



KNOWLEDGE OF RESILIENCE STRATEGIES IN LIVESTOCK MANAGEMENT DURING DRY PERIODS IN SOUTHWESTERN NIGERIA

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Abstract

Recurring elongated dry seasons in South west Nigeria pose a significant threat to livestock production. Knowledge of adaptation strategies to build resilience and lowers vulnerabilities to climate change among livestock farmers is limited. This study assessed livestock farmers' knowledge of resilience strategies in farm management during dry seasons in southwest Nigeria. Using a purposive sampling procedure, a total of 118 farmers were interviewed on knowledge of livestock management during dry periods, specific challenges to management, and opinions on efficient livestock management. The result shows that increased feed costs challenged farmers during the dry season while insufficient funds were identified as the most severe constraint. Knowledge of management was high among 42% of farmers and 89.5% of them disagreed on the mechanism for temperature control structure in livestock building. Knowledge of good management practices was influenced by farmers' ability to read and write in Yoruba language ($\chi^2= 9.179$; $p < 0.05$) and constraints faced ($r = 0.21$; $p < 0.05$). Climate change information in local languages will improve livestock farmers' resilience to challenges induced by unpredictable climate change.

Keywords: Literacy, Management skills, Resilience strategies, Southwestern Nigeria, Yoruba language.

DOI: <https://doi.org/10.3126/ije.v12i1.52642>

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Introduction

Climate change is not a new phenomenon in the world. It was mentioned as part of the Millennium Development Goals (MDGs) and also a major concern in the Sustainable Development Goals (SDGs). Climate change is mostly associated with an increasing global temperature (Agbeja *et al.*, 2021). In recent years, the southwest geographical zone of Nigeria has recorded longer periods of dryness and several weeks of dry spells during wet seasons caused by climatic change and variability. These dry seasons and hydro-climatic fluctuations have increased the demand for water use and the sensitivity of agricultural producers. Changes in rainfall patterns, humidity, and intensity of sunshine affect the productivity of both crop and livestock farming. It is, however, a major threat to livestock productivity (Agbeja *et al.*, 2021). Flooding, droughts, erosion, off seasonal rains, are some of the climate change impacts that have sent the growing season out of the way of a rain-fed dependent country (Nzeh *et al.*, 2016; Fadairo *et al.*, 2022).

Livestock production is an integral aspect of the food supply chain and an important contributor to food availability in Nigeria and Africa at large. Globally, livestock products contribute 17% of kilocalorie consumption and 33% of protein consumption (Rosegrant *et al.*, 2009) There is a global demand for livestock products to satisfy the food security gap of the increasing human population (Godber and Wall, 2014). In the past few years, the livestock industry in Nigeria strives to meet the ever-growing demand due to the increase in population. Food insecurity is at an alarming rate as the population goes higher (Inyeinyang and Ukpong, 2019). Despite all the effort put in place by farmers to increase production, the militating effect of climate change affects almost every aspect of production, thereby, mitigating commensurate supply to demand. Agricultural production has a large share of the direct effect of climate change, because of the close relationship that exists between production and climate (Liu *et al.*, 2020). Henry *et al.* (2012) identified effective management practices as a major step to climate change adaptation in livestock production at all seasons.

A sloppiness in livestock management is always more obvious in extreme weather conditions (Henry *et al.*, 2012), such as elongated dry seasons and at the peak of the rainy season. The effect of climate variability discourages optimum livestock production. Issues such as shortages of feed supplies, extremely high temperatures, and disease outbreaks are associated with changes in weather conditions. With the more frequent unpredictable change in climate, there are tendencies for more livestock farmers to retrieve from full-scale production resulting in increased nutrition deficiencies among rural households. Climate change adaptation strategies can be of two main forms: autonomous (reactive) adaptive strategies and conscious adaptation strategies (Berrang-Ford *et al.*, 2011). The second option is resilience - strategies that prepare for envisaged climate change

Lamidi and Ologbose (2014) and Rekwot *et al.* (2016) admitted that other challenges of livestock management during dry seasons are offshoot of the challenge of feed and feeding. The peculiarity of the Nigerian livestock management system that allows free range for almost all types of livestock production limits the extent of knowledge acquisition by livestock farmers (Ettu *et al.*, 2020). The majority of animals are raised in extensive production systems comprising smallholders and nomadic herders. A major challenge in the past few years comprising of conflicts generated by the herders-farmers interface and unforeseen disease outbreaks suggests the need for more efficient livestock management practices (Ali *et al.*, 2020).

Resilience strategies are adaptive behaviours put in place to minimize risk and exposure to climate change effects thereby reducing vulnerabilities. Poor people are likely to be more vulnerable to climate change effects because of limited risk-mitigating abilities. Vulnerability to climate change can therefore be gauged by the socio-economic factors of the individual. Resilience strategies in livestock production are mainly introduced to ensure sustainable production, supply of feeds and feeding and to prevent diseases and parasitic effects (Rekwot *et al.*, 2016).

Livestock resilience to unpredictable climate events depends on the ability of producers to alter some management patterns and skills and get acclimatized to climate change (Koirala and Bhandari, 2020; Zossou *et al.*, 2020). The inability to favorably mitigate the effects of extreme dry periods increases farmers' sensitivity to climate change and its effect. The diverse opinion justifying insufficient knowledge and adaptive capacity for climate change by rural farmers (Ayanlade *et al.*, 2017), raises a curious need for training. Increased dissemination of relevant climate change information through training from different media outlets in the South west Nigeria is expected. However, to what extent are livestock farmers knowledgeable about effective management practices during dry seasons, how has long-held opinion influenced such acquired knowledge, and what could be the constraining factors of effective livestock management practices during dry periods? This study hypothesized a mean difference in the knowledge of dry season livestock production among the six categories (Table 1) of respondents interviewed. It also assumed a relationship between the personal characteristics of farmers and knowledge of livestock management practices during dry periods. Several studies on climate change and livestock production in the study area have focused on general climatic variables and their effect on livestock production. This study specifically provides information on the resilience strategies of livestock farmers during recurring dry periods.

The purposes of the study were to (1) identify the constraints to efficient livestock management during the dry spells of the year, (2) determine farmers' disparate opinions on management practices in dry season livestock production and (3) determine the farmers' knowledge of dry season livestock management practices.

Materials and methods

Study area and sampling procedure

The study area is the southwestern region of Nigeria (Figure 1). The region comprised the six Yoruba-speaking states of the country. This includes Oyo, Ondo, Osun, Ekiti, Lagos, and Ogun states. The regions' usual two main seasons; the rainy season (April – October) and the dry season (November –March) are recently unpredictable. Other climatic information about the region is described in Odekunle (2006). The study was carried out in the Institute of Agricultural Research and Training (IAR&T), Ibadan, Oyo state. The Institute has a regional mandate on livestock production and improvement and also on farming systems and extension research. This mandate informed extension research into different livestock production in south west Nigeria. Frequent interaction through research dissemination and training has fostered relationships with livestock farmers and provide means of getting information on the effects of climate on various animals raised by farmers in southwestern Nigeria. Information was gathered through one-on-one contact, and questionnaires were adopted as means of garnering information from those farmers. Responses from farmers were gathered and documented for further analysis. A large number of farmers have benefited from training over many years of interventions. Only a few farmers willingly report any observation on their field to the livestock programme in the Institute. Livestock farmers with enterprises located in Ogun, Oyo, Lagos, Ekiti, Osun, and Ondo states were interviewed for the study (Table 1).

The study population comprised all (123) livestock farmers that reported having received climate change adaptation information in the institute in the 12 months of 2020. The sampling procedure was through the use of the purposive sampling method. Purposively, the study targeted all respondents that gave feedback on the climate change adaptation seminar in the year. Only 118 indicated an interest in the survey. Table 1 shows the category of farmers interviewed according to their enterprise. The sampling was thus purposive for the interested respondents. The English language is the official language in Nigeria, and while the southwest region of the country is predominantly occupied by native Yoruba-speaking people, intentions were informally expressed in the Yoruba language.

Data collection and measurements of variables. The survey made use of an interview schedule to gather information on the socioeconomic characteristics of respondents, livestock resilience practices, knowledge, and constraints to management practices. Knowledge of livestock management practices was determined using the option of yes and not sure (Yes- 1, Not sure- 0) and identified constraints to efficient livestock management practices were ranked according to the popularity of responses to each issue. Respondents identified all possible constraints faced in their enterprise and indicated the severity of each factor mentioned. The ranking of the constraints was done by calculating the mean responses to a scale of not severe, severe,

and very severe options method. Opinion on livestock management was measured using a scale of agree, undecided and, disagree.

Data analysis

Data were analysed using Statistical Package for Social Sciences (SPSS, 2003) version 12.0. Knowledge of management practices especially during the dry season was measured using eleven (11) knowledge statements. Scores for each statement were pooled to generate a total score per respondent. A mean score of responses per respondent was used to categorize the respondents into high and low knowledge. The influence of the items on the overall category was determined using the Chi-square test at a 5% significance level. Chi-square and Pearson Product Moment Correlation tests were carried out to determine the relationships between the independent variables and knowledge of dry season livestock management.

Table 1: Categories of livestock enterprise and distribution of the study population by state

Livestock production type	No of farmers	State	No of Farmers
Piggery	24	Ondo	25
Poultry	33	Oyo	34
Fishery	11	Osun	24
Rabbit keeping	14	Ogun	19
Sheep and goat	12	Lagos	9
Snail keeping	24	Ekiti	7
Total	118	Total	118

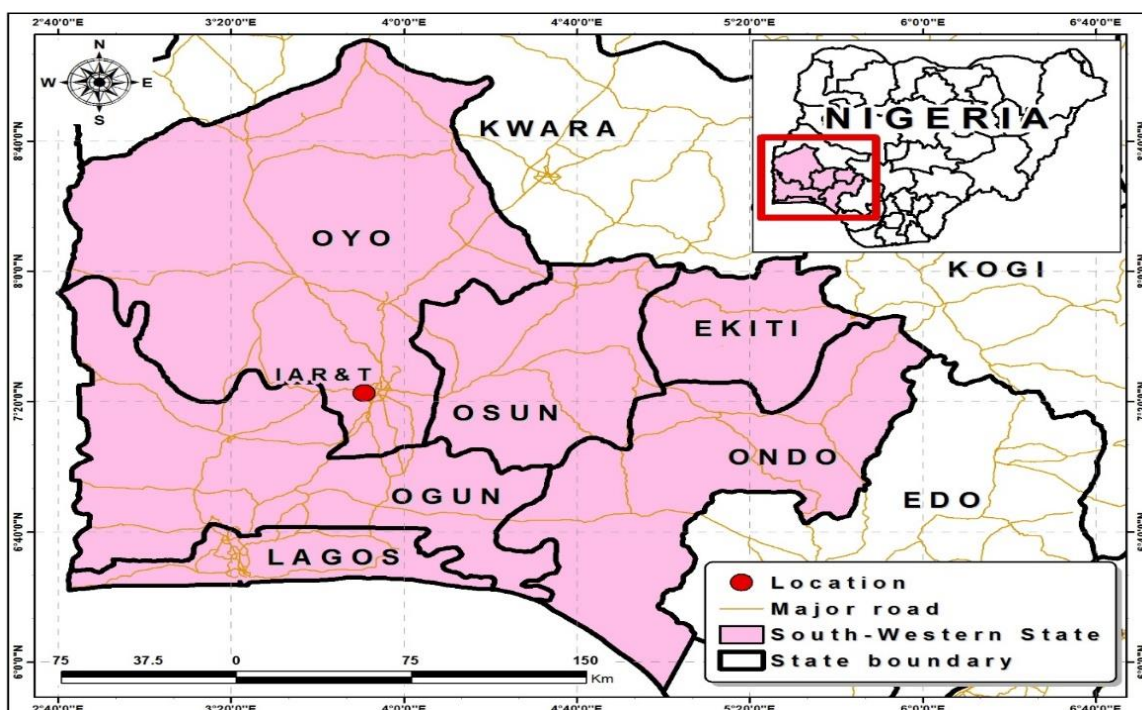


Figure 1: Map of the study area indicating IAR&T

Results

Descriptive analysis of respondents

Table 2 shows that most (75.4%) of the farmers were male, with an average age of 44 years. Only very few, (1.7%) had no formal education, while an average (56.8%) of respondents had a university degree. The majority (96.6% and 89.8%) could read and write English and Yoruba languages respectively. Also, most (69.5%) of the farmers belonged to livestock associations as appropriate to the enterprise of interest. The ability to cope with adverse situations in any production type depends on several inherent factors. Such factors are developed over years of experience in production.

Table 2: Descriptive statistics of respondent's personal characteristics

Variables	Categories	Frequencies	Percentages
Sex	Female	29	24.6
	Male	89	75.4
Age (years) Mean age 44years±11.9	20 – 30	19	16.1
	31 – 40	32	27.1
	41 – 50	28	23.7
	51 – 60	31	26.3
	Above 60	8	6.8
Education attainment	No education	2	1.7
	Primary	6	5.1
	Secondary	25	21.2
	University degree	67	56.8
	Post university degree	18	15.3
Ability to read and write English	Yes	114	96.6
	No	4	3.4
Ability to read and write Yoruba language	Yes	106	89.8
	No	12	10.2
Household size (In numbers) Mean household size 5 people ± 2.8	1 – 5	86	72.9
	6 – 10	30	25.4
	11 – 15	1	0.8
	16 – 20	1	0.8
Membership of livestock association / group	Yes	82	69.5
	No	36	30.5

Challenges of Resilience Strategies in Livestock Management Practices

Some of the factors constraining the effectiveness of management strategies in dry seasons were identified by livestock farmers and listed in Table 3. The table shows the ranking by the severity of each item. The ranking was done using the mean of responses given for each constraint item. From the itemized constraints, lack of funds for farm management ($\bar{x} = 3.1$), insufficient grazing land ($\bar{x} = 3.0$), and increased feed cost ($\bar{x} = 2.9$) were the top factors constraining effective livestock management practices during the dry seasons. These factors are interwoven in the feed challenge. It summarizes the challenge of feed and feeding in livestock

management. On the other hand, little awareness of climate effects ($\bar{x} = 2.5$) and ineffective vaccination schedule ($\bar{x} = 2.5$) were the least identified constraints challenging effective resilience practices in livestock management.

Table 3: Constraints to effective resilience strategies in livestock management at dry season (N – Number of respondents affected; NS – Affected but not severe; S -affected and severe; VS – Very severely affected) \bar{x} = mean

Constraints	N	NS (%)	S (%)	VS (%)	Mean (\bar{x})	Ranking
Lack of fund to implement management skills	72	21(17.8)	23(19.5)	28(23.7)	3.1	1 st
Insufficient feeder and silo	50	13(11.0)	23(19.5)	14(11.9)	3.0	2 nd
Increased feed cost	86	29(24.6)	36(30.5)	21(17.8)	2.9	3 rd
Poor labour access	56	26(22.0)	22(18.6)	8(6.8)	2.7	4 th
Poor government policy	68	34(28.8)	18(15.3)	16(13.6)	2.7	4 th
Lack of alternative feed source	69	37(31.4)	19(16.1)	13(11.0)	2.7	4 th
Unpredictable temperature conditions	63	36(30.5)	19(16.1)	13(11.0)	2.6	7 th
High cost of temperature control maintenance	42	23(19.5)	13(11.0)	6(5.1)	2.6	7 th
Poor Veterinary interventions	71	35(29.7)	24(20.3)	11(9.3)	2.6	7 th
Paucity of information	58	33(28.0)	18(15.3)	7(5.9)	2.6	10 th
Unaware of climate effects	51	29(24.6)	16(13.6)	6(5.1)	2.5	11 th
Ineffective vaccination schedule	75	48(40.7)	14(11.9)	13(11.0)	2.5	11 th

Knowledge of Dry Season Livestock Production Management

The contingency table (Table 4) analysis of the respondents' knowledge of dry season livestock production indicates the existence of a significant relationship between the knowledge variables of respondents and the knowledge category. Respondent's knowledge of dry season's effect on production cost ($\chi^2=15.61$), fodder supply ($\chi^2=31.72$), livestock mortality ($\chi^2=30.93$) was among significant knowledge variables that influence the general knowledge of dry seasons among livestock farmers. On the other hand, the high frequency of respondents with uncertain knowledge of feed adjustment ($\chi^2=4.18$) and of regular fresh water supply ($\chi^2=0.66$) contributed insignificantly to the knowledge level of livestock farmers. The summary of the responses in the categorization shows that 57.6% had low knowledge of livestock management during the dry season. This result implies a higher influence of the uncertain knowledge variables on the overall livestock farmers' knowledge of management practices during the dry season. Thus, more livestock farmers interviewed were likely to be vulnerable to climate change effects as it unfolds unless for knowledge intervention.

Table 4: Distribution and mean categorization of responses to knowledge of issues in dry season livestock production management.

Statements	Yes	Not sure	(χ^2)
Able to maintain conception rate during dry season to reduce production cost	42(35.6)	76(64.4)	15.61**
Able to increase fodder supply during dry season	32(27.1)	86(72.9)	31.72**
Able to detect the effect of dry season on animal size	29(24.6)	89(75.4)	14.21**
Able to adjust changing livestock feeding pattern	18(15.3)	100(84.7)	14.59**
Able to control the dry season effect on the general performance of animal	19(16.1)	99(83.9)	12.41**
Understand that cost of production increases by 10 – 15% during dry season	36(30.5)	82(69.5)	10.04**
Able to control mortality during dry season	38(32.2)	80(67.8)	30.93**
Opressive heat during dry season affects the level of production	14(11.9)	104(88.1)	16.58**
Able to provide fresh water always during dry season	7(5.9)	111(94.1)	0.67
Understand that good housing is a major requirement in salvaging the effect of dry season	11(9.3)	107(90.7)	7.73**
Adjust feeds and feeding to changes during dry season	3(2.5)	115(97.5)	4.18
Scores (Mean 21.6±1.9)	Frequencies	Percentages	
15 – 21.59	50	42.4	
21.6 – 24	68	57.6	

** Significant @5% level

Farmers' Opinion to Livestock Management Practices During Dry Season

Farmer's opinions on management practices in livestock production are shown in Table 5. Majority (89%) of the farmers disagreed with the possibility of including temperature control mechanism in livestock housing structure. Many (80%) do not make adequate feed preparations towards the dry season, only an average of the respondents (50%) agreed that effective management ensures adequate biosecurity and avert livestock mortality in production. This result implies that farmers do not have a positive disposition to the reality of climate change and the adverse effect this could have in realizing efficient livestock farming at dry season as posited by Ayanlade *et al.* (2017).

Table 5: Farmers' opinion on livestock management system distribution (A – Agree; U – Undecided and D – Disagree)

Opinion items	A	U	D
Mechanism for temperature control should be included in the housing structure from the onset of the production	4.2	6.8	89.0
Biosecurity control saves much stress during dry seasons	50.0	21.2	28.8
Temperature control will reduce incidences of diseases and pest attacks	13.6	11.9	74.6
Adequate feeding/ feed arrangement is required	10.2	16.1	73.7
Silage and hay preparation before the onset of dry season is important for a large scale farm	52.5	16.9	30.5
Dry season livestock requires provision of fresh water regularly	17.8	19.5	62.7
Supplements improve nutrient conversion rate of livestock	5.9	20.3	73.7
Livestock size can be maintained during dry season	39.0	26.3	34.7
Lightings during dry season period for livestock is essential	28.0	22.9	49.2
Training can help to improve management skills in livestock production	83.1	11.9	5.1
High mortality of livestock in dry season can be as a result of poor farm management	77.1	15.3	7.6
Reduction in animal size observed during dry season can be prevented	49.2	20.3	30.5
Total (Cumulative responses)	25(29.4)	15(17.4)	45(53.2)

Relationship between major livestock farming types and knowledge level of dry season farming

Respondent's ability to read and write Yoruba ($\chi^2=0.213$; $p < 0.005$), constraints to production ($r = 0.003$; $p < 0.005$), and farmers' opinion on efficient livestock management practices ($r = 0.327$; $p < 0.005$) during the dry season were factors that significantly influenced knowledge of dry season as shown in Table 6. The ability or inability of respondents to read or write English, the livestock production types and educational level did not influence their knowledge of dry season management practices.

Table 6a and 6b. Relationship between farmers' variables and knowledge of dry season farming

Table 6 (a)

Variable	χ^2	Df	<i>p</i>
Sex	3.890	1	0.144
Ability to read and write Yoruba	9.179	1**	0.003
Ability to read and write English	0.099	1	0.567
Education level	3.398	4	0.494
Livestock type	8.488	6	0.205

Table 6 (b)

Variables (Correlations)	R	<i>p</i>
Age	-0.0917	0.294
Household size	0.208	0.265
Constraints to production	0.213**	0.024
Opinion to efficient management	0.327**	0.<0001

**Significant at the 0.05 level of significance

Discussion

The advanced age of farmers and their ability to gather relevant information in letters (Table 2) could be a positive coping mechanism for the variability of climate in livestock production (Fadina and Barjolle, 2018). Understanding information disseminated in English and Yoruba would afford farmers the privilege of access to relevant climate information packaged in modern communication media tools. Literacy could have also aided confidence in the expression of intentions among the livestock farmers. Communication in the Yoruba language is an advantage in information dissemination and inquiry in South West region of Nigeria. Furthermore, gender difference in the ownership and management of livestock had been registered in the literature (Bonis-Profumo *et al.*, 2022). This has far-reaching implications for gender empowerment, household food security, and the economy in the area.

The cost of feeds and the management of medications comprise major production costs in most livestock production. The shortage of funds indicated as most severe in Table 3 could imply limited funds for adequate feeding for livestock during the dry season. One major feature of the elongated dry season is the lack of / reduced rain which causes increased temperature (Ayanlade *et al.*, 2017) which naturally reduces green vegetation and food production (Agbaje *et al.*, 2021). Livestock that depends on feeds derived from green vegetation and on the free range will seek alternative feed resources thereby increasing the demand for feeds. However, some items such as increased feed cost, and ineffectiveness of scheduled vaccination affected more farmers but were not identified as very severe constraints to management practices in livestock farms. This either suggests confidence in the management of the challenges or an improved resilience to adapt to the reoccurring challenges. The alternative feed sources to cater for different animal types are at increased prices. The effects of climate change on the quantity and quality of feeds are dependent on location, livestock system, and species (Rojas-Downing *et al.*, 2017). Climate exacerbates land degradation and reduces natural water sources (Ikhuoso *et al.*, 2020) thereby affecting the quantity and quality of feedstuffs such as pasture, forage, and grain also the severity and distribution of livestock diseases (Rekwot *et al.*, 2016). However, ranking of the constraint items suggests that farmers would imbibe better adaptive strategies with increased available fund and cheaper grazing options during dry seasons.

The findings of Leinonen (2019) on the basic requirement in responding to environmental climate variations including housing and feeding types corroborate the result in table 4. Farmers with low knowledge are likely to be more dependent on natural resources available for production, and unsustainably, leaving their livestock to fate at extremely dry periods. Ikhuoso *et al.* (2020) posited a meticulous planning of production systems for sustainable livestock production. In the context of Nigeria's recent farmer-herder crisis, this result implies an increased possibilities of conflict with crop producers in the search for feed during dry periods. Livestock

owners need new knowledge and better skills to overcome the issue of increasing challenges associated with production such as improving the quality of production (Hosseini and Ameri, 2014). The increasing herders-farmers crisis in the past months and especially during dry seasons in Nigeria has escalated into a major security concern for both rural and urban dwellers. The crisis is thus a reflection of low knowledge of efficient livestock management or a case of negligence among livestock owners. The many years of practicing a free range production system, especially for larger ruminants such as cattle, sheep and, goats and pigs which requires little or no management cost is reflected among some producers interviewed. Olafadehan and Adewumi (2010) affirm that many rural households practice free range livestock systems to reduce the cost of production.

Livestock is reared for different purposes in Africa. The purpose of rearing will determine the cost and attention committed to the business. Household livestock management could be for livelihood diversification or for traditional rites which do not require much intensive system of rearing either during the wet season or at dry seasons. In line with this, the opinion (Table 5) around livestock management among farmers might not incorporate dry season effects. Knowledge is acquired by exposure to relevant reliable information and livestock management practices can be influenced by positive opinions and reliable information (Mark, 2019; Teixeira *et al.*, 2018) Thus, positive opinions about efficient livestock production management could spur knowledge acquisition among the respondents. The contingency table of knowledge variables shows the significance of the level of knowledge (certain or uncertain) to the low management knowledge by the majority of respondents. The possible state of inaccessibility or non-utilization of relevant climate effects information among the livestock producers is obvious in the result. One important piece of information required to manage livestock during the extreme dry seasons is the coping strategy for heat management and diseases outbreak due to lack of rain (Ali *et al.*, 2020). Effective communication of such information would probably encourage more farmers to continue active production in periods of drought.

Yoruba is a major language of communication in the region of the study, disseminating or receiving information through any channel could significantly be determined by the level of expression of the Yoruba language. The significance of the ability to read and write Yoruba with knowledge of livestock production (Table 6) indicates the relevance of dry season farming information communicated in the Yoruba language. It is expected that an average resident of the south west region of Nigeria understands basic communication tips in the Yoruba language. It is also not impossible to have non-speaking Yoruba residents in the region that are just establishing a farming business which underscores the importance of information dissemination in the official English language. On the other hand, the significance of constraints to effective resilience practices on knowledge in livestock management could imply farmers' search for relevant information on those challenging items of production. Some of the constraints identified in this study include increased feed costs,

poor veterinary interventions and insufficient funds for production among others (Table 3). These factors are potent enough to dissuade farmers from production during adverse climatic conditions. This finding thus affirms the position of Rojas-Downing *et al.* (2017) that livestock farming during the dry season is not at the optimum level of production due to significant constraints.

Limitations of the study

This study made use of a convenience sampling method which is a non-probability method to gather respondents. Although the data collection was purposive on intended respondents, it would have been more elaborate to get a representative sampling of livestock farmers in south west Nigeria.

Conclusions and recommendations

This study found that livestock farmers in southwest Nigeria had developed resilience strategies mitigating elongated dry periods. However, limited funds constrained efficient management practices. More farmers disagreed with the possibilities of efficient management practices for all-scale livestock production during dry seasons because of climate-induced resilience practices. The low knowledge of efficient livestock management during dry periods informed the poor management practices observed in the study which implies a more devastating effect on land and other natural resources. Resilience of livestock farmers in the region was not well coordinated due to associated constraints. Free-range and nomadic production system has entrenched livestock production and barred farmers from the urge to acquire formal knowledge in management. Regular information dissemination on adaptation strategies of climate would help maximize risk mitigation efforts, reduce exposure to dry season effects, and preserve our natural resources for sustainable production. Climate adaptation information dissemination through informal mediums among livestock owners such as farmer's associations and online mobile platforms is also recommended in the region. Effective climate information dissemination and mapping of adaptation strategies among livestock enterprise is thus recommended in this study.

Authorship of contribution

The four authors contributed to the content of the paper in the order presented. Fadairo A.O conceptualize the study and did the write up, Popoola YA and Sorunke AO collected and analysed the data while Omole AJ supervised the study and edited the manuscript.

Conflict of interest statement

There is no conflict of interest in the publication of this manuscript. The authors declare that this manuscript is their original work and it has not been presented or published anywhere.

Acknowledgements

The authors appreciate the contributions of the administrative staff of livestock Improvement Programme of the Institute of Agricultural Research and Training, Ibadan, for their support during the interview of the livestock farmers in the institute. The understanding of the livestock farmers interviewed for this research is also well acknowledged.

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