

Cultural Resilience of Livestock Production in South West Sumba

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Abstract. The sustainability of livestock production systems is influenced by environmental, economic, and social conditions, as well as technological advancements. In Sumba, Indonesia, livestock is not only an economic asset but also a symbol of social status, integral to various traditional rituals. This study aimed to identify local livestock production systems and examine the role of culture in their sustainability across three agroecosystem zones: Kodi, Wewewa, and Loura. The research employed a structured survey methodology based on the Livestock On-Farm Trials method and involving 420 farmers. Results show that Sumba's livestock production systems apply an integrated crop- agro-pastoral, kaliwo agroforestry-livestock system, also rangeland-based, predominating in Loura. Socio-cultural aspects strongly influence livestock practices, with sources of capital stemming from agricultural revenues (dry-land and rice fields), kaliwo agroforestry, family inheritance, livestock barter, profit-sharing arrangements, and surplus animals from wedding dowries and other cultural ritual ceremonies. Feed resources are primarily derived from cultivated dry-land and kaliwo agroforestry. Livestock are primarily raised for cultural, ceremonial, and ritual purposes, including funerals, wedding dowries, and the pasola festival, as well as for income and education support. Preservation of local wisdom and socio-cultural values is crucial to advancing sustainable livestock production in Southwest Sumba.

Keywords: livestock production system, socio-culture, livestock business capital, kaliwo agroforestry, Southwest Sumba

Abstrak. Keberlanjutan sistem produksi peternakan dipengaruhi oleh kondisi lingkungan, ekonomi, sosial, serta perkembangan teknologi. Di Sumba, Indonesia, ternak tidak hanya berfungsi sebagai aset ekonomi, tetapi juga sebagai simbol status sosial yang melekat dalam berbagai ritual adat. Penelitian ini bertujuan untuk mengidentifikasi sistem produksi peternakan lokal dan mengkaji peran budaya dalam keberlanjutannya pada tiga zona agroekosistem, yaitu Kodi, Wewewa, dan Loura. Penelitian menggunakan metode survei terstruktur berdasarkan pendekatan Livestock On-Farm Trials yang melibatkan 420 peternak. Hasil penelitian menunjukkan bahwa sistem produksi peternakan di Sumba menerapkan sistem terintegrasi tanaman–agro-pastoral, sistem agroforestri kaliwo–ternak, serta sistem berbasis padang penggembalaan yang dominan di wilayah Loura. Aspek sosial budaya memiliki pengaruh yang kuat terhadap praktik peternakan, dengan sumber modal usaha yang berasal dari pendapatan pertanian (lahan kering dan sawah), agroforestri kaliwo, warisan keluarga, barter ternak, sistem bagi hasil, serta kelebihan ternak yang diperoleh dari pembayaran belis dan berbagai upacara adat lainnya. Sumber pakan ternak terutama berasal dari lahan kering budidaya dan agroforestri kaliwo. Ternak dipelihara terutama untuk memenuhi kebutuhan budaya, upacara adat, dan ritual, seperti upacara kematian, belis perkawinan, serta festival Pasola, selain juga sebagai sumber pendapatan dan dukungan biaya pendidikan. Pelestarian kearifan lokal dan nilai-nilai sosial budaya menjadi faktor penting dalam mendukung pengembangan sistem produksi peternakan yang berkelanjutan di Kabupaten Sumba Barat Daya.

Kata kunci: sistem produksi peternakan, sosial budaya, modal usaha peternakan, agroforestri kaliwo, Sumba Barat Daya

Introduction

Environmental, social, economic, and technological advancements have a significant impact on animal production systems (Steinfeld et al., 2006). However, socio-cultural aspects are often overlooked. These aspects refer to the

community's perceptions and cultural practices related to livestock, which are closely tied to the sustainability of livestock production systems (Boogaard et al., 2011; Mayala et al., 2019; Cisneros-Saguilán et al., 2024). Integrating economic needs with socio-cultural values in livestock production systems is increasingly

perceived as essential for ensuring sustainability (Nkonki-Mandleni et al., 2019).

Based on the land used, the livestock production systems that have been widely accepted are defined as grazing systems, integrated farming systems, and industrial (or landless) systems (Steinfeld et al., 2006). In Indonesia, smallholder livestock production is commonly integrated with crop farming in various forms, including (1) integrated crop–livestock systems, (2) integrated agro–pastoral–forestry–livestock systems, and (3) integrated crop–agro–pastoral–forestry–livestock systems (Devendra, 2011; Gunawan et al., 2019). These systems are aligned with the principles of Low External Input Sustainable Agriculture (LEISA), optimizing the use of local resources such as crop residues, animal manure, plantation, and forest products to support productivity and ecological balance (Endris Ahmed and Ahmed Bihi, 2019; Elly et al., 2020).

In eastern Indonesia, particularly in Southwest Sumba, both integrated and rangeland-based livestock systems coexist. Historically, rangeland-based systems thrived due to the abundance of grazing lands; however, over the past decade, these systems have declined due to land conversion and pasture degradation, pushing farmers toward more crop-based integration models (Ngongo et al., 2023; Kii et al., 2025). Livestock production in the region remains largely smallholder and part-time, focusing on breeding and fattening of ruminants and non-ruminants for household income, education, and socio-cultural functions (Agus and Widi, 2018; Sujarwanta et al., 2024).

A distinguishing feature of livestock farming in Southwest Sumba is deeply connected with local culture. Livestock are not only valued for their economic utility but are integral to ritual practices, dowry exchanges, traditional festivals, and symbols of social status (Onvlee, 1980; Barokah, 2016). Horses, for example, are central to the pasola festival (a traditional war ritual of

the West and South West Sumba community which is a game of skill, where two groups of horsemen face each other and throw wooden spears at their opponents. This ritual is performed as part of the ritual ceremony and also to celebrate the planting season), while buffaloes, pigs, and chickens are essential for ceremonial offerings such as the urrata (a traditional ceremony of self-cleansing and solving various human problems such as illness, unnatural death, and dispute resolution) and the kedde (a tradition of giving livestock and woven cloth to those holding traditional events or ceremonies, such as weddings, deaths, or others ceremonies). These cultural roles drive animal farm maintenance and influence livestock management decisions, such as ownership structures, feeding practices, and livestock purposes business (Adeyemo and Silas, 2020; Dabasso et al., 2022).

Despite its significance, there is limited empirical documentation on how cultural traditions interact with livestock production systems in various agroecosystem zones of Southwest Sumba, specifically Loura (dry lowlands), Kodi (wet lowland), and Wewewa (wet upland hills). A better understanding of these local systems and cultural dynamics is essential for developing context-specific strategies that align with both ecological conditions and community values (Acebes et al., 2021).

This study aims to (1) identify and characterize the existing livestock production systems in Southwest Sumba, and (2) explore the cultural factors that influence livestock ownership, management, and purpose. Ultimately, the research investigates whether traditional practices and cultural values can contribute to the sustainability and adaptability of livestock systems in the region. Insights from this study are expected to inform development approaches that are not only technically sound but also socially and culturally grounded.

Materials and Methods

Study Area and Time

The study was conducted from November 2022 to July 2023 in Southwest Sumba Regency, East Nusa Tenggara, Indonesia. The region comprises 11 sub-districts and is characterized by hilly topography. Elevation ranges from 0-300 masl in Kodi and Loura and 100-800 masl in Wewewa. The average temperature is 24.2-29.1°C, with 152 rainy days per year (BPS-SBD, 2024). Fourteen villages were selected purposively based on agroecosystem diversity, including land use, vegetation types, and livestock-carrying capacity (Palinkas et al., 2015). Locations were grouped into three agro-ecological zones: dry lowland, wet lowland, and wet upland hills (Figure 1).

Sampling Design

Sampling was conducted in two stages. First, agroecosystem zones were selected using purposive sampling. Then, villages and respondents were chosen using a Cluster Random Sampling technique (Asari et al., 2023). A total of 420 farmers were interviewed: 181 from Kodi, 189 from Wewewa, and 50 from Loura. Key informants in this study were the village heads, livestock officers, and traditional

leaders, who were also involved through interviews and FGDs (Kii et al., 2025).

Observed Variables

The study observed variables across four domains:

1. Farmer characteristics: age, education, family size, income.
2. Resource use: land ownership, crops, plantations, and agroforestry practices.
3. Livestock system: species kept, population, management, and constraints (feed, health, capital).
4. Cultural practices: traditional roles of livestock, rituals, and customary ownership norms.

Research Design and Protocol

This study applied a Livestock On-Farm Trials (LOFTS) approach to assess livestock production systems under farmers' real conditions (Sodiq and Susanto, 2011; Kii et al., 2025). The protocols involved system identification, stakeholder interviews, and triangulation of qualitative and quantitative data. The LOFTS method was chosen to allow a holistic understanding of production types, management practices, and influencing socio-cultural and ecological factors.



Figure 1. Administrative area of Southwest Sumba Regency: A. Karuni, B. Ramadan, C. Weepangali, D. Tanjung Karoso, E. Radaloko, F. Tana Mete, G. Panenggo Ede, H. Kori, I. Bukambero, J. Kalembo Kanaika, K. Kalembo Weri, L. Kalembo Daramane, M. Lele Maya, N. Weepatando, O. Weepaboba (BPS-SBD, 2024)

Data Collection and Validation

Data Collection methods included structured interviews, participatory observation, and FGDs. Tools ensured data triangulation and contextual validation. Data were collected using validated and pre-tested instruments in Kalembe Weri Village (November 2022), involving 45 participants.

Data Analysis

Descriptive statistics were used to summarize quantitative data, followed by cross-tabulation and Chi-square analysis to explore variable associations, using IBM SPSS Statistics 25. Qualitative data were analyzed through the Miles and Huberman model: data reduction, display, and conclusion drawing (Miles and Huberman, 1994). Previously established methods were adopted with minor adaptations relevant to the local cultural context (Kii et al., 2025).

Results and Discussion

Livestock Production Systems in Three Agroecosystem Zones of Southwest Sumba

The average age of farmers is 47 years, with 56% having either never attended school or not completed primary education. Household size typically ranges from 6 to 7 members, with 2-3 family members involved in fieldwork and another 2-3 still in school. Labor is predominantly sourced from family members, with minimal use of hired labor. Monthly household income is low, with 59.88% earning between IDR 250,000-500,000 and 21% earning less than IDR 250,000. Land and livestock ownership are generally limited, and technological adoption remains minimal.

Characteristics such as small herd sizes, reliance on family labor, low technological inputs, and low returns align with the defining features of traditional integrated livestock production systems (Rangel et al., 2020; Bottani-

Claros et al., 2022). Further classification of these systems, based on cultivated plant types and land use, suggests the presence of two main system types in the study area: 1) Integrated Crop- Agro-Pastoral (dry-land farming), Kaliwo Agroforestry-Livestock System (Kodi and Wewewa region); 2) Integrated Crop- Agro-Pastoral (dry-land farming), Kaliwo Agroforestry, Rangeland-Livestock System (Loura region).

The characteristics of the livestock production system in Southwest Sumba Regency can be described in Table 1.

Integrated Crop-Agro-Pastoral, Kaliwo Agroforestry-Livestock System (Kodi and Wewewa)

The dominant system in Kodi and Wewewa is the Integrated Crop-Agro-pastoral-kaliwo Agroforestry-Livestock System (ICAALS). This model involves the spatial and functional integration of livestock with multiple land use systems, including irrigated and rain-fed rice fields, dry-land farms, *kaliwo* agroforestry, and areas of grazing. Farmers optimize the integrated system by utilizing crop residues (e.g., maize stalks, rice straw) and grasses as feed, especially post-harvest, and feeding livestock with tree foliage such as *Leucaena leucocephala* (lamtoro), *Gliricidia sepium* (gamal), and *Calliandra calothyrsus*, which grow as shade trees or live fences in *kaliwo* agroforestry systems (Devendra, 2011; Kii et al., 2025). In addition, livestock, particularly pigs and chickens, are raised in small-scale household units and fed with crop residues, kitchen waste, and forage gathered from dry-land farms and *kaliwo* agroforestry. Farmers also provide additional fodder for goats from banana stems, jackfruit leaves, and taro leaves. These forages enhance animal nutrition and soil quality while improving carbon and nitrogen retention in the agroecosystem (Singh et al., 2023; Franzluebbbers and Hendrickson, 2024).

Table 1. The characteristics of the livestock production system in Southwest Sumba Regency

a.	Agricultural-Livestock Production System	Characteristics of the System (wet upland hills -Wewewa Agroecosystem Zone, wet lowland - Kodi Agroecosystem Zone, and dry lowland-Loura Agroecosystem Zone.
	Main Classification	: Traditional Livestock System
1	Type (classification) Sub-type	: <ul style="list-style-type: none"> • Crop-based; • Agro-pastoral farming (dry-land farming) based • <i>Kaliwo</i> agroforestry-based • Rangeland-based in Loura
2	Integrated farming and livestock systems	: <ul style="list-style-type: none"> • Integrated Crop-Agro-pastoral-<i>Kaliwo</i> Agroforestry-Livestock Systems (ICAALS) • Integrated Crop-Agro-pastoral-<i>Kaliwo</i> Agroforestry-Rangeland-based-Livestock Systems (ICAARLS) in Loura
3	Livestock ownership	: <ul style="list-style-type: none"> • Limited livestock ownership (smallholders) with the number of livestock (<10 heads) in Kodi and Wewewa • Livestock ownership in a limited number (smallholders) with livestock > 10 in Loura
4	Availability of land	: <ul style="list-style-type: none"> • Rice fields, dry-land farm, <i>kaliwo</i> agroforestry, grazing area, and marginal land. • Mini-ranch in Loura
5	Availability of labor	: <ul style="list-style-type: none"> • Family labor. • Labor payment is carried out during planting and harvesting in the rice field.
6	Availability of capital	: <ul style="list-style-type: none"> • Source of business capital of rice fields, dry-land farm, and <i>kaliwo</i> agroforestry comes from the sale of agricultural and livestock products (for herbicides and inorganic fertilizers). • Source of business capital for livestock comes from agricultural revenues (dry-land farm and rice fields), <i>kaliwo</i> agroforestry, family inheritance, livestock barter, profit-sharing arrangements, and surplus animals from wedding dowries and other cultural ritual ceremonies.
7	Production orientation/goals	: Daily family needs, education, and cultural ceremonies.
8	Main Production	: <ul style="list-style-type: none"> • Dry-land farm: corn, paddy, cassava, and banana. • <i>Kaliwo</i> agroforestry: coconut, coffee, cashew, candlenut, and other plantation commodities, including wood. • Livestock: local chickens, pigs, goats.
b	Livestock Production Subsystem	
1	Adaptation of livestock breeds	: Sumba ongole, Sumba buffalo, sandalwood pony horses, Sumba pigs, crossbred Sumba pigs, Kacang goats and crossbred Etawa and Kacang goats, local chickens and ducks.
2	Productivities	: Low reproductive and productivity.
3	Functions in the system	: Household needs, education, and customary rituals.
4	Management of Pens	: Pens are made of local materials, located under the house or around the house.
5	Feeding system	: Feed sources from rice fields, dry-land farm, <i>kaliwo</i> agroforestry, and grazing in a mini-ranch.
6	Interaction with crop production	: Livestock feed sources rice fields, dry-land farm, <i>kaliwo</i> agroforestry, pasture, and manure are utilized in rice fields, dry-land farm, and <i>kaliwo</i> agroforestry.
7	Constraints: feed	: Low quality and limited availability of feed during the dry season, lack of knowledge about feed technology.
8	Constraints: health	: Surra, bloat, diarrhea, hog cholera, African Swine Fever, classical avian flu

Livestock manure is actively recycled in the system. In these zones, manure is used to fertilize horticultural crops (e.g., chili, tomatoes, beans), rice fields, and dry-land farms. In the wet upland hills of Wewewa, farmers dig channels that direct liquid manure from pens to surrounding agroforestry plots, dry-land farms, and rice fields during the rainy season, creating a natural fertigation system. The grazing of livestock in fallow fields or post-harvest rice fields and dry-land farms further improves nutrient cycling and soil fertility (Simões et al., 2023; Sime et al., 2025). This integration promotes sustainability by reducing input costs (feed and fertilizer), enhancing environmental resilience, increasing food security through diversified production, and supporting climate-smart agriculture by reducing greenhouse gas emissions (Russelle et al., 2007; Lehmann et al., 2020). However, the limited land size and high population density, particularly in Wewewa and Kodi, restrict herd size and mobility.

Integrated Crop–Agro-Pastoral, Kaliwo Agroforestry and Rangeland-Based Livestock System (Loura)

In Loura, farmers practice the Integrated Crop- Agro-Pastoral, Kaliwo Agroforestry and Rangeland-Based Livestock System (ICAARLS), with a rangeland-based livestock system predominantly practiced in this region (Sodiq, 2021). The system is mainly applied to cattle, buffalo, horses, and goats, especially in the villages of Karuni, Ramadana, Letekonda, South Letekonda, and Weepangali. However, in the last few years, farmers have applied three management strategies, such as (1) *Free-range grazing in mini-ranches*. Large areas such as the Karuni (800 ha) and Lendongara mini-ranch (500 ha) serve as communal pastures. Animals are released for extended periods, and farmers conduct monthly inspections to assess livestock condition, reproduction, and to repair fences. Livestock graze on native grasses with minimal

supplementation. The system is low-input but vulnerable to seasonal feed shortages, especially during the dry season. Water availability and veterinary support are also limited in these areas, affecting herd health and productivity (Endris Ahmed and Ahmed Bihi, 2019). (2) *Day-grazing with night confinement*. Livestock graze in dry-land farms and rice fields during the day, and are penned or tethered at night near farmers' homes. (3) *Free-roaming backyard livestock*. Chickens and ducks are allowed to roam freely, with supplementary feeding provided in the morning and evening. Other animals, such as pigs, goats, horses, and cattle, are also released during the dry season but confined at night. Although this system offers the benefit of low labor demand and utilizes extensive land resources, it faces challenges, including seasonal feed shortages, water scarcity, disease outbreaks (e.g., Surra, African Swine Fever, classical avian flu), and poor infrastructure (Dewi et al., 2020; Duguma and Janssens, 2021).

Livestock and Its Relation to the Socio-Cultural Aspects of Southwest Sumba Society

The socio-cultural life of the Southwest Sumba community related to livestock is identified through livestock population, sources of livestock business capital, feed management, livestock farming purposes, and livestock utilization.

Livestock Population and Sources of Livestock Business Capital

This section presents information about the livestock population raised by respondents in 3 agroecosystem zones (Table 2) and identifies the sources of Livestock Business Capital (Table 3).

The results showed substantial variation in livestock populations across different agroecosystem zones (Table 2). Sumba Ongole cattle, Sumba buffalo, horses, local chickens, and ducks were dominant in the predominantly rangeland-based agroecosystem zone of Loura,

Table 2. The types and number of livestock kept by respondents in Southwest Sumba Regency

Livestock Species	Kodi Agroecosystem zone		Wewewa Agroecosystem zone		Loura Agroecosystem zone		South West Sumba zone	
	Sub Total	Number of Animals/ Respondent	Sub Total	Number of Animals/ Respondent	Sub Total	Number of Animals/ Respondent	Total	Number of Animals/ Respondent
	Sumba Ongole Cattle	8	0.04	5	0.03	43	0.86	56
Sumba Buflalo	44	0.24	56	0.3	25	0.5	125	0.3
Horse	30	0.17	8	0.04	17	0.34	55	0.13
Goat	129	0.71	137	0.72	157	3.14	423	1.01
Pig	149	0.82	388	2.05	117	2.34	654	1.56
Local Chicken	1481	8.18	1080	5.71	758	15.16	3319	7.9
Local Duck	80	0.44	144	0.76	217	4.34	441	1.05
Total	1921	10.61	1818	9.62	1334	26.68	5073	12.08

while pig populations were relatively similar in the ICAALS Wewewa and ICAARLS-Loura zones, and slightly lower in ICAALS-Kodi. Goats were evenly distributed across zones but slightly more prevalent in Loura. Ongole cattle and Sumba horses were present in smaller numbers across all agroecosystem zones, whereas local chickens were found in significantly higher numbers across all zones. The most commonly raised livestock among respondents included local chickens, pigs, ducks, and goats.

The concentration of large ruminants in the predominantly rangeland-based Loura zone can be attributed to two interrelated factors. First, this zone provides greater land availability and space for mobility, supporting semi-extensive grazing systems that align with traditional open-range herding practices. Second, this area is predominantly inhabited by indigenous communities who strongly adhere to customary law, including the maintenance of two communal mini-ranches for livestock grazing. In contrast, the ICAALS zones in Wewewa and Kodi, characterized by higher population density and more intensive agriculture, a higher variety of plants in *kaliwo* agroforestry, tend to favor smaller livestock such as pigs and chickens, which are easier to manage and reproduce more quickly.

The overall limited number of livestock is primarily due to low reproductive performance and high mortality rates. This study found that calving or birthing intervals were long for buffalo (46%), cattle (53%), and horses (46%), indicating low reproductive rates. Mortality rates were also notably high: 4.6% for cattle, 13.7% for horses, 6.2% for goats, and 28.7% for pigs. Pigs exhibited the highest mortality rate, mainly due to factors like inadequate feed quantity and quality, as well as disease outbreaks, like African Swine Fever (Tadesse et al. 2021). Livestock population dynamics are influenced by multiple factors, including reproductive and productivity rates (Sodiq et al., 2017; Wea et al., 2020; Harmoko et al., 2021; Arifin et al., 2022; Ndona et al., 2024).

Furthermore, the limited livestock population is driven by the frequent sale or use of productive animals to meet household needs (especially for income, education) and customary ritual expenses. This practice can negatively affect the genetic quality of local livestock. The overall livestock population in this region is also shaped by farmer characteristics (e.g., age, education, farming experience, family size), motivations, and livestock management practices, including breeding, feeding, reproduction, and health care (Sodiq et al., 2017; Ikun, 2018).

Table 3. The Sources of Livestock Business Capital in Southwest Sumba

Sources of Livestock Business Capital	Agroecosystem Zone (number of respondents)							
	Kodi	%	Wewewa	%	Loura	%	Total	%
Livestock sales and inherited animals, often resulting from traditional bartering practices, for example, exchanging dogs for pigs, or pigs for horses or buffalo, form a key part of capital accumulation in livestock farming	13	26.0	51	53.7	11	32.4	75	41.9
Borrowing from neighbours or relatives through the <i>tau ngaa-tau ruta</i> profit-sharing system, or using leftover resources from traditional ceremonies	10	20.0	22	23.2	8	23.5	40	22.3
Government aid	0	0.0	4	4.2	1	2.9	5	2.8
Income from selling agricultural and <i>kaliwo</i> agroforestry products, wage-based labor (e.g., weaving, handicraft, construction work), and remittances from migrant family members	24	48.0	18	18.9	12	35.3	54	30.2
Mix sources	3	6.0	0	0.0	2	5.9	5	2.8
Total	50		95		34		179	

This section identifies the sources of livestock business capital in Southwest Sumba (Table 3). The development and sustainability of livestock production in Southwest Sumba are closely linked to the availability and structure of business capital among smallholder farmers. The findings indicate that most livestock owners rely on animal sales and inherited stock, often obtained through traditional bartering practices, for example, exchanging dogs for pigs or pigs for horses or buffalo, which form a key component of capital accumulation in livestock farming. In addition, capital is supplemented by income from the sale of agricultural and *kaliwo* agroforestry products, wage-based labor (e.g., weaving, handicrafts, construction works), and remittances from migrant family members.

A potentially important source of capital is traditional socio-cultural capital (22.3%), with farmers reporting that their livestock business capital is often obtained through borrowing from neighbours or relatives under the *tau ngaa-tau ruta* profit-sharing system, or through leftover resources from traditional ceremonies. These social mechanisms, such as *tau ngaa* (primarily for pigs) and *tau ruta* (for goats, horses, and buffalo), involve lending livestock between relatives or neighbours with agreed-upon terms for profit sharing. These systems are

deeply rooted in local customs and function as informal financial safety nets, often preferred over formal financial institutions (Guirking, 2008).

Access to formal credit remains limited, largely due to a lack of awareness among farmers of small- and medium-enterprise credit programs provided by banks or other formal institutions. Farmers tend to build their livestock gradually through inheritance, informal profit-sharing arrangements, surplus resources from traditional events, and the proceeds from seasonal agricultural sales. This reliance on informal capital sources reflects both a cautious approach to financial risk and a cultural preference for communal interdependence rather than individual financial ventures (Desmiwati et al., 2021; Datta and Behera, 2024).

The dual role of livestock as both cultural and economic assets further reinforces conservation-oriented herd management, with minimal reliance on cash outflows for herd expansion. Therefore, any interventions aimed at enhancing livestock production must consider these socio-cultural dynamics and seek ways to bridge traditional and formal capital systems in a culturally sensitive and locally adaptive manner

(Guirkinger, 2008; Kresna, 2021; Gómez et al., 2022).

Feed management related to the availability and utilization of feed sourced from dry-land farms, rice fields, and kaliwo agroforestry

The sustainability of livestock production in Southwest Sumba is highly dependent on the availability and quality of animal feed, which is shaped by the region's diverse agroecosystem zones. This study found that farmers employ flexible and adaptive feeding systems that make use of harvested rice fields, dryland farms, fallow land, *kaliwo* agroforestry areas, and communal grazing lands. The Loura zone is characterized by an Integrated Crop-Agro-Pastoral, *Kaliwo* Agroforestry, and Rangeland-Based Livestock System, whereas the Wewewa and Kodi zones feature Integrated Crop-Agro-Pastoral and *Kaliwo* Agroforestry-Livestock Systems.

Ruminant feed primarily consists of local grasses and various types of forage, including *Leucaena (lamtoro)*, *Gliricidia (gamal)*, *Calliandra*, jackfruit leaves, white teak leaves, banana leaves, corn stalks and leaves, and grasses found around homesteads, roadsides, rice fields, and harvested dryland farms (Sutaryono, 2021; Achmad et al., 2022). Farmers who integrate *kaliwo* agroforestry benefit from more diverse sources of biomass and vegetation, enabling more stable feed availability throughout the year. In contrast, the rangeland-based zones rely on extensive grazing of natural grasslands, which are highly susceptible to seasonal fluctuations. During the dry season, feed shortages are common, forcing farmers to depend on communal grazing areas or to reduce livestock numbers.

Integrating agriculture and livestock systems can help mitigate seasonal feed shortages. Farmers utilize forage from *kaliwo* agroforestry and agricultural by-products such as rice straw, corn stalks, and legume waste (Sodiq, 2010). His strategy not only alleviates feed scarcity and reduces feeding costs, but also lowers labor

demands, allowing farmers to expand their livestock operations (Sodiq, 2010; Sodiq et al., 2017). The traditional *kaliwo* agroforestry system exemplifies a synergistic land-use model in which tree-based systems support livestock by providing forage and regulating the microclimate, while livestock contribute to nutrient cycling through manure deposition. These reciprocal interactions enhance system resilience and provide a valuable model for sustainable intensification elsewhere in Sumba.

Despite these advantages, feed availability remains a limiting factor for livestock expansion, particularly in areas facing land pressure or insecure land tenure, which restricts the cultivation of forage crops. This underscores the need for policies and extension services that promote forage cultivation, silvopastoral practices, and equitable access to land as integral components of sustainable livestock development strategies (Herrero et al., 2023; Low et al., 2023)

Cultural Drivers of Livestock Ownership and Purpose

The culture of communities that rely on livestock to fulfill economic, educational, and ritual needs positions livestock as an integral part of their socio-cultural life. To understand the relationship between the livestock production system and the socio-cultural life of the Sumba community, it is essential first to examine the underlying purposes of livestock keeping. Based on the findings of this study, the purposes of livestock raising in Sumba are presented in Table 4.

Based on Table 4, people in Southwest Sumba raise livestock to meet daily needs, support customary rituals, and finance children's education. These data indicate that the majority of farmers raise animals for multiple purposes (71%). Only 9% of respondents stated that they raise livestock solely for traditional ritual purposes. However, the results of the focus group discussions (FGDs) revealed that,

particularly in rural villages, people tend to prioritize customary rituals over economic and educational needs.

The primary purpose of livestock farming is to enhance social status, especially through preparation for traditional events such as *saiso* and *woleka* (ceremonies expressing respect and gratitude to ancestors), as well as funerals and dowry payments. Over the past two decades, however, the purpose of livestock keeping has gradually shifted. While traditional and social functions remain important, increasing emphasis is now placed on meeting daily household needs and supporting children's education

Around 80% of livestock farmers in Southwest Sumba stated that the highest livestock sales rates occur in the Kodi (93%) and Laura (89%) areas. Figure 2 illustrates the sales levels of various types of livestock in Southwest Sumba.

Farmers in Kodi reported that chickens and goats were the two most frequently sold types of livestock. Observations at the main district market showed that most sellers of chickens and ducks were farmers or collectors from the Kodi area. In contrast, Farmers in Wewewa sold more pigs (28%) and chickens (27%), while those in Laura predominantly sold chickens, pigs, and goats.

Table 4. The Purpose of Livestock Farming

The Purpose	Agroecosystem Zones (number of respondents)							
	Kodi	%	Wewewa	%	Loura	%	Total	%
Customary rituals	15	10	14	8	5	10	34	9
Households need	18	12	19	11	5	10	42	12
Education	11	7	15	9	5	10	31	8
Mix	103	70	121	72	34	69	258	71
Total	147		169		49		365	

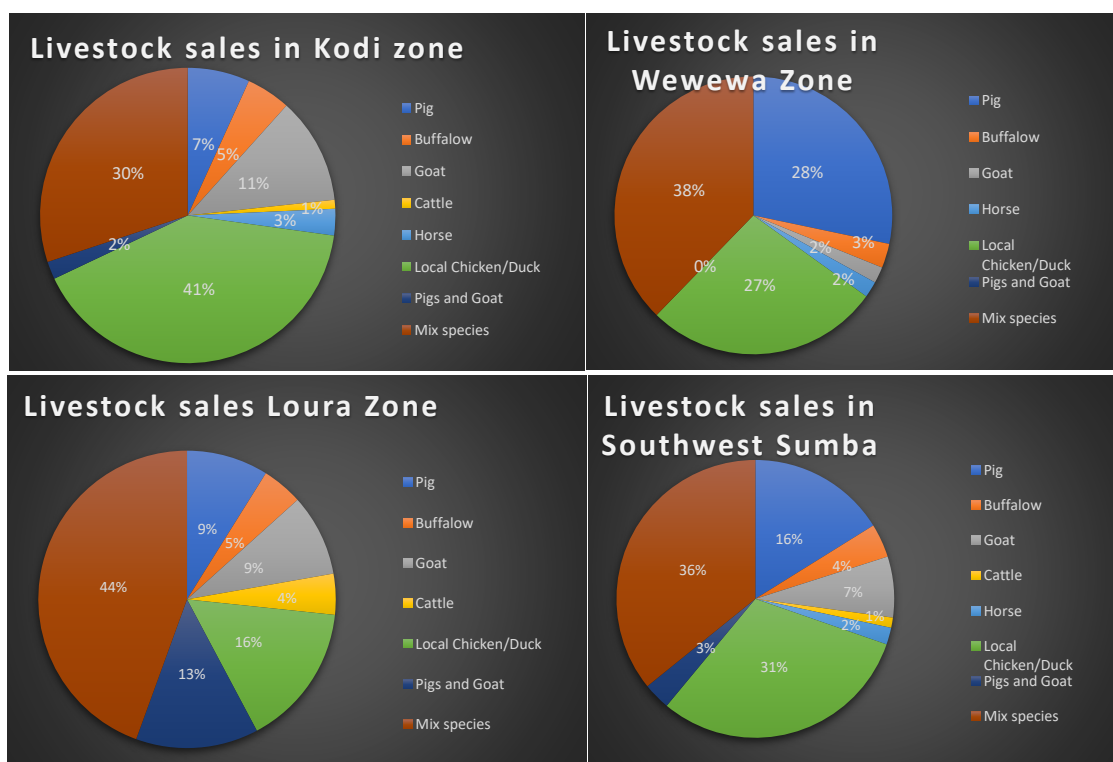


Figure 2. Types and percentages of livestock sold by livestock farmers during 2022
 Livestock sales typically occur during the planting season (October-December) and during the school enrolment period (May–August), when households need additional income.

Moreover, based on observations and focus group discussions (FGDs), the volume of livestock sales and utilization (particularly buffaloes, pigs, and chickens) tends to increase during the dry season (April-November), coinciding with the occurrence of traditional rituals such as *urrata* (a traditional ceremony of self-cleansing and solving various human problems such as illness, unnatural death, and dispute resolution) and *kedde* (a tradition of giving livestock and woven cloth to those holding traditional events or ceremonies, such as weddings, deaths, or others ceremonies)(Keray et al., 2024).

These traditional rituals require sacrificial offerings in the form of livestock such as chickens, pigs, horses, and buffalo. In events such as *saiso*, a ritual conducted for various purposes including conflict resolution, purification after perceived sins, spiritual safety for deceased family members, healing for the sick, and sanctification of rice, corn, or burnt houses, dozens to hundreds of local chickens may be required, depending on the duration of the ritual. Typically, 5 to 10 chickens are sacrificed per day, and *saiso* ceremonies can last 5 to 10 days. The chicken's meat was then served as food for attending guests. In addition, horses are central to *the Pasola* festival (a traditional war ritual of the West and South West Sumba community which is a game of skill, where two groups of horsemen face each other and throw wooden spears at their opponents. This ritual is performed as part of the ritual ceremony and also to celebrate the planting season)

In the Loura community, pigs are considered a greater social value than buffaloes, cattle, or other livestock, especially in funeral rituals. During mourning and funeral ceremonies, 10 to 30 pigs may be sacrificed, depending on the family's financial capacity and livestock availability. Farmers in Wewewa often serve as pig suppliers for the Loura community. These animals are usually contributed by relatives or family members as a form of condolence.

However, the livestock is expected to be reciprocated by the recipient at a similar or future traditional event.

In the Kodi and Wewewa communities, buffaloes are regarded as having the highest social value. During funerals or *woleka* rituals, it is common for families to slaughter between 2 and 10 buffaloes. In addition, horses and buffalo are used as part of the traditional dowry system in Sumba. The number of animals given as dowry typically ranges from 10 to 15, but can be higher for families with elevated social status. Goats are not commonly used in traditional rituals in Southwest Sumba. However, the sale of goats (7%) generally increases ahead of Eid al-Adha, as they are often shipped to other islands, including Sumbawa and Sulawesi.

The socio-cultural role of livestock in Sumba distinguishes it from many other regions in Indonesia, where commercial and subsistence motives tend to be more dominant, where livestock function not only as a source of income but also as a form of cultural capital (Keray et al., 2024). However, our findings suggest a stronger alignment in Sumba between livestock type and cultural function. For instance, pigs and buffaloes are often retained for extended periods specifically for ritual use, rather than being sold frequently in the market (Widi et al., 2014; Randu and Hartono, 2018; Mayala et al., 2019)

This culturally driven livestock management system presents both strengths and limitations. On the one hand, it supports social cohesion and cultural continuity. On the other hand, it may limit economic optimization, as animals are often withheld from sale even in times of financial need. For example, many households keep large ruminants not for commercial purposes but as long-term savings for ceremonial rituals or symbols of social status. Cattle sales are typically delayed unless driven by urgent needs or ceremonial obligations. This finding describes livestock in Southwest Sumba

as socio-symbolic assets (Marsiah et al., 2019; Ishak et al., 2020; Kresna, 2021)

Moreover, the emphasis on ritual use means that herd management is not always oriented toward productivity or efficiency. This is reflected in the low reproductive performance and irregular marketing practices observed across all three agroecosystem zones. In Sumba, the cultural orientation helps explain why some farmers continue to raise low-productivity animals with limited commercial output; economic profit is secondary to cultural legitimacy (Bremer et al., 2022).

The cultural integration of livestock is also evident in the way knowledge is transmitted across generations. Herding practices are passed down through oral traditions and daily involvement in animal care, rather than through formal education. This process reinforces a cyclical relationship in which livestock knowledge and cultural identity are co-produced, contributing to what may be termed cultural resilience in livestock management (Ishak et al., 2020; Hilmiasi et al., 2024).

Challenges and Implications for Sustainable Livestock Development

Despite the cultural significance and ecological diversity of livestock systems in Southwest Sumba, several constraints persist. Feed scarcity during the dry season, limited access to veterinary services, low reproductive rates, and a lack of capital investment all hinder productivity. In agroforestry and grazing zones, farmers face increasing competition over land use, as expansion of cash crop activities threatens traditional grazing zones.

Moreover, the cultural retention of livestock for ceremonial use can create tension with market-driven approaches promoted by development programs. External interventions that focus solely on productivity, breed improvement, or commercialization may clash with local priorities unless cultural dimensions are acknowledged. This was demonstrated in a

government initiative promoting fattening programs, which had low adoption rates due to misalignment with community values and the timing of rituals.

Therefore, livestock development strategies in Sumba should be culturally contextualized. Programs need to recognize the symbolic value of livestock while promoting innovations that enhance animal health, feed availability, and reproductive efficiency. Strengthening community-based breeding and health services, promoting drought-resilient fodder crops, and developing participatory extension models can bridge tradition and innovation without displacing local identity (Adeyemo and Silas, 2020; Octavia et al., 2022).

Therefore, the livestock population and distribution in Sumba are shaped not only by agroecosystem conditions but also by deep-rooted cultural imperatives. Understanding this dual influence is crucial for designing sustainable livestock interventions that respect local values while addressing productivity and welfare. Future development programs must integrate cultural insights to avoid mismatches between external interventions and local realities (He and Ahmed, 2022; Bilotto et al., 2024)

Conclusions

This study identifies that livestock production in Southwest Sumba is characterized by integrated crop-livestock and rangeland-based systems that vary across agroecosystem zones. It further demonstrates that socio-cultural factors play a decisive role in shaping livestock ownership, management decisions, and production objectives, thereby directly influencing the sustainability of these systems. The findings provide empirical evidence that livestock sustainability in Southwest Sumba is not driven solely by biophysical or economic factors, but is strongly anchored in cultural capital, including traditional mechanisms of resource mobilization, feed use strategies, and culturally defined livestock functions. By

applying a LOFTS-based, multi-zone comparative approach, this study fills an important knowledge gap on how socio-cultural dynamics interact with livestock production systems in Eastern Indonesia.

From a practical and policy perspective, livestock development strategies in Southwest Sumba should prioritize culturally sensitive interventions, including the strengthening of integrated crop-livestock-agroforestry systems, the promotion of drought-resilient local feed resources, and community-based livestock support services. Development programs and extension services that recognize and incorporate local cultural values are more likely to enhance farmer participation, system resilience, and long-term sustainability. Future research should examine livestock productivity and reproductive performance, value chain dynamics, and the impacts of socio-cultural change on the sustainability of livestock systems under evolving economic and climatic conditions.

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