each region. So it can be seen that there is a criminal influence on land resources in different places, namely in the highlands and lowlands.
The land has its important meaning for the community, apart from being a place to live and in the agricultural sector as well as a source of forage availability for livestock. In the agricultural sector, the land is used to grow crops in rice fields or fields, raise livestock, and build housing for family members.

The large number of families who have traditional cattle farming will make it difficult to obtain forages so that breeders have to provide land to grow forage for livestock. The availability of feed ingredients must also be guaranteed at all times and in sufficient quantities, based on the availability of land, livestock, and human resources. However, in reality, the market demand cannot be fulfilled optimally because of the low production capacity in terms of various limitations, including (a) the availability of feed, especially during the dry season, (b) traditional management of beef cattle breeding, (c) farmer institutions which have not been functioning optimally. and (d) there is a shift in the function of cultivated land as a source of ruminant feed. In the last five years, the total cultivated land (fields, and yards) decreased by 23.41% or about 4.7% per year, causing a decrease in the availability of forage and waste as a source of animal feed. Farmers are trying to anticipate this by increasing land capacity, such as planting superior grass, utilizing agricultural waste, and implementing crop patterns that can provide forage in the dry season. So we need a study related to the people's livestock based on climatological conditions, land resources, and farmer profiles to see the factors for increasing sustainability [2].

2. Material and methods

2.1. Material

The subjects used consisted of Bali cattle farmers who are members of a herd numbered 200 people.

2.2. Method

The method used in this study was the Participating Rural Appraisal (PRA) survey to determine farmers' profile. Land resource and Climatological Conditions use data from BPS and BMKG Bali and The method which conducted from January-February 2020.

3. Results and discussion

The basic physical condition of the regency is based on the aspects of crime, topography, geology, and hydrology. The topography of the Bangli Regency area is at an altitude between 100 – 2.152 meters above sea level, with the highest peak being Writing Peak. In general, the altitude ranges of Susut District (100–920 m), Bangli District (100 - 1200 m), Tembuku District (320 - 920 m), and Kintamani District 920 - 2.152 m. The slope of the area varies between sub-districts and is generally in plain conditions (0–2%), sloping (2-15%), wavy (15-30%), steep (30-40%), and very steep (>40%). Relatively flat conditions are only found in the area at the foot of Mount Batur, sloping and bumpy in the Susut, Bangli, and Tembuku Districts, while wavy and steep and very steep in the Kintamani District area. Climatology Bangli Regency has a tropical climate, the temperature is relatively low, ranging from 150 - 300°C, the temperature gets colder to the north. The lowest average rainfall figure is 900 mm and the highest is 3.500 mm. The distribution of rainfall is relatively high (2.500-3.500mm) including the northern part (slopes of Mount Batur) and is getting lower towards the south of the region. The highest rainfall occurs in December-March and the lowest is in August.

The Gianyar region as well as the Bali region generally has a tropical sea climate, which is influenced by monsoons. As a tropical area, Gianyar has a dry season around April - September and a rainy season around November - February, which is interspersed with transitional seasons. The highest rainfall intensity occurs during the rainy season at 336 mm and the lowest rainfall intensity occurs during the dry season at 18 mm which occurs in August. The highest rainfall intensity during the rainy season is 450 mm and the lowest rainfall intensity during the dry season is 38 mm which occurs in August with the assumption that rain still occurs in other dry months. The average air temperature in Gianyar Regency reaches 27°C, with temperature The average minimum temperature is 24°C and the average maximum temperature is 300°C. The average humidity of 75.50% ranges from 74% to 77%. Meanwhile,
The development of climatic conditions in Gianyar, in five years, shows the average air temperature ranges from 27.00–28.33°C with humidity decreasing from 77.15% to 75.50%.

Land Resources based on land use, area, and type of land use in Bangli Regency: plantation 42.502 ha (29.92%). The area and types of land use in the Bangli Regency are presented [3]. Based on the land use mentioned in Table 1, it is very likely to produce forage and agricultural waste as land that can provide animal feed. Until now, there has been no collaboration between Perhutani and the Livestock Service in managing the potential forage on plantation or forest land. The provision of forage is mostly obtained from arable land such as rice fields, fields, plantation products, then from forests. The provision of forage is highly influenced by the season. In the rainy season, the forage is very abundant, especially during the growing season for coffee, rice, and secondary crops, while in the dry season only a small part of the area contributes to the provision of animal feed, especially in areas with sufficient water sources. Forage production during the dry season is only around 35-40%, namely 57.770 ST, while forage production during the rainy season is 160.589 ST. Strategies in livestock management during the rainy season and dry season, management of land resource management during the rainy season, and forage preservation, planning for planting crops that can contribute to providing forage during the dry season. Another factor that causes decreased feed availability is the shift in arable land that produces agricultural waste. The shift in land use which is a source of forage production, including rice fields, has decreased by an average area of 1.77 ha each year, as a result, the production of rice straw which is an agricultural waste decreases while the need for animal feed, especially in the dry season, is quite high. The shift in the function of arable land to settlement and other functions has reduced the availability of ruminant feed. Arable land has decreased over the last five years, the total arable land (fields, and yards) has decreased by 23.41% or about 4.7% per year, pasture by 0.76 ha has changed its function to residential land every year, resulting in a decrease in the availability of forage and waste as a source of animal feed. This condition encourages breeders to strive to plant types of grass and available forage sources to meet animal feed needs.

Table 1. Extent and type of land use in Bangli regency.

| Type of use       | Large (ha) | Persentation (%) |
|-------------------|------------|------------------|
| Field             | 33.27      | 21.86            |
| Yard              | 11.42      | 7.50             |
| Farm              | 35.25      | 23.16            |
| Field             | 6.95       | 4.47             |
| Lea               | 1.31       | 0.87             |
| Community Forest  | 12.66      | 8.32             |
| State Forest      | 3.947      | 25.9             |
| Plantation        | 42.50      | 29.92            |
| Swamp             | 6.63       | 0.43             |
| Others            | 4.22       | 2.77             |
| Total             | 152.22     | 100.00           |

Source: BPS Bangli District 2018

The situation until the end of the 2018 field area of 14.790 ha (40.19%), is a big enough potential to support the agricultural. Dryland 21.839 ha (59.81%) and another land in the form of swamps, ponds, ponds/stockings/ponds covering an area of 171 ha (0.46%) [4]. In detail, land use in Gianyar Regency is shown in Table 2. Land use in Gianyar Regency as shrubs/shrubs, gardens/plantations, settlements, irrigated rice fields, rainfed rice, and moor or fields. The conversion of agricultural land (wetland) to non agricultural land as a consequence of the rapid pace of development has also occurred in Gianyar Regency. Agricultural land in Gianyar Regency, especially paddy fields, although some have changed their function, their existence is still relatively well maintained. The sub-district with the largest area of rice fields is the Sukawati sub-district with an area of 2.727 ha and the smallest is Tampaksiring with an area of 1.478 hectares. Meanwhile, the sub-district with the largest area of dry agricultural land is the
Payangan District with an area of 3.573 hectares. The main food crops cultivated by farmers are rice, vegetables, and fruits, all of which play a very large role in fulfilling people's consumption and increasing farmers' income. The dominant plantation crop cultivated by farmers is coconut which reaches an area of 4.186.51 ha with a total production of 3.635.61 tons. Coffee plants are also plantation crops that have a productive area of up to 483.88 hectares with a production of 230.39 tons. The dominant large livestock population in Gianyar Regency is 57.815 cattle.

Table 2. Size and type of land use in Gianyar Regency.

| Type of use            | Large (ha) | Persentation (%) |
|------------------------|------------|------------------|
| Field                  | 33.27      | 21.86            |
| Yard                   | 11.42      | 7.50             |
| Farm                   | 35.25      | 23.16            |
| Field                  | 6.95       | 4.47             |
| Lea                    | 1.31       | 0.87             |
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Source: BPS Gianyar District 2018

The differences in topography, geography, and climatology of an area give the appearance of different numbers and types of vegetation. These differences also lead to differences in activity and different species dominance at each research location in Bali Province [5]. In addition to the three factors above, these differences are also caused by differences in agricultural land use and are still not solid in the support of farmers in efforts to provide forage in Indonesia [6]. Profiles of breeders obtained from the results of research in Kintamani and Gianyar District, Bali Province are presented in Table 3.

Based on profile data farmer in Tabel 3, it is known that the age of the Farmers Bali cattle are in the productive age, which ranges from 15 to 60 years, amounting to a total of 174 people (88%) and non-productive age more than 60 years as many as 26 people (12%). Productive age is very valuable time because in this age people spent their time to work. It is one of the good chance for farming development in Kintamani. [7] states that the productive age farmers are able to develop his farm with a level of maturity, a good way of thinking and good emotional level. Based on that statement, the socialization process on new technology in farming field become one of the ways to optimize the farming development with this productive age composition. It’s describes that the farmers has much experience so that they already have tips how to manage their livestock. Farmers in the district of Bali get guidance of farming by its self-practice and the experiences derived from their families. [8] states that the more experienced farmers will become more rapidly absorb technological innovation compared to farmers who have not or less experienced. However, this experience still could not make them optimize their farming because of their low education level.

The livestock ownership data of Profil farmers can be seen in Table 3. Most farmers have two to three head of cattle each person. This conditions is similar with the opinion [9] that almost all ruminants in Indonesia maintained by farmers on a small scale. The little livestock ownership can be caused by several problems faced by the farmers, such as limited land resources, capital, labor, and management. The motivation for farming determines how the farmer manages his livestock. If their motivation is only to save, then they do farming as a habitual action to fulfill their daily needs and do not consider the prospects of their farming in the future. This will make it difficult for their farming to develop.
Table 3. Profile’s of farmer in Kintamani and Gianyar District, Bali Province.

| Parameter                          | Persentasion (%) |
|------------------------------------|------------------|
| Age Farmers                        |                  |
| Productive age                     | 87               |
| Non Productive                     | 13               |
| Farming experience                 |                  |
| 10-20                              | 46               |
| 21-30                              | 34               |
| 31-41                              | 18               |
| 41-50                              | 2                |
| Level of education                 |                  |
| Not Take a Grade                   | 43               |
| Primary School                     | 37               |
| Middle School                      | 12               |
| High School                        | 8                |
| Ownership of Livestock             |                  |
| 2 head                             | 25               |
| 3 head                             | 36               |
| 4 head                             | 18               |
| 5 head                             | 14               |
| 6 head                             | 4                |
| 7 head                             | 3                |
| Production system                  |                  |
| Fattening                          | 0                |
| Farming Motivation                 |                  |
| Savings                            | 70               |
| Fertilizer                         | 15               |
| Workforce                          | 15               |
| Land Ownership                     |                  |
| field                              | 34.8             |
| Yard                               | 7.0              |
| Forage                             | 58.2             |
| Maintenance system                 |                  |
| Extensive                          | 0                |
| Intensive                          | 100              |
| Marriage                           |                  |
| Natural mating                     | 55               |
| Artificial insemination            | 45               |
| Estrus Detection Ability           |                  |
| Good                               | 36               |
| Middle                             | 34               |
| Poor                               | 30               |
The low or high motivation that a person has will have an impact on the small or large he does [10]. Most (70%) of Bali cattle breeders in Bali Regency use livestock as savings, not as their main source of income. As savings, livestock can be sold easily at any time at a higher price than other livestock. Estrus detection ability is an important competence for farmers so that they can know the right time to breed their livestock. Farmers have varied knowledge of the detection of cattle estrus signs. It includes the knowledge about the appearance of the vulva which colored translucent liquid and the behavior of cattle that tried to mount other cattle. Therefore, cattle production in this place is not good enough. This poor competency can be caused by their low level of education and also by the lack of socialization about farming management from the government. In the Bali area, intensive care is often used by farmers for maintenance management. This is in line [11] which states that smallholder farms with younger breeders will have the ability to increase livestock production by looking at the products produced.

Sustainable in the livestock sector is of course very concerned. Especially for cattle, beef cattle are a commodity in the livestock sub-sector as a meat producer, job creation, and a source of income for farmers. The contribution of cattle farms to farmers' income is 24–34% of the total farmer income. The high interest of farmers in raising livestock, both as a main and secondary source of income, is influenced by the level of demand for cattle. The demand for cattle is predicted to increase continuously in line with the improvement in people's income and the high awareness of the community to consume nutritious food. The province of Bali has varying climatological conditions in each region. So it can be seen that there is a criminal influence on land resources in different places, namely in the highlands and lowlands. The land has its important meaning for the community, apart from being a place to live and in the agricultural sector as well as a source of forage availability for livestock. In the agricultural sector, the land is used to grow crops in rice fields or fields, raise livestock, and build housing for family members. The large number of families who have traditional cattle farming will make it difficult to obtain forages so that breeders have to provide land to grow forage for livestock. The availability of feed ingredients must also be guaranteed at all times and in sufficient quantities, based on the availability of land, livestock, and human resources. However, in reality, the market demand cannot be fulfilled optimally because of the low production capacity in terms of various limitations, including (a) the availability of feed, especially during the dry season, (b) traditional management of beef cattle breeding, (c) farmer institutions which have not been functioning optimally and (d) there is a shift in the function of cultivated land as a source of ruminant feed. In the last five years, the total cultivated land (paddy fields, fields, and yards) decreased by 23.41% or about 4.7% per year, causing a decrease in the availability of forage and waste as a source of animal feed. Farmers are trying to anticipate this by increasing land capacity, such as planting superior grass, utilizing agricultural waste, and implementing crop patterns that can provide forage in the dry season. So we need a study related to the people's livestock based on climatological conditions, land resources, and farmer profiles to see the factors for increasing sustainability.

4. Conclusion
It can be concluded that climatological conditions in Bangli Regency has a tropical climate, the temperature is relatively low, ranging from 150 - 300°C. The lowest average rainfall figure is 900 mm and the highest is 3.500 mm. The highest average rainfall occurs in December-March and the lowest is in August. The Gianyar regions as tropical area, Gianyar has a dry season around April - September and a rainy season around November - February, which is interspersed with transitional seasons. The highest rainfall intensity occurs during the rainy season at 336 mm and the lowest rainfall intensity occurs during the dry season at 18 mm which occurs in August. Land Resources based on land use, area, and type of land use in Bangli Regency plantation 42.502 ha (29.92%) and Gianyar Regency as shrubs, plantations, settlements, irrigated fields. Farmer profile It concluded that most farmers have old age, but they have low education levels. The majority of the farmers do farming as their primary occupation with middle farming experience (10–20 years). Their motivation for farming was for saving. However, they only have small livestock ownership, and their estrous detection ability was good. Three Approaches are very useful to see the factors for increasing sustainability.
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