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Realizing the Potential of Eastern Uganda's Smallholder Dairy Sector through Participatory Evaluation

Sushil Paudyal

Department of Animal Science, Texas A&M University, College Station, TX 77843, USA; sushilpaudyal@tamu.edu

Abstract: This study explored smallholder dairy production and cattle welfare in Eastern Uganda using mixed methods evaluation approaches. A focus group of 17 members performed a SWOT analysis of local farms, identifying strengths like available land, forage, and community support but weaknesses including disease, parasites, and lack of technologies. Field assessments of 12 farms using a modified Welfare Quality® protocol revealed 25% had inadequate body condition; 33% lacked adequate water access; 50% provided comfortable housing; and 42% had animals with health issues. Six recommendations were formulated to address needs via training, veterinary services access, data systems, finance, milk market development, and pasture improvements. Though struggling with resource constraints and animal health, eastern Uganda's favorable climate and community present opportunities to enhance productivity and welfare with targeted actions like skills development and access to technologies. However, external inputs require alignment with smallholder realities. Findings detail current conditions while highlighting local perspectives to guide appropriate innovations sensitive to economic limitations and values-based motives. Collaborating with producers to incrementally elevate management can improve livelihoods and animal well-being.

Keywords: participatory rural appraisal; welfare assessment; multistage mixed methods evaluation; SWOT; dairy cooperatives

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1. Introduction

Dairy production is an important sector in the agricultural economy of the East African country Uganda, contributing to the livelihoods and food security of millions of people [1]. The dairy industry in eastern Uganda largely consists of small subsistence livestock producers forming communities to be organized as user groups and cooperatives. The marketing of untreated milk is popular in Uganda and it is estimated that 72.1% of milk is sold through formal channels, including cooperative purchases and milk collection centers, while 27.9% of milk is sold through informal channels [2]. Uganda's dairy industry is steadily growing at an average rate of 7–10% each year [3,4]. Annual milk production increased from 2.08 billion liters in 2015 to 3.85 billion liters in 2023 [5]. This followed a similar increase from 1.5 million tons in 2013 to 2.04 million tons in 2018, an increase of 35.6% [6]. However, this growth in milk production has contributed to an increase in the number of dairy animals and not an increase in productivity per animal [7]. Because of the uneven distribution of milk production, Uganda's eastern region is a milk deficient region whereas the western region is a milk surplus region.

Smallholder dairy production in this region is characterized by farmers who own small herds of 1 to 10 cows, representing local and crossbred cattle. The cattle are raised mostly by grazing on about 60 acres with either a fully or partially fenced perimeter. Common forages available for animal feeding include Napier grass (*Pennisetum purpureum*), Calliandra (*Calliandra calothyrus*), Rhodes grass (*Chloris gayana*), and Mulato (*Brachiaria* sp.) The average daily milk production per cow is 10 L, which drops by 40% in the dry season. The transportation of raw milk to collection centers is mostly carried out using motorbikes traveling 0.5 to 20 km from the farm. A majority of the milk marketing happens

through local milk collection cooperatives, whereas a large milk volume still goes through informal channels [8]. Farmers registered in a cooperative commonly receive lower pay due to deductions for operation costs and capital investments by the cooperative, contributing to less milk entering the formal market. However, services and support systems available through the cooperatives (e.g., milk marketing, extension services, training) attract farmers to sell milk through the cooperatives rather than informal channels [9].

The Ugandan dairy industry faces many challenges, such as low productivity, poor milk quality, and inadequate infrastructure. Management and husbandry not only impact production and profitability, but also influence the welfare of dairy cows because of the impact on various aspects of their performance, wellbeing, and health condition. Dairy cow welfare is also a matter of ethical concern, as cows are sentient beings that can experience pain, suffering, and positive emotions. Therefore, assessment of farms from their production perspective should be conducted in association with the welfare aspects of dairy cows.

The aim of this study is to explore the dairy management systems and dairy cattle welfare issues in eastern Uganda, a region that accounts for 21% of the national milk production [5]. Eastern Uganda is characterized by a diverse agroecological and socio-economic context, with different types of dairy systems and practices. While the western region contributes the majority of milk production with 44% of total milk produced, the eastern region has the highest number of livestock-keeping households [10]. Despite having fewer cattle, the western region's focus on exotic and cross-bred cattle and better pasture management and agroecological conditions contribute to its higher milk production. This paper will discuss field observations on the current status and trends of dairy production in a district within eastern Uganda, as well as the major welfare problems faced by dairy cows in this region. The paper will also identify the gaps in knowledge and research on dairy cow welfare in Eastern Uganda and suggest some recommendations for future interventions and studies. We use a mixed methods approach, using a participatory rural appraisal [11] and on-farm welfare assessment [12]. The study will contribute to the understanding of the dairy sector and its challenges in eastern Uganda and provide insights into the improvement of the welfare of dairy cows and the sustainability of dairy production in this region.

2. Materials and Methods

A participatory multistage mixed methods evaluation [13] was conducted among the dairy farmers in the Kamuli district in Eastern Uganda between May and June 2023. The mixed methods research integrates quantitative and qualitative evaluation along with heavy participation from the community [14]. The assessment included guided focus group discussion as the first stage followed by on-farm visits to 12 representative dairy farms as the second stage evaluation while receiving input from the participants on both stages. The findings from field observations were collected on site and the study site was identified based on recommendations from the dairy cooperative (Balawali dairy cooperative). The evaluation included a participatory meeting to discuss critical issues for dairy farming followed by a focus group discussion identifying a SWOT analysis of the farming system and a participatory meeting to formulate recommendations specific to the area. Finally, the evaluation included an in-person visual farm evaluation of 12 representative dairy farms by the author. The farms were chosen based on purposive sampling to represent diversity in farming systems and methods while being constrained by the time available for farm visits. This on-farm assessment was based on a modified Welfare Quality® evaluation protocol adapted for extensive dairy farming systems that evaluated animal feeding, drinking, housing, and animal health. The study was determined to be exempt by the IRB review committee at Texas A&M with IRB number (IRB2023-0633M) for the activities presented in this study.

2.1. Study Location

The research was conducted in the Kamuli district, eastern Uganda, among livestock farmers who are members of the Balawoli Kyebaja Tobona dairy cooperative. Established in 1960 [15], this cooperative operates under the umbrella of the Busoga Dairy Cooperative Union. Despite facing organizational challenges that led to a temporary slowdown, the cooperative was revitalized in 2014 with support from the East Africa Dairy Development (EADD) project, which was implemented by Heifer International. Although the project concluded in 2018, the cooperative continues its operations. The cooperative is governed by an eight-member board and has a dedicated management team responsible for day-to-day activities. With a total membership of 795 individuals, including 35% female members, the organization manages three milk cooling centers. Two of these centers are located within Kamuli, serving as the main branch where milk from cooperative members is consolidated and chilled before transportation to other cooling centers. Farmers in the cooperative travel 0.5 to 20 km with their milk. There is another cooling center in Jinja, which is 63 km south of the region. Currently, the cooperative operates below its full capacity, collecting 2200 (44%) liters of milk per day out of a 5000 L capacity, with the average farmer supplying 6 L of milk per day. As part of its expansion efforts, the cooperative has ventured into yogurt processing, with a weekly production of 500 L that are sold within the surrounding communities.

The study area represents a typical sample for socio-economic activities in the region. With a largely diverse population representing Christianity, Islam, and Traditional beliefs; the Basoga and Iteso ethnic groups are predominant, followed by other Ugandan ethnicities. The economy of the region is based on agriculture, livestock, and fish-related activities. The region heavily depends on rainfall for agriculture and the vegetation reflects its tropical climate with grasslands, wetlands and swampy areas, and agriculture crops.

2.2. Focus Group Discussion

A focus group discussion was conducted among the members and key personnel of the dairy cooperative group (n = 17). The study participants were chosen based on their roles within the cooperative and technical knowledge of animal production systems in this region, and represented the executive committee of the cooperative, resource persons, and extension personnel. A face-to-face group discussion was facilitated by the author and lasted for 2.5 h. The discussion was centered around the identification of critical issues of economic importance and subsequent SWOT (strength, weakness, opportunity, and threat) analysis of the typical farms of the region. Participants were provided a safe space to express their viewpoints and ideas and were encouraged to provide their thoughts on the critical issues and their views of the SWOT analysis (Table 1).

Table 1. SWOT analysis of the Balowali dairy farms.

Strengths	• Milk sector has increase its performance in the past decade; • Availability of pastures, water; • Good fertile land for crops and milk production; • Opportunity to move towards forage-based dairy production; • Interest among public to learn new practices; • Adequate availability of labor; • Established livestock-dependent culture by a community of support formed as a cooperative approach.
Weaknesses	• Unskilled and inefficient labor; • Limited use of good milking equipment and proper milking practices; • Feeding program—no minerals or salts; • Low sensitization to innovation; • Lack of adequate resources for farmers to use technology; • Indiscriminate breeding of cattle leading to cattle with inferior genetic merit; • Outbreak of acaricide-resistant ticks and tickborne diseases.

Table 1. *Cont.*

Opportunities	• Growing demand and market for milk produced in the area; • Climate conditions with enough sunshine and rain conducive for forage and dairy production; • Opportunity for product diversification with yogurt and ghee with existing facilities; • Artificial insemination services locally available; • Technical staff on the cooperative board; • Government policy; • Improving milk quality.
Threats	• Lack of security in farm investment; • Expensive input cost for farm operation; • Endemic diseases and ticks; • Heat stress.

2.3. Farm Observations

During the study period, a total of 12 representative dairy farms, as indicated by the dairy cooperative, were visited by the evaluator (Figure 1). The dairy field visits lasted an average of 1 and a half hours, and each evaluation was based on a predetermined checklist of items. These evaluations consisted of 4 critical areas of animal welfare concern including access to water, feed, facilities, and care. All of these were evaluated on a scale of 1 to 3 indicating unsatisfactory, satisfactory, and good production practices. In addition to the cow- and farm-level observations, key management information relating to the farm's management was noted down in conversations with the dairy farmers. To mitigate subjective bias and observer variance, a single evaluator conducted all assessments. Given the inherently subjective nature of the evaluation, this approach effectively reduces interobserver agreement concerns. The evaluator possesses expertise as an animal scientist with experience in welfare assessment.

A total of 12 farms were assessed using a modified Welfare Quality® assessment protocol for dairy farms in tropical conditions as suggested by Hernandez et al. [12]. The modifications were made to generalize and capture welfare conditions prevailing in smallholder extensive systems in tropical conditions. The assessment was carried out by continuous observation of the animals for a period of 20 min at pastures and sheds. However, due to the timing of the evaluation, some of these features were evaluated during milking sessions when animals were gathered in milking stanchions. These observations were made on the individual animal levels including cows, calves, and bulls on a 3-point scale and the mode value of the observation was reported as a farm-level observation.

Good feeding: As a proxy for adequate feeding or the absence of prolonged hunger was evaluated. In addition to feed availability, each animal was observed from behind and from the side in relation to loin, tail head, and vertebrae areas [12]. All animals were categorized as having one of three body condition scores (1 = very lean, 2 = adequate condition, 3 = very fat), and the mode value of these observations was reported as farm-level observations (Table 2).

Absence of prolonged thirst: All water sources within the farm were counted and evaluated. Water sources were divided into animals having access at all times, including pasture and barn, natural sources, including rivers, streams, ponds, and underground water wells on the site. The score was based on the number of animals and the availability of water to these animals.

Good housing: As a proxy for cow comfort, opportunities for resting of animals were evaluated in each farm. Cows lying partly or completely on the lying area were assessed and the percentage of animals not lying (perching, standing) was calculated. The housing category also included the cleanliness of the animals in the udder and leg area and the ability to move freely between stalls.

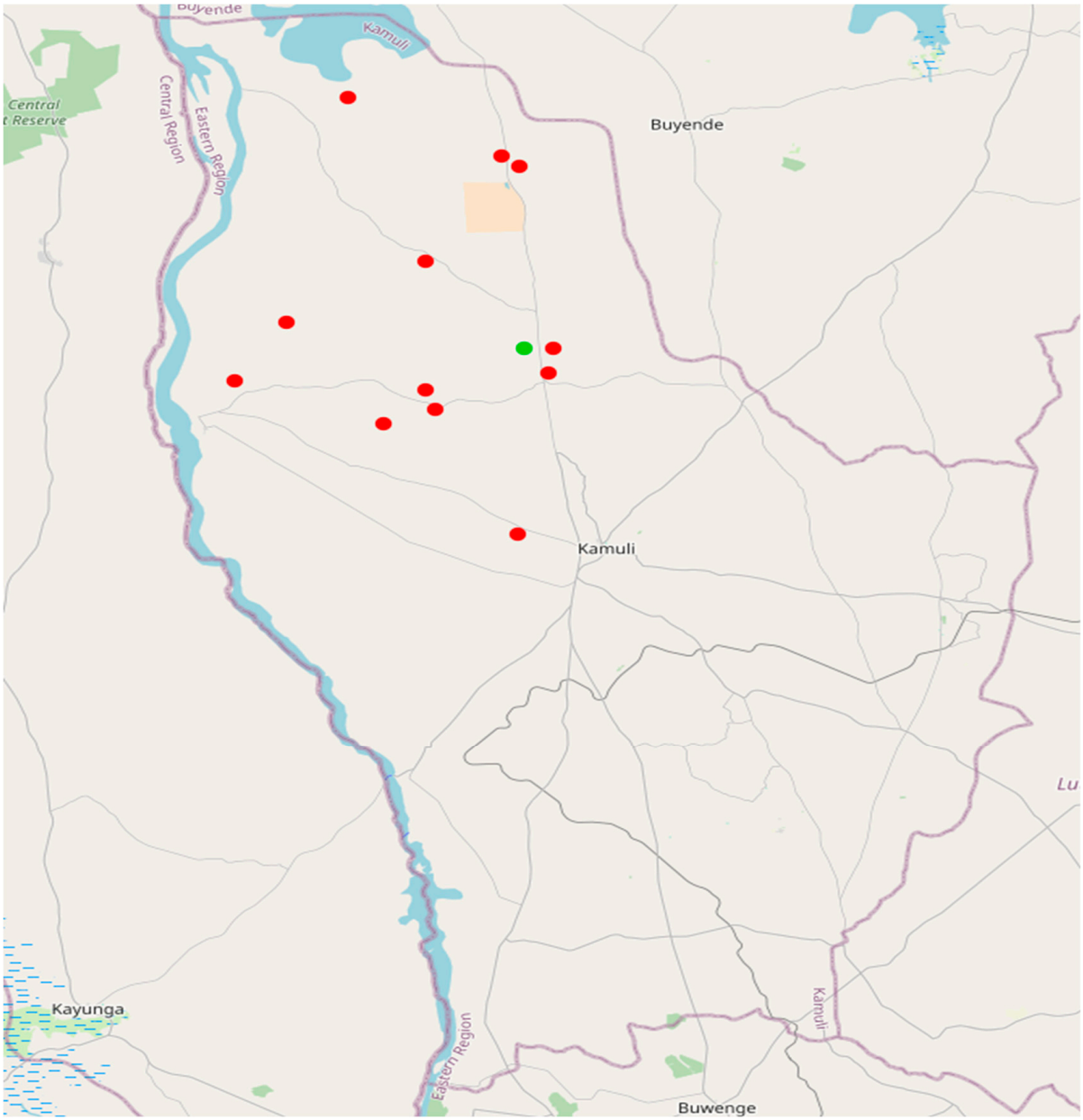

Figure 1. Map of the study area (Kamuli district, Uganda) with farms visited (red dots) and the focus group discussion area (green dot).

Table 2. Criteria and observation parameters for on-farm evaluation.

Criteria	Observation Parameters
Good feeding	• Feed availability • Body condition scores (1–3)
Absence of prolonged thirst	• Source of water • Access of animals to water
Good housing	• Cow comfort (resting, perching, standing) • Cleanliness in the udder and legs • Ability to move freely

Table 2. *Cont.*

Criteria	Observation Parameters
Good health	• Absence of injury • Absence of diseases • Lameness • Skin alterations • Ectoparasites • Nasal and ocular discharge • Respiration • Diarrhea

Good health: As a proxy for good health, the absence of injury and absence of diseases were evaluated in each farm. In this criterion, the following aspects were recorded: reluctance to bear weight on a foot, an uneven temporal rhythm between hoof beats, frequent weight shifting, and integument alterations including hairless patches. When the animals displayed an area smaller than 5 cm of hair loss with no damaged skin and lesions/swelling vs. when the animals had an area larger than 5 cm of damaged skin in the form of a scab or a wound dermatitis. Finally, the presence of visible ectoparasites on the cow body was evaluated. Observations for the presence of disease indicators include nasal and ocular discharge, hampered respiration, diarrhea, and bloated rumen.

3. Results

3.1. Focus Group Discussions

Critical issues identified: Low milk production, endemic cattle diseases, tick-borne diseases, and resistance to insecticides and parasiticides were identified as key issues by all the participants. Livestock parasites (ticks, liver flukes, fleas) and diseases (foot and mouth, tick-borne diseases, and others) are key concerns, all leading to poor production of milk and meat. In the study area, as in many other parts of the country where farmers are particularly smallholder livestock farmers, livestock species do not perform well; they are slow in growth and are often in poor physical condition, leading to extreme underperformance in production. The group discussed that most farmers do not have adequate knowledge and skills for proper management including pest and disease identification, disease control, treatment as well as for the proper feeding and housing of animals. The farmers lack the necessary knowledge and skills for appropriate management, housing, pests, diseases, and control/treatment which are critical to the success of livestock operations. Due to these challenges, the livestock production was below optimal, with animals taking a long time to reach maturity, and subsequently, remaining with the farmer for a long time before they can become productive. In addition, many animal health experts reside in urban centers, and programs that bridge the gap by building and strengthening the capacity of dairy farmers in disease recognition, reporting, and the provision of basic animal healthcare services, proper animal care, and management at their farms are crucial. Due to emerging livestock pests and diseases as well as zoonotic diseases, new control and preventive measures have become a concern. On this basis, dairy animal farmers and health workers struggle hard to keep up to date with changing trends.

3.2. SWOT Analysis of the Local Farms

The focus group performed a SWOT analysis of the representative smallholder dairy farms in the community (Supplementary Figure S1). The strengths identified include adequate availability of pasture, forage, water, and fertile land (Table 1). The agriculture-friendly climatic conditions of the region were also considered to be a strength given the warm and rainy conditions with plenty of available sunshine that presents favorable conditions for forage growth. However, the increasing number of extreme weather events leading to heat stress conditions in the animals was identified as a threat. Another strength identified included adequate human power and labor available locally. The final strength

considered by the group included an established livestock-dependent cooperative culture which provided access to a community of supporters and other support available through the organization.

Weaknesses identified included low-skilled labor and an inefficient workforce largely due to a lack of modern machines and technologies. This was largely attributed to the absence of timely training opportunities and programs suitable for the socioeconomic and technical conditions of the producers. The unavailability of milking machines and unhygienic milking practices were considered another weakness contributing to overall suboptimal milk production. The lack of appropriate feeding practices without the use of minerals and salts was considered another weakness. The group identified lower sensitization to innovation, a lack of enough capital for farmers to use technology, and the poor quality of improved livestock breeds available as weaknesses of the farming system.

Subsequently, the availability of a closer market for the produced milk, artificial insemination services available locally and within reach of the farmers, the availability of adequate land for the expansion of farms, opportunities for adopting forage-based production systems for a reduced input cost of production, the inclusion of technical staff on the cooperative board, the availability of good transportation to the farm, recent government policy to support livestock, and concentrated efforts to improve milk quantity and quality were considered to be opportunities by the group. The group decided to include frequent disease outbreaks, a lack of security in farm investments, high input costs, a higher prevalence of endemic diseases and ectoparasites including ticks, and a low heat stress abatement capability as threats to the local dairy system.

3.3. On-Farm Observations

Dairy cattle welfare evaluations were conducted at the herd levels on farms based on the modified Welfare Quality® assessment for the tropics [12]. Each farm was evaluated to understand good feeding, good housing, and good health (Figure 2). A total of three farms (25%) were categorized as inadequate for the absence of prolonged hunger because the Body Condition Score (BCS) of the majority of their animals tended to be 1, one farm had cows with a BCS of 2, and eight farms had cows with good BCS (>3) (Figure 3). A total of four farms were included in the inadequate category for the absence of prolonged thirst mainly due to a lack of available drinking water when the cows are thirsty. On these farms, water was provided at a certain point in the day according to the owner's conscious decision. Another six farms were included in the adequate category because of the availability of ponds or rivers where animals could go to drink water when grazing or resting and two farms had a source of water on site to provide animals with a constant supply of clean drinking water. Three farms (33%) had good comfortable housing and areas to lie down, as evidenced by clean udders and legs. Five farms had adequate housing indicating by a provision of shade and a concrete floor but had tie stall barns where cows were tied to a pole. Another four farms with inadequate housing included no shed for the cows during hot and cold weather, and unhygienic conditions in the barn including cleanliness, airflow, and lighting. Farms determined to be inadequate for the absence of injuries had cows with mastitis incidence, parasite load, or visible presence of external parasites including ticks. Adequate health implies minimal health and disease reported by farmers but is not currently a big issue, whereas the good category represents poor health as not a big concern on dairy farms.

Specific Actions: Based on the SWOT analysis and on-farm observations, a 6-point action plan was developed utilizing a multiparty participatory approach involving farmers, cooperatives, and the author. To make the recommendations SMART (specific, measurable, achievable, relevant, and timebound), individuals responsible for conducting the activity were identified, and the time needed for the action was determined. The final list (Table 3) was agreed upon by the focus group participants, these recommendations support addressing the most pressing issues within the SWOT analysis, and are assumed to be implemented within a specific time period.

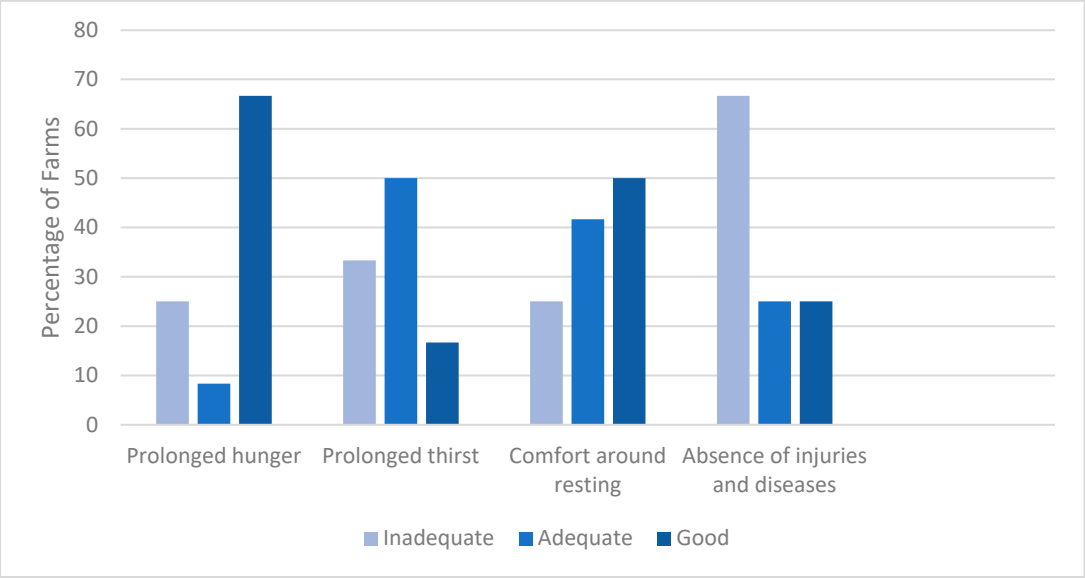

Figure 2. Diagram representing performance of each farm on the modified Welfare Quality® assessment.

Farms	Good feeding	Prolonged thirst	Good housing	Good health
A				
B				
C				
D				
E				
F				
G				
H				
I				
J				
K				
L				

Figure 3. Distribution of farms classified as inadequate, adequate, and good based on modified Welfare Quality® assessment (with the green color representing good, yellow representing adequate, and the orange–red color representing inadequate).

The first recommendation was to increase training opportunities for the farmers as they were identified to be eager to improve their farms. In this context, dairy interest groups within the community will be established by the cooperative board within 6 months that function as a knowledge-sharing platform between the farmers about best practices on their farm. The second recommendation was made to increase access to information about drugs and animal health services. Two specific actions were suggested for developing vaccination and deworming programs for the community of farmers that help to secure vaccines and genuine drugs for farmers to compact acaracide resistance and parasite resistance. The veterinary personnel within the board will identify animal health service technicians within the community to help farmers identify inappropriate medication and use genuine medicine instead.

Table 3. Recommendations and action plan for the dairy farms developed from participatory rural appraisal.

Recommendations	Specific Action	Responsible Person	Months Needed	Expected Results	Critical Points Addressed
1. Farmers are very eager to learn and need more training opportunities	(a) Establish Dairy Interest Groups (DIGs) within the community that function to serve as a knowledge-sharing platform	Cooperative board	Within 6 months	Increased access to accurate information	Unskilled labor
2. Increase access to and information about drugs and animal health services	(a) Develop vaccination and deworming program for the farmers that helps to secure vaccines and genuine drugs for farmers (b) Identify animal health service technicians within the community to support farmers	Veterinary personnel within the board	Within 6 months	Easy availability of vaccines and drugs	Sensatization to innovation
3. Profiling and creating database of animals raised by cooperative members	(a) Create database with number and details of cows, calves and bulls in the community	Board and dairy interest groups	Within 6 months	A database with farm-specific information	Unorganized health and breeding programs
4. Farmers have desire to implement practices but lack resources and access to resources	(a) Work with a microfinance organization for securing small loans to farmers with promise of milk submission to the dairy	Board	Within 3 months	More farmers adopt new tools and technologies	Inadequate resources
5. Utilize the milk cooling system available at the dairy	(a) Look for alternate markets for cooled milk (b) Diversity the milk products to sell ghee, ice cream, buttermilk and baked goods	Board	By 3 months	Increased market for the milk produced	Limited use of available resources
6. Focus on pasture growth and preservation	(a) Identify pasture demonstration sites for farmers (b) Make utensils, e.g., hay boxes and seeds available for rent at the dairy center (c) Identify market for excess forage produced by the farmers	Board	Within 2 months	Increased producer participation in forage-based dairy production	Feeding programs

The third recommendation was to improve and increase record keeping at the farm level and the cooperative level by profiling and creating a database of animals raised by cooperative members. For this activity, the board will work with dairy interest groups to create a database with the number and details of cows, calves, and bulls in the community so that demand for AI services, medication, and future milk production and yield can be estimated and a support system developed accordingly. To address the lack of available resources and access to resources, the board will work with a local microfinance organization within three months to secure small loans to member farmers with the promise

of milk submission to the dairy. The fifth recommendation was to maximize the use of the milk cooling system available at the dairy by looking for alternate markets for cooled milk and increasing milk products to sell ghee, ice cream, buttermilk, and baked goods as value-added products. The final recommendation was to increase the collective focus on pasture-based milk production by improving growth and preservation. The board will identify pasture demonstration and learning sites for farmers and make utensils, e.g., hay boxes and seeds available for rent at the dairy cooperative center.

4. Discussion

The smallholder dairy conditions observed in the current study, including suboptimal productivity, animal health issues, and constraints around feeding, breeding, and housing align with previous characterizations of Ugandan dairy farms [3,16]. Our on-farm welfare assessments indicated concerns on multiple fronts but with variation across farms, reaffirming conclusions that blanket solutions rarely suit the diversity of regional smallholder contexts [17]. However, prioritizing key improvement areas through participatory rural appraisal techniques can tailor interventions to local needs within this heterogeneity.

The focus group's emphasis on endemic disease and parasite threats reflects prevalent cattle health challenges linked to hindering productivity and welfare in low-input, pasture-based Ugandan systems identified by previous studies [18]. The inadequate feeding and access to quality breeds discussed in this study also rank among the fundamental issues identified among smallholder dairies in Uganda and Kenya in previous reports [9,19]. Our results confirm consistent water availability as another regional struggle, exacerbated by increasing droughts with climate change as indicated by Amour et al. [20]. Targeted solutions around health management, nutrition, and breeding are reaffirmed in our study as critical to elevating household-level dairy production across metrics [18].

The welfare assessment conducted in this study explained some of the production and performance issues in this area. For example, many farms not feeding cows well could be suggestive of the poor milk production performance of the region. Each of these evaluation parameters, including good feeding, absence of thirst, good comfort, and good health, are related to milk production, reproduction, and profitability [21]. The opportunities identified in this study align with previous studies [8,22]. This study highlights concerns related to animal welfare issues in the region that align with already established production challenges.

We built our assessment and recommendations on community experiences using deliberative, bottom-up approaches [23,24]. The collaborative process revealed local strengths like cooperative structures and mutual learning opportunities while ensuring realistic actions tailored to on-the-ground capacities and motivations. Contextual sustainability factors encompass environmental, economic, and social considerations [25], all of which were integrated in our participatory planning. By jointly formulating interventions around training access, veterinary services, data systems, financing, markets, and pasture improvement through a welfare lens, our roadmap envisions animal, farmer, and community development in synergy [17] rather than through top-down interventions. The specific actions recommended are very local in scope and based on specific constraints and available resources locally. These recommendations may be different for another farming community or cooperative based on the specific constraints and opportunities of that area. However, the participatory approach presented in this study will provide guidance for identification of problems and their possible solutions.

5. Conclusions

The eastern Ugandan dairy farming system demonstrates production and animal welfare problems but also presents an opportunity for improving the situation. A participatory approach to conducting a SWOT analysis, identification, and prioritizing key improvement areas through participatory rural appraisal techniques used in this paper will help tailor interventions to local needs.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/agriculture14071173/s1, Figure S1: Representation of the process for participatory SWOT analysis. The supplemental material attached demonstrates the SWOT analysis conducted at the research site. The figure includes strengths, weaknesses, opportunities, and threats that are discussed in detail in the manuscript.

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Institutional Review Board Statement: The study was determined to be exempt by the IRB review committee at Texas A&M (IRB2023-0633M) for the activities presented in this paper.

Data Availability Statement: The datasets generated during and/or analyzed during the current study are not publicly available due to the confidential or sensitive nature of the observations but are available from the corresponding author on reasonable request.

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Conflicts of Interest: The author declares no conflicts of interest.

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