

Awareness and adoption of climate-smart livestock production in the West Coast, Central River and Upper River Regions of The Gambia

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ABSTRACT: This study investigated climate-smart livestock production in The Gambia. Three regions (West Coast, Central River, and Upper River Regions) were selected using a cluster sampling method. A total of 344 livestock farmers were randomly selected and individually interviewed using a structured questionnaire. The variables collected included respondents' socio-economic characteristics, livestock production systems, climate change awareness, and climate-smart livestock production practised by the farmers. The data were analysed using descriptive statistics. The results showed that the majority of livestock farmers were male (86.9%) and mostly (98.5%) married. They were predominantly (74.1%) the Fula (Fulani) ethnic group, and 17.7% of them had an average herd size of 21- 30. Only a few proportions (13.1%) of the participants were aware of methane, carbon dioxide, and nitrous oxide as greenhouse gases. However, all the respondents were aware of climate change and its negative impacts on livestock production. The majority (93.9%) of the respondents raised resistant breeds, and 59.6% adapted composting method of waste management as climate-smart livestock strategies. Ranching and using feed additives were the least rated (1.2 %) of the climate-smart livestock production methods practised by the respondents. A good proportion of the respondents (63.7%) practised climate-smart livestock production. It could be concluded that the majority of the farmers were aware of the climate change threat to livestock production, even though ignorant of the greenhouse gases responsible, and were already practising certain climate-smart livestock strategies like rearing resistant breeds and composting as a waste management technique to increase productivity. It is recommended that farmers should be further trained on other climate-smart livestock techniques, such as using feed additives and ranching to reduce greenhouse gases in livestock production.

Keywords: Climate change, feed additives, Gambia, greenhouse gases, ranching, resistant breed.

INTRODUCTION

In West Africa, rapid population growth, urbanisation, rising incomes, and economic development are driving a significant increase in the demand for animal-source foods (Giro and Kumar, 2022). This shift has led to greater commercialisation of livestock production systems and a corresponding need to enhance productivity to meet the growing demand (Baltenweck *et al.*, 2020; FAO, 2024). However, efforts to increase livestock production and productivity are associated with environmental consequences, particularly through increased greenhouse gas emissions such as methane and nitrous oxide. These emissions contribute to climate change, thereby creating a

complex challenge of balancing productivity with environmental sustainability (FAO, 2013; Gerber *et al.*, 2013). This global concern has necessitated the emergence of climate-smart livestock production, which aims to sustainably increase productivity, enhance resilience, and reduce emissions (FAO, 2021; Thornton and Herrero, 2015). The livestock sector plays a vital role in the livelihoods of the Gambian population, with cattle, sheep, goats, and poultry being the predominant species reared across the country. The sector contributes significantly to the national economy, accounting for approximately 13.8% of the agricultural gross domestic product (GDP) and 2.6%

of the total GDP as of 2019 (Bahta *et al.*, 2023). Despite its importance, livestock production in The Gambia is constrained by numerous challenges, including limited access to quality feed, fodder, and water resources. These constraints are largely exacerbated by climate variability and change, which continue to threaten the sustainability of the sector (Bahta *et al.*, 2023).

Climate change remains one of the most critical challenges affecting livestock production in The Gambia (Eeswaran *et al.*, 2022). Its impacts are increasingly evident through rising temperatures, erratic rainfall patterns, and the growing frequency of extreme weather events such as droughts and floods. These changes result in heat stress, reduced water availability, and declining pasture productivity, all of which negatively affect livestock performance and productivity (IPCC, 2022; FAO, 2024). Livestock are directly affected through their dependence on climatic conditions for grazing and survival, while indirect effects occur through alterations in ecosystem dynamics, including reduced availability, quality, and diversity of feed and fodder resources.

These climate-related challenges disproportionately affect rural populations in Africa, where livestock production is a primary source of livelihood. A significant proportion of livestock keepers in the region operate under traditional production systems, which are often characterised by low inputs and high vulnerability to climate shocks (Thornton and Gerber, 2010). In The Gambia, climate-related issues such as heat stress, flooding, irregular rainfall patterns, drought, and pasture degradation have had profound effects on livestock production and the livelihoods of rural households.

In response, various climate change mitigation and adaptation strategies have been introduced by governments and development partners, including capacity-building programs, financial support mechanisms, and awareness campaigns targeting livestock farmers. These interventions are largely aligned with the principles of climate-smart agriculture (FAO, 2013; World Bank, 2021). However, despite these efforts, there remains limited empirical information on the adoption and effectiveness of climate-smart livestock practices among farmers in The Gambia (Ceesay *et al.*, 2020; Nget *et al.*, 2022). Therefore, this study aims to evaluate climate-smart livestock production practices in The Gambia, with a focus on identifying existing coping strategies, challenges, and opportunities for improving resilience and sustainability in the sector.

MATERIALS AND METHODS

Study area

The study was conducted in three regions of The Gambia: West Coast Region (WCR), Central River Region North (CRRN), and Upper River Region (URR), each representing different agro-ecological zones. WCR (13°N,

16°W) is situated at an altitude of 11 meters above sea level, with average annual rainfall of approximately 1,000 mm, temperatures ranging from 32–40°C, and relative humidity of 43% (GBOS, 2024). The region spans about 1,764 km² and has an estimated poultry population of 75,000–80,000 birds (Bahta *et al.*, 2023). URR (13°30'N, 14°47'W), which shares a border with Senegal, is located in the Sudano-Sahelian zone, with a semi-arid climate characterised by distinct wet (June–October) and dry (November–May) seasons. It receives about 840 mm of annual rainfall, with a mean temperature of 38°C and relative humidity of 47% (GBOS, 2024). CRRN (Sami Ward; 13°35'N, 14°35'W) lies within the Guinea Savannah zone, with similar rainfall (840 mm) and average temperatures (38°C). This area is characterised by mixed crop–livestock production systems (IFAD, 2019; Ministry of Agriculture, 2021).

Sampling techniques

The cluster method was used to select the three study locations, and 344 respondents (195, 105, and 44 from URR, CRRN, and WCR, respectively) were randomly selected for an equal chance of being selected based on the population of the livestock farmers in the areas.

Data collection

A structured questionnaire was used to elicit information from respondents, which included socio-economic characteristics, climate change, and climate-smart livestock production awareness and climate change mitigation strategies practiced.

Statistical analysis

The data were analysed using descriptive statistics (Tables, frequency, percentages) in IBM SPSS Statistics Version 20.

Ethical approval

Ethical approval was not required for this study, as it involved only interviews and did not include any direct experimentation on animals or human subjects.

RESULTS AND DISCUSSION

Socio-economic characteristics

Table 1 presents the socio-economic characteristics of the respondents. The majority (86.9%) were male, while most (97.4%) identified as Muslims, reflecting the religious composition of The Gambia (GBoS, 2024). Livestock farming was the predominant occupation (70.3%) across the study areas, with a large proportion (74.1%) of respondents

Table 1. Socio-economic characteristics of the respondents

Variables	Frequency	Percentage (%)
Gender		
Male	299	86.9
Female	45	13.1
Age		
<20	1	0.3
20-39	122	33.5
40-60	159	46.2
>60	62	18.0
Total	344	100.0
Educational level		
Tertiary	33	9.6
Senior	21	6.1
Primary	19	5.5
Arabic	40	11.6
None	231	67.2
Marital status		
Single	2	0.6
Married	339	98.5
Widow	3	0.9
Widower	0	0.0
Ethnic group		
Mandinka	63	18.3
Fula	255	74.1
Wolof	14	4.1
Jola	6	1.7
Manjago	3	0.9
Kongai	3	0.9
Sarahulle	0	0.0
Occupation		
Crop farming	68	19.8
Livestock farming	242	70.3
Civil servant	34	9.9
Religion		
Islam	335	97.4
Christian	9	2.6
Family size		
<5	7	2.0
6-10	39	11.3
11-15	62	18.0
16-20	45	13.5
>20	191	55.5

belonging to the Fula ethnic group. This supports earlier findings that livestock production in West Africa is largely dominated by the Fula, who are traditionally pastoralists (FAO, 2018). The dominance of male participants may be attributed to the labour-intensive nature of livestock

production, which is often culturally and physically demanding (Eeswaran et al., 2022). A substantial proportion of respondents (67.2%) had no formal education, consistent with reports of high illiteracy levels among rural farmers in The Gambia (GBoS, 2024). Furthermore, most

Table 2a. Livestock production.

Variables	Frequency	Percentage (%)
Cattle		
Yes	262	76.2
No	82	23.8
Type of cattle		
Beef	264	76.7
Diary	0	0.0
Both	0	0.0
No cattle	80	23.3
Breed of cattle raised		
N'dama	260	75.8
Zebu	1	0.3
Both	3	0.9
None	80	23.0
Sheep		
Yes	276	80.2
No	68	19.8
Breed of sheep		
West African dwarf	263	76.5
Sahelian	11	3.2
Both	3	0.9
No sheep	67	19.5
Goats		
Yes	297	86.3
No	47	13.7
Breed of goat		
West African dwarf	293	85.2
Sahelian	3	0.9
Both	1	0.3
No goat	47	13.7
Poultry		
Yes	270	78.5
No	74	21.5
Type of poultry		
Layers	25	7.3
Broilers	19	5.5
Both	226	65.7
None	74	21.5

respondents (98.5%) were married, with over half (55.5%) having household sizes exceeding 20 members. This reflects the reliance on family labour in agricultural production systems in developing countries (Temesgen and Aweke, 2023; IFAD, 2019).

Livestock production in the study area

Tables 2a and 2b present the livestock production

characteristics in the study area. The results indicate a high level of engagement in livestock farming, with the majority of respondents involved in sheep production (86.3%), while 76.2%, 80.2%, and 78.5% were engaged in cattle, goat, and poultry production, respectively. These findings are consistent with reports that the livestock sector is a significant contributor to the economy of The Gambia (Ministry of Agriculture, 2021). Local breeds, including N'Dama cattle, West African Dwarf (WAD) goats, indigenous sheep, and local chickens, were predominantly

Table 2b. Livestock production.

Breed	Frequency	Percentage (%)
Local breed	227	66.0
Rhode Island red	11	3.2
Hyaline white	25	7.3
New Hampshire	8	2.3
No poultry	73	21.2
Donkey	129	37.5
Horse	114	33.1
Duck	13	3.8
Pig	7	2.0
None	81	23.5
Animals raised by respondents		
Cattle	13	3.8
Sheep & goat	47	13.7
Poultry	10	2.9
Poultry & small ruminants	23	6.7
Poultry & cattle	1	0.3
All	250	72.7
Farm size of cattle		
<10	21	6.1
11-20	33	9.6
21-30	61	17.7
31-40	60	17.4
41-50	43	12.5
51-100	34	9.9
>100	12	3.5
No cattle	80	23.3
Farm size of sheep & goat		
<20	123	35.8
41-60	144	41.9
61-80	45	13.1
81-100	14	4.1
>100	4	1.2
No sheep & goat	14	4.1
Farm size of poultry		
<50	229	66.5
101-150	3	0.9
151-200	7	2.0
201-300	8	2.3
301-500	8	3.2
501-1000	11	3.2
2000-10000	9	2.6
No poultry	69	20.1

reared. The preference for these breeds may be attributed to their adaptability to harsh environmental conditions, ability to thrive on low-quality feed resources, trypanotolerance (particularly N'Dama cattle), and high reproductive performance, especially in WAD goats (Ofori *et al.*, 2021; Bosso *et al.*, 2009). The production system was largely smallholder-based. Only 17.7% of respondents owned

between 30 and 40 cattle, while the majority (66.5%) kept fewer than 50 poultry birds, and 41.9% owned between 41 and 60 sheep and goats. This pattern aligns with previous findings that livestock production in developing countries is predominantly characterised by smallholder farmers operating under extensive management systems (Resti *et al.*, 2024; IFAD, 2019).

Table 3a. Awareness of climate change on livestock production

Variables	Frequency	Percentage (%)
Negative impact awareness		
Yes	344	100.0
No	0	0.0
Total	344	100.0
Methane awareness		
Yes	45	13.1
No	299	86.9
Total	344	100.0
CO ₂ awareness		
Yes	45	13.1
No	299	86.9
Total	344	100.0
N ₂ O awareness		
Yes	45	13.1
No	299	86.9
Total	344	100.0
Source of methane		
Yes	30	8.7
No	314	91.3
Total	344	100
Source of CO ₂		
Yes	25	7.3
No	319	92.7
Total	344	100.0
Source of NO ₂		
Yes	25	7.3
No	319	92.7
Total	344	100.0
Poor waste disposal		
Yes	31	9.0
No	313	91.0
Total	344	100.0
Experience flood		
Yes	205	59.6
No	139	40.4
Total	344	100.0

Awareness and impact of climate change on livestock production

Tables 3a and 3b present farmers' awareness and the perceived impacts of climate change on livestock production. All respondents (100%) reported being aware of the negative effects of climate change on livestock production (Ayal and Mamo, 2024; Eeswaran et al., 2022). However, only 44 respondents (13.1%) correctly identified methane (CH₄), carbon dioxide (CO₂), and nitrous oxide (N₂O) as greenhouse gases. This finding aligns with previous reports indicating that, although general awareness of

climate change is high, detailed knowledge of its causes and mechanisms remains limited among rural populations (IPCC, 2022). The majority of respondents (86.9%) were unaware of the sources of greenhouse gas emissions, and only 9.0% recognized poor waste management as a contributing factor. This limited understanding is consistent with earlier findings reporting low awareness of the link between livestock waste management and greenhouse gas emissions among farmers (FAO, 2018). A substantial proportion of respondents reported experiencing climate-related impacts on livestock production. Nearly all (98.3%) indicated that their animals suffer from heat stress due to

Table 3b. Awareness of climate change on livestock production

Variables	Frequency	Percentage (%)
Suffer from intense heat		
Yes	338	98.3
No	6	1.7
Total	344	100.0
Experience drought		
Yes	247	72.4
No	95	27.6
Total	344	100.0
Pasture shortage		
Yes	156	45.3
No	188	54.7
Total	344	100.0
High mortality		
Yes	183	53.2
No	161	46.8
Total	344	100.0
Poor growth		
Yes	329	95.6
No	15	4.4
Total	344	100.0
Low milk production		
Yes	254	73.8
No	90	26.2
Total	344	100.0
Reduce offspring & egg No		
Yes	326	94.8
No	18	5.2
Total	344	100.0
Windstorm		
Yes	178	51.7
No	166	48.3
Total	344	100.0
Other negative effects		
Yes	340	98.8
No	4	1.2
Total	344	100.0

high temperatures, while 95.6% observed reduced growth performance. Similarly, 94.8% reported decreased reproductive performance, including reduced offspring numbers and egg production. About 73.8% noted a decline in milk yield, while 72.4% experienced drought linked to irregular rainfall patterns. In addition, 59.6% reported flooding due to excessive rainfall, 53.2% experienced increased livestock mortality, and 51.7% indicated

damage to animals and housing from windstorms. Furthermore, 98.8% of respondents observed other adverse health effects in their animals associated with harsh weather conditions. Overall, these findings confirm that climate change has significantly affected livestock production through reduced productivity, increased mortality, and occasional damage to farm infrastructure (Otsuka and Fan, 2021).

Table 4. Awareness of climate-smart livestock production.

Variables	Frequency	Percentage (%)
Concept of CSLP awareness		
Yes	207	60.2
No	137	39.8
Total	344	100.0
Training		
Yes	26	7.6
No	318	92.4
Total	344	100.0
Proper health management		
Yes	344	100.0
No	0	0.0
Total	344	100.0
Adequate waste management		
Yes	59	17.2
No	283	82.8
Total	344	100.0
Crop-Livestock integration		
Yes	265	77.0
No	79	23.0
Total	344	100.0
Ranching, lots of water		
Yes	252	73.3
No	92	26.7
Total	344	100.0
Feed additives		
Yes	22	6.4
No	322	93.6
Total	344	100.0
Local breeds more tolerant		
Yes	330	98.5
No	5	1.5
Total	344	100.0
Adequate feeding/balance d		
Yes	344	100.0
No	0	0.0
Total	344	100.0

Awareness of climate-smart livestock production

Table 4 presents the awareness of climate-smart livestock production (CSLP) among the respondents. The majority (60.2%) indicated that they were aware of CSLP concepts, despite not having received formal training. This awareness may be attributed to informal knowledge exchange among farmers, particularly through interactions with peers who have participated in training programmes. Previous studies have shown that agricultural innovations are often disseminated through informal communication channels such as farmer-to-farmer interactions and local networks. All respondents (100%) acknowledged that

proper animal health management and welfare practices can reduce the adverse effects of climatic stress, while adequate feeding with balanced diets enhances livestock productivity under changing climatic conditions. Effective health management has been widely reported as a key factor in improving productivity and enhancing the resilience of livestock to environmental stressors (Balehegn *et al.*, 2025). Furthermore, nearly all respondents (98.5%) perceived that indigenous breeds are more tolerant or resistant to harsh conditions. A majority (73.3%) also believed that improved management practices, such as ranching and providing adequate drinking water, can enhance livestock performance. Ranching (extensive

Table 5. Adoption of climate-smart livestock production in the study location

Variables	Frequency	Percentage (%)
CSLP practice		
Yes	219	63.7
No	125	36.3
Raised a resistant breed		
Yes	323	93.9
No	21	6.1
Animal Health and Welfare		
Yes	220	64.0
No	124	36.0
Practice ranching		
Yes	4	1.2
No	340	98.8
Feed with balanced ration		
Yes	44	12.8
No	300	87.2
Manure management		
Burning	73	21.3
Compost	205	59.6
Throw away	44	12.8
Sale	22	6.4
Practice crop-livestock system		
Yes	150	43.6
No	194	56.4
Total	344	100.0
Treat feed		
Yes	4	1.2
No	340	98.8
Willingness to shift		
Yes	343	99.7
No	1	0.3
Preferred CLSP methods		
Ranching		
Yes	300	87.2
No	44	12.8
Integrate crop-livestock		
Yes	317	92.2
No	27	7.8

livestock systems) can contribute to lower greenhouse gas emissions because it relies less on externally produced concentrate feeds and reduces dependence on energy-intensive inputs, including fossil fuels used in feed production and transport (Horrillo *et al.*, 2025).

These findings are consistent with earlier studies indicating that the use of adapted breeds, improved water availability, and better management systems are effective

strategies for mitigating the impacts of climate change on livestock production (IPCC, 2022). However, awareness of mitigation strategies such as proper waste management and the use of feed additives to reduce greenhouse gas emissions was relatively low, at 17.2% and 6.4%, respectively. This suggests a gap in knowledge regarding specific climate change mitigation practices within livestock systems that should be filled (Dijk *et al.*, 2015).

Climate-smart livestock production practices in the study location

Table 5 presents the climate-smart livestock production (CSLP) practices adopted by respondents in the study areas. A substantial proportion of respondents (63.7%) reported engaging in various CSLP practices at different levels. The majority (93.9%) reared resistant or indigenous breeds, indicating strong awareness of their advantages in climate adaptation. The use of locally adapted breeds is widely recognised as a key CSLP strategy, as such breeds require fewer external inputs and are better suited to local environmental conditions while maintaining productivity (FAO, 2018). A considerable proportion of respondents (64%) also paid attention to animal health and welfare. This aligns with climate-smart principles, as improved animal health enhances resilience and productivity under changing climatic conditions (Munywoki, 2021). Although awareness of the link between waste management and greenhouse gas mitigation is often limited, a moderate proportion of farmers adopt composting and integrated crop–livestock systems. These practices are recognised as climate-smart livestock production strategies that enhance resource-use efficiency and reduce environmental impacts through nutrient recycling (IPCC, 2022; Ryschawy *et al.*, 2021). In contrast, practices such as feeding treated feeds, use of feed additives, and ranching were minimally adopted, with only 1.2% of respondents implementing these strategies. Ranching and improved feeding practices have been associated with better feed efficiency and reduced greenhouse gas emissions when properly managed (FAO, 2018). Encouragingly, nearly all respondents (99.7%) expressed willingness to improve their CSLP practices, with 92.2% and 87.2% indicating interest in adopting ranching and integrated crop–livestock systems, respectively. This highlights strong potential for scaling up climate-smart interventions in The Gambia.

Conclusion

The findings reveal a high level of awareness among livestock producers regarding the adverse effects of climate change, with all respondents acknowledging its impact on livestock production. The predominant use of resistant or indigenous breeds (93.9%) indicates strong adoption of climate-smart livestock production (CSLP) practices that enhance resilience through locally adapted genetic resources. However, the uptake of other CSLP strategies—such as feeding treated feeds, use of feed additives, and ranching—remains very low (1.2%), suggesting constraints related to knowledge, access, or resources.

Recommendation

Targeted training programs should be implemented to

enhance farmers' technical knowledge of climate change, particularly on greenhouse gas emissions and advanced CSLP practices such as feed treatment, feed additives, and improved livestock management systems.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest in this article.

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