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Local Awareness of Agriculture and Livestock Integration in Maintaining the Value of the Ranu Pani Lake Conservation

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Abstract— *The livestock system is the backbone of sustainable economic growth for poor farmers in rural areas. The Ranu Pani Village as an enclave village (within the area) of the Bromo Tengger Semeru National Park has local wisdom to protect nature, namely through the integration of terrace patterns. In the meantime, agricultural land activities are focused on production. The tendency of unhealthy agriculture has resulted in the low quality of Ranu Pani Lake. The occurrence of land grabbing and the change in the pattern of polyculture are gradually disappearing the value of environmental wisdom. This paper discusses the local paradigm of wisdom used by Ranu Pani farmers in choosing the integration of crops and livestock to conserve Lake Ranu Pani. This information used to assist the Lumajang District Mid-Term Development Plan program in improving forest protection and management, as well as water catchment management and protection of local water sources. In this case, in addition to researching the resources of the livestock system, it is necessary to regulate the village regulations for the implementation of healthy agricultural patterns. Increase the area of the Galengan area based on the remaining local wisdom that has conservation value in the village. This integration requires adjusting the motivation of farmers because there is an imbalance in economic value. Participatory support from village officials through Village-Owned Enterprises in collaboration with farmer groups to accept innovations from sub-management and restore sustainable conservation farming systems.*

Keywords— *Conservation, Ranu Pani, Crop livestock system*

I. INTRODUCTION

From 2014 to 2020, East Java has the highest cattle population with around 4.75 million head and an annual growth rate of 14.28% (BPS, 2020). The contribution of animal production is still made by rural areas with a pattern of integration between crops and livestock. Traditional breeders generally have restrictions on sufficient sources of feed for their livestock due to changing rainfall. The animal production period requires adequate land and water resources, with around 33% of the land that can be planted with food crops being used for animal feed (forage crops) or around 70% of the total agricultural area (Bambang and Edi, 2013).

Agriculture and ranching have long been used and are the backbone of sustainable economic growth for poor farmers in rural areas (Wright et al. 2011). The cycle of integration consists of a cycle where livestock can help farmers through their labor, manure can become fertilizer, and agriculture has a variety of plant species for fodder. Ranu Pani Village is a traditional and tourist village in the enclave of Bromo Tengger Semeru National Park (TNBTS). In overcoming limited feed sources, Ranu Pani Farmers use feed sources from agricultural garden and forest areas. This activity has been used by the Tengger culture for a long time until it was included in the category of environmental wisdom (Wimmy, 2016).

Integration allows farmers to use manure to balance soil nutrients and increase the economic value of farmers in relative terms. Farming can also provide flexible financial guarantees in an emergency in the event of a crop failure. Land integration through the application of a stratified pattern system can protect the environment from the threat of soil erosion and soil erodibility (Horden et al., 2018). Ranu Pani Farmers also use weeds as natural fertilizer by burying them without using bacteria. Delaying planting time can also affect soil fertility. This wisdom was used before chemical fertilizers, as they are now.

However, the use of the integration of crops and livestock is currently decreasing as the profits from agriculture are higher than those from livestock farming. Most of the communal agricultural area changed from an integrated system of terraced patterns to an intercultural polyculture system. This change had a significant impact on one source, namely Ranu Pani Lake (Reva, et al. 2018). The main problem in developing horticultural crops requires a lot of fertilizer for plant growth (Siswati and Nizar, 2012). The tendency of the soil hydrological path to always carry erosion particles to Ranu Pani Lake, while the lake is one of the nature reserves of the national park as a water source for the Senduro district and the Ranu Pani village itself. It's just that manure residues, as well as solid and liquid waste, make this lake unusable (Reva, et al. 2019).

There is no binding village law on common land to protect the spring water in the village. However, the farmers in Ranu Pani Village have local knowledge that can balance the ecosystem with a combination of plant and animal integration that is still possible today. Therefore, the article aims to explore a local wisdom model of integrating horticultural agriculture and ranching to support the Lumajang District Medium Term Development Plan (RPJMD) program in improving forest protection and management, and water

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catchment management and protection of local water sources to support.

II. Plant Integration Pattern – Livestock

The concept of integrated agriculture with plants has existed since humans invented agricultural systems. The introduction of an integrated cultivation system began in 1970 with research on dual cultivation by the Agricultural Research Institute (LP3) in Bogor and gradually began to use terms such as cultivation patterns, cropping systems, agricultural systems and livestock systems (Bambang and Edi, 2013: I wayan, 2013). Meanwhile, livestock crop systems are being formed and selected from farmers' responses to risk factors that need to be addressed due to uncertainty in agriculture (Saptan and Nyak, 2015). On the one hand, agriculture is required to provide food quickly so that it is highly exploratory for its resources. On the other hand, an agricultural model is needed that implies sustainable agricultural development based on agroecosystems.

Livestock need protein and energy every day, while agriculture produces dry matter per land area. This assumption combines the use of agricultural waste as animal feed from manure fertilization (Rina, et al. 2018). Forage consists of the part of the plant that can be eaten by livestock (the part of the plant that can be eaten) through grazing or without grazing. However, whole grains are not included in the forage. Optimizing various forage resources in mountainous tropical areas requires a combination of agricultural system strategies that combine local agricultural waste to substitute forage, a case study in Ranu Pani Village, namely cabbage, potato and corn waste. Agricultural waste products are reported as compound feed, while basalt feed is elephant grass and natural grass in forest areas (Deddy, 2013; Buton, et al. 2016).

The dual role of agricultural culture in rural communities, generally as farmers and breeders, has a lasting value based on local wisdom. Livestock as savings, as a source of manure and as a religious activity. Then agricultural land provides an abundant source of feed, which is a positive value to support the capacity of livestock per hectare of land. However, because it is far from the city, the breeders still have difficulty selling cows and finding local breeds of cattle to be fattened up to ±40 km from Senduro District, Lumajang Regency and Tumpang District, Malang Regency, Indonesia.

III. Local Arification of Agriculture

Local wisdom from an agricultural perspective arises from a long process of activity between humans and the environment in order to satisfy their needs. The process of formation of local wisdom is highly dependent on the local potential resources, the natural resources and the environment of the area, which are influenced by the views, attitudes and behaviors of the local population towards nature and the environment (Rina, et al. 2018). The result of this knowledge is the creation of local technologies to achieve the best possible production so that they can be taught and followed by their descendants. This is how the created agricultural system creates the right results without destroying nature so that it can be used for future generations. However, not all local knowledge is local or environmental wisdom. Local knowledge also has limits when farmers show a tendency not to openly, exclusively, narrowly and confidently reveal new wisdom ideas (Sandi et al., 2020). Local wisdom should be able to show ideas of environmental wisdom that are broad, universal, and acceptable in all places (Rina, et al. 2018).

IV. Local and Conservation Awareness

Based on the Basic Law Number 32 of 2009, discusses local wisdom as ancestral values that are applied in the way of life of most people in order to maintain and manage the environment so that it remains sustainable (Siombo, 2011). To achieve a balance between natural resources and human resources, it is necessary to limit human behavior in consuming natural resources contained in conservation principles. In the Tengger tribe in Ranu Pani, the term "conservation" has long been practiced in their activities as farmers (Wimmy, 2016). Based on Figure 1, it tells of the hydrological pathway (red) from the direction of the National Park forest starting to decrease (Wimmy, 2016). As a result of excessive logging by local people in the past for heating fuel, the forest hydrological path leads to agricultural land (yellow) and ends at Ranu Pani Lake. The village, which has a slope of 80.55%, makes high water speed by carrying soil particles which cause silting of Lake Ranu Pani's springs.

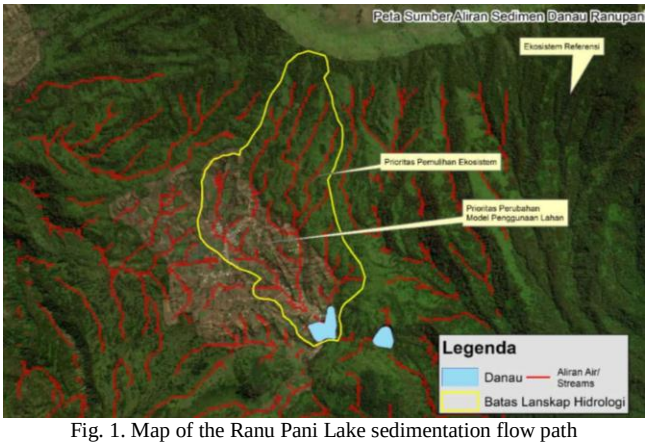

Fig. 1. Map of the Ranu Pani Lake sedimentation flow path

The soil morphology, which is similar to the ash of the volcanic Mount Semeru, binds water from heavy precipitation (> 100 mm) very easily and causes sedimentation of 465.61 tons / ha / year. The steep topology ensures flow speed and high air mobility in the direction of the lake source. (Arif, 2013). This affects the quality of the lake water from the fields and takes up erosion debris from the surrounding hills (Reny and Mariana, 2019; Siswo and Luchman 2011).

Using an integrated livestock system with an intercropping polyculture growing pattern by planting maize between cabbage plants and vertical runoff in steep fields to avoid landslides and optimizing the side area of the fields (Galengan) for planting grass and pine trees as a vegetation sediment inhibitor (Dian et al. 2019: Listumbinang et al. 2012). Soil conditions in the form of volcanic ash and softly structured, difficult to produce pure terraces. Optimizing

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Galengan can also act as an inhibitor of sedimentation flow as well as a feed source for livestock (Tien, et al. 2014). However, due to the use of the Galengan, it is still not sufficient (0.5 m) to need more Galengan area (2-3 m) to reduce soil erodibility and it is necessary to plant standing trees or forage around the Support soil to be retained by tree roots (Sandi, et al. 2020).

V. Effect of Integration on Conservation

According to Dian et al. (2019) Integration can occur as the regeneration of natural resources from the effects of excessive land use. Community support has a major impact on interest in leveraging integration. Through a process of mentoring and engaging the government with farmers to solve the problems they face, to strengthen their role in economic and social policy.

The change in integration by farmers is mainly due to their strong economic influence. The terrace system began to decline in Ranu Pani when potatoes kicked in and the price of livestock began to decline due to imported frozen meat (Kholifah, 2019; Anggiana et al. 2014). There is an economic imbalance between farms that is greater than the livestock business. The capital for livestock production is higher than the selling price of the unit of production, so farmers who own livestock suffer great losses. On the other hand, the reduced area of the grass stands has led to a tendency towards increased sedimentation (Sandi et al. 2020).

TABLE 1. Cropping patterns in Ranu Pani Village

Pattern	Types of plants that are intercropped	Proporsi (%)
1	Potatoes-Cabbage	20
2	Onions - Cabbage, Leek - Potatoes, Potatoes - Cabbage	30
3	Potatoes - cabbage - Leek	35
4	Potatoes - cabbage – leek - corn	15

Source : BPS, Kecamatan Senduro (2019).

Based on table 1, it explains the cropping patterns that exist in the Ranu Pani Village area. According to Dian, et al. (2019) there are indications of a change where the land area integrated with the alley cropping pattern has been transformed into a polyculture and a monoculture. Farmers are starting to focus on converting land use to intensive agriculture to do horticulture (potatoes, cabbage and green onions) which is three times more profitable. (Dian et al. 2019). Currently the ruminant population in 2014-2018 has decreased by 8.62% and high agriculture by 91.33% (BPS, Kec.Senduro, 2019: Edi, 2020). Livestock gradually gave up, only a few breeders owned cattle, but agricultural land remained polycultural.

The impact of the loss of integration has the water quality of Lake Ranu Pani due to the suspended matter (TDS) of 46.6 mg / L. This amount comes from the debris carried by the current and seeping into the lake. The size of the TDS value in agricultural land (47%), settlements (35%) and infrastructures (18%) that allow a sewage infiltration of 24,822.66 mm / year with climate type A. Based on the chemical properties of the lake, the pH is 6.87 Acid disrupts the balance of the lake ecosystem as it affects the biota. Due to the oxygen content of the lake, the value is 3.40 mg / l, where the lake is moderately polluted. The indicator is DO values> 3 mg / l. DO levels act as levels of oxygen in the water that are useful for small fish life (Reny and Mariana, 2019).

VI. Integration Development Strategy

Efforts to preserve nature from land sedimentation by adopting local culture must be a participatory approach to farmers in the village. The role of government agricultural extension agents here is very important in motivating farmers to carry out environmental wisdom and local wisdom such as the integrated farming system. Assisted by the village government in issuing applicable technical regulations for sustainable agriculture based on environmental wisdom. As a result of this push, agricultural extension workers need a system that can offer commensurate benefits from reduced land area. Accelerated government policies with land slopes> 40% require a portion of land for the soil hydrological pathway in order to reduce erodibility (Deddy, 2013; Syamsu, 2015).

The establishment of an integrated farming system infrastructure requires several information components, namely agricultural commodities, cropping patterns, land use, the latest animal population, animal carrying capacity, village policies, water resources, market access, infrastructure, transportation and labor (Bambang and Edi, 2013). Currently, the supporting capital for the implementation of integration is land use, from the average area of communal agricultural land is 3863.95 m^2 with an average galengan area of 111.45 m2 or only 2.88% per land and 97.12% is active agriculture. Galengan area functions as a source of elephant grass feed. If you look at Table 2, it is an area of forage source for animal feed with an area of 276,58 ha and the productivity of forage dry matter reaches 4.842.116 tons / year.

TABLE 2. Value of production of fresh forage sources

Potential forage areas	Land area (ha)	DM Production (ton/yr)
Galengan/Farmyard	7,35	158.085
Deep Forest TNBTS	119,71	2.916.946
Field	81,58	1.583.794
Croop by product	67,94	183.291
Total	276,58	4.842.116

The potential for forage utilization activities is still influenced by rainfall in the village. In October - July (343 mm) are rain months and August - September (122 mm) are dry months. According to (Listumbinang et al. 2012) the Schmidt - Fergusin climate classification, Ranu Pani has a type 2 climate with Q = 20. This means that Ranu Pani is a wet area with tropical rain forest vegetation. This is the agricultural production and availability of forage following the cropping pattern in the village (Tien and Djuwanto, 2014: Silvi, 2015). So that the sustainable integration of the farming system, cropping patterns affect the availability of livestock nutrition per meter in each month, and it is shown in Table 3.

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TABLE 3. Production period based on the cropping pattern

Spesies name	Cropping patterns											
	Okt	Nov	Des	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Agst	Sept
Hortikultura												
Potatoes												
Cabbage												
Leek												
Tomeo												
Corn												
Forage												
Pennisetum purpureum												
Digitaria argyrostahya												
Spergula arvensis												
Isachne rhabdiana												
Pogonatherum paniceum												
Eragrostis amabilis												
Paspalum srobiculatum												
Widelia Montana												
Leucaena glauca												
Note :		Plants do not live in this month										
		Plant vegetation can be alive but little										
		High plant vegetation										

The response to rainfall affects the productivity of vegetation. Grass species are more dominant all year round, as the water content in the soil promotes the life of the plants. The forest area has 50 types of plants that can be used as animal feed (Jati, 2012). Despite the large number of species, Pennisetum purpureum, Digitaria argyrostahya, Spergula arvensis, Isachne rhabdiana, Pogonatherum paniceum, Eragrostis amabilis and Paspalum srobiculatum are widely used as fodder, since their availability is always there. In addition, the intercropping pattern system has an impact on the state of croop by product in the village. Generally, horticultural crops have a three month, for a fourth and five month planting time is the peak agricultural waste is available. The application of fermentation technology in villages is difficult because the average temperature is below 16 ° C and the humidity is 90% (Wright et al., 2011; BPS, Kec. Sendruo, 2019). Forage productivity is high in the rainy season, but low in the dry season. So far, local breeders have only relied on fresh, dried grass for animal feed.

One of the reasons for the underdevelopment of farms is that the farmer's working hours are more flexible, the value of economic benefits is high, the land ownership is high, the supply of livestock is insufficient, the maintenance distance is long, and the selling price the livestock low. BPS, Kec. Senduro (2019) reports that the growth rate of agricultural agriculture is 94.09% higher that of farm animals is 5.91% lower. The solution to this situation is the collaboration between official village bodies and local breeders. The Ministry of Agriculture has participated fairly in the Regulation of the Minister of Agriculture No. 18 / Permentasn / RC.040 / 4/2018 on guidelines for the development of agricultural land on the basis of farming enterprises. Development of agricultural land that is integrated into the extent of economic improvement and functionally related to the potential of natural resources, socio-cultural conditions, factors of production and the existence of supporting infrastructure. The main objective is to improve the well-being and production of farmers as well as the added value and regional competitiveness for the sustainability of agriculture with a view to sustainable ecological sustainability. The strategic steps that can be taken to pull the integration system are shown in Figure 2 and are explained as follows.

First, farming businesses can provide farmers with the opportunity to harness the potential of Galengan's usable land. The village government can assist in setting rules regulating land areas with a slope> 40% to use an alley cutting pattern with a combination of elephant grass.

Second, at the implementation stage, the village government needs to specialize in the capacity in which technical activities are carried out by Village-Owned Enterprises (BUMDES). BUMDES duties as a supervisory authority, technical maintenance of grass cultivation, registration of members and the need for fertilizer for the operation of community agricultural land. BUMDES offers the opportunity for farmers to work together in the Galengan area to be planted by raising cattle. On the other hand, BUMDES can encourage the younger generation who are indigenous to supervise and maintain the galengan area and alley cropping on communal agricultural land. Young people in the village are able to recognize the natural conditions of Ranu Pani and recognize the name of the person who owns the land.

Third, even though the farmer does not own a cow, the grass can be sold to BUMDES. Then BUMDES took it and invited him to join as a member. Farmers who become members get special behavior, namely subsidizing agricultural production facilities (inputs) such as fertilizers and pesticides from the sale of grass. The input production value can help provide fertilizer to members. There, the price of fertilizer is currently being shifted to the cabbage factory. The catch cropping pattern (potato-cabbage-green onion) is still used to produce high production. The crop land is divided into three areas, the potato crop as the main commodity and an economic source, then the benefits of the cabbage plant are paid for the

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price of fertilizer, while the profit from the leek crop is paid for workers.

Fourth, BUMDES has merged into a professional institution and can cooperate with national parks in traditional use zones for BUMDES cattle sheds. Traditional use zones can be used for the benefit of meeting daily needs for local communities (Syamsu, 2015). In order for the integration system to work, BUMDES creates a livestock sector. The results of grass production from communal agricultural areas can be used by livestock to be used as livestock breeding. High production of livestock grass in Ranu Pani has an average body weight of 677.57 kg / head with an ADG of 1.1 kg / day. On the other hand, the state needs temperature and humidity as well as the need for beef cattle, considering that beef cattle are rarely found.

Fifth, the strategic location of the Ranu Pani area is restricted by three districts with high animal potential, namely the Seduro District, the Poncokusumo District and the Tumpang District. Local breeders still need good breeds of cattle so that meat productivity can be high to meet the demand for meat in the district (Kholifah 2019 and Edi 2020). Then the manure can be sold to village farmers in order to increase BUMDES 'money profit.

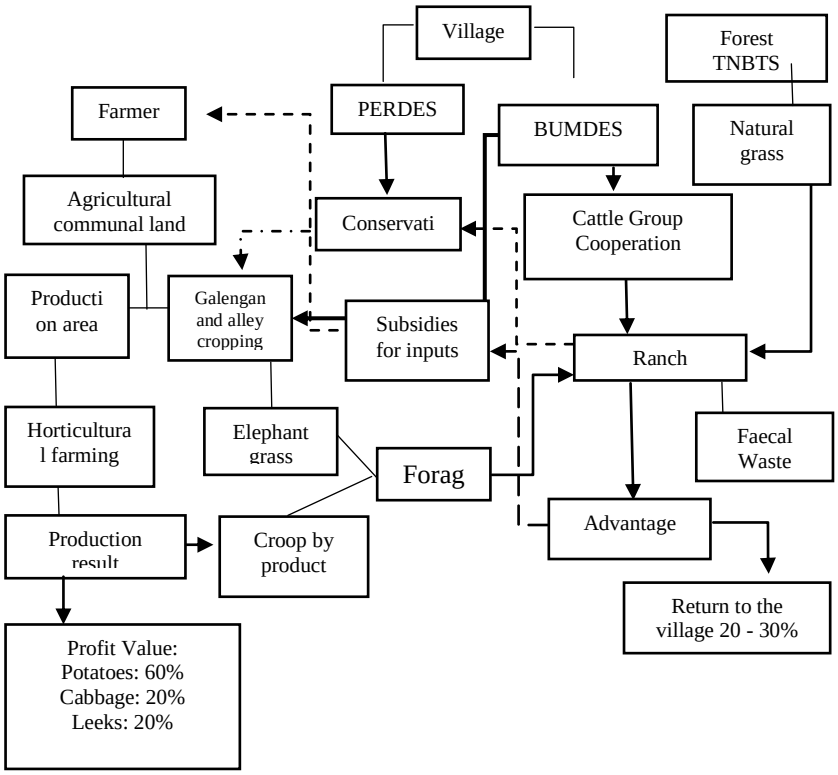

Fig. 2. Schematic of an integration development strategy through BUMDES

VII. Conclusion

Farmers and ranchers must be taken on in a participatory way in realizing nature conservation values through the implementation of village regulations. The integration requires adjustments to the current motivations of farmers as there is an imbalance in economic value that leads to the ranch being abandoned. Management innovations need to be changed, accompanied by local wisdom and environmental wisdom. Strengthening the role of agricultural advisors for every farmer, as well as supporting the government for the livestock sector, so that people can be motivated to become environmentally aware in order to create sustainable values.

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