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Regular Article



Pastoralists' knowledge of napier cultivation: Implication for social and environmental security in Nigeria

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ABSTRACT

Conflicts involving farming communities and itinerant pastoralists have resulted in social unrest while the cultivation of Napier grass can ensure feed, social and environmental security. Literature of the knowledge level of pastoralists in cultivating Napier grass is scarce, hence this study seeks to ascertain if pastoralists can cultivate Napier grass to raise cattle and determine the potential influence of cultivation on social and environmental security. The study was conducted in North Central Nigeria. A two-stage sampling procedure was adopted to select 208 participants (200 pastoralists and 8 extension practitioners) for the study. Questionnaire, focus group discussions and interview guide were used to collect quantitative and qualitative data and analyzed using descriptive, inferential statistics and content analysis respectively. Results showed that the majority (76.5%) of the pastoralists had no knowledge of Napier grass cultivation. Multiple regression showed that age, area of residence, years of experience in cattle rearing, method of feeding cattle, and awareness of Napier grass were factors determining pastoralists' knowledge of Napier cultivation ($R^2 = 0.561$, $F = 35.028$, $p < 0.01$). The extension practitioners affirmed that massive cultivation of Napier grass by the pastoralists is a sustainable roadmap to socio-environmental security whilst securing constant feed for cattle. The study concluded that although 76.6% of the pastoralists (through Focus Group Discussion) are willing to cultivate Napier, they do not have the requisite knowledge of the benefits and implications. Findings from this study are equally important to help in planning extension education aimed to foster social and environmental security. Thus, agricultural extension policy and training that can improve the knowledge of pastoralists is needed to promote social and environmental security.

1. Introduction

Nigeria has an estimated population of 223.8 million by mid-2023; making it the highest population of people in Africa and occupying the seventh position in the world (United Nation, 2022). Land mass is approximately 911,000 km^2 with up to 78.0% arable land. This consists of 33% permanent pasture while 36% of this is being utilized for agriculture among 60% of the country's population (FAO/IFAD/UNICEF/WFP/WHO, 2017). The sector contributed up to 21.1% to the nation's GDP (National Bureau of Statistics [NBS], 2022), while livestock farming sub-sector in Nigeria is mainly the primary occupation of the Fulani/Bororo tribe. Nigeria has the 6th largest cattle herd in Africa with an estimated 12 million pastoralists (Maina, 2016) who are involved in rearing more than 90% of about 20.7 million cattle (FAO, 2018) while this is expected to grow to 53.6 million by 2050. The pastoralists are also accountable for about 90% of domestic milk production in the country which is only about 13% of global dairy output (FAO/IFAD/UNICEF/WFP/WHO, 2017). Pastoralism means herding animals, most especially large ruminants (including cattle and sheep), for livelihood (Ducrotoy et al., 2016). It is a branch of agriculture that contributes about 10% of global meat production and supports around 200 million households in Africa (FAO/IFAD/UNICEF/WHO, 2017). It is a phenomenon that has not only experienced many inequalities in history but is usually omitted from most policy documents on regional economic integration (Catley et al., 2013).

Already, the negative impacts of climate change are being felt, in the form of increasing temperatures, weather variability, shifting agro-ecosystem boundaries, invasive crops and pests, scarcity of green

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pasture and more frequent extreme decline in grassland (Fereja, 2016; Hidosa & Guyo, 2017). It goes without gainsaying that climate is one of the fundamental indicators that determine both crop cultivation and livestock keeping (Aderinoye-Abdulwahab & Abdulbaki, 2020) while past works have shown that climate change has huge impacts on livestock productivity, sustainability and livelihoods of pastoralists (Habte et al., 2022; Uddin & Kebreab, 2020). Consequently, the impact of climate change is capable of making any government transformation tasks more demanding as livestock sub-sector of agriculture is one of the sectors most sensitive to climate change in Nigeria, with productivity set to decline by 10–25% by 2080 (Terdoo & Adekola, 2014). This may result in a 4.5% reduction in GDP by 2050 and a critical loss of livelihoods and increased poverty for households who depend on livestock rearing as their main occupation (OECD/FAO, 2016).

Climate smart agricultural practices (CSAP) increase productivity and resilience (adaptation) whilst reducing the emission of green-house gases (FAO, 2021). One of such practice is the cultivation of Napier grass to provide sufficient quantity of grass to feed cattle as this will mainly build herders' resilience to climate change effects. This is because Napier grass (*Pennisetum purpureum*) is a fast-growing tropical grass that is easy to establish with high productivity. It has the ability to regrow after frequent harvest with a year-round availability in the tropics and sub-tropics (Africa, Asia and part of Americas) where up to 77% of the world cattle are reared (Ekta, 2020; FAO, 2018). When converted to silage, its mixture with carbohydrate-based feed will improve feed intake, increase body weight and milk production of cows (Olorunnisomo & Ibhaze, 2013; Sembiring et al., 2017). Napier grass has the capacity to grow almost on any type of soil and can be fed directly to cattle and also processed into hay and silage (Muktar et al., 2022); massive cultivation in the form of grassland intensification also has the capacity to reduce the rate of emissions as cattle has the tendency of releasing large amounts of methane (CH4) into the atmosphere. Thus, this study anticipates that Napier grass can be introduced to pastoralists for cultivation to ensure feed security for cattle (Muktar et al., 2022; Ntege et al., 2021) and reduce the impact of climate change; thereby translating into social and environmental security for pastoralists and the nation at large.

Economic, social and environmental dimensions are integrated in CSAP for sustainable development to jointly address food insecurity, ecosystems management and climate change challenges (FAO, 2021; IPCC, 2022; World Bank, 2021). Hence, it is apparent that climate change poses different threats to the sustainability of agriculture in general and more specifically to that of food/feed security in most parts of Africa with the inclusion of Nigeria; while food/feed security may not be attainable without an all-inclusive integrated approach like CSAP (Ifeanyi-Obi et al., 2022). For extension practitioners' supports in Napier grass cultivation, the knowledge level of end users (pastoralists) is important to formulate relevant extension policy as well as planning and implementation of extension educational program aimed to foster environmental and social security. Unfortunately, there is a dearth of literature as to whether pastoralists have the requisite knowledge that will promote the cultivation of Napier grass. This study therefore seeks to fill this gap by ascertaining if pastoralists know how to cultivate Napier grass to feed or raise cattle.

1.1. Problem statement

Pastoralism, as practiced, poses a great demand on land and this leads to unsustainable land management practices such as overgrazing, desertification, soil erosion, and deforestation; while all of these further translate into shortage of land for human endeavors and get the ozone layer depleted (Aderinoye-Abdulwahab & Abdulbaki, 2020). The persistent nature of droughts has made farmers and pastoralists to realize that there is a need to mitigate and adapt to such hazards (Aderinoye-Abdulwahab & Chimgonda-Nkhoma, 2015). It has equally been established that the knowledge of climate smart practices among stakeholders is low in Nigeria and this could translate into a low uptake of the climate smart practices. Further, there is a need to clearly define climate smart policies that are directly targeted to favor farmers (pastoralists) who heavily rely on rain-fed agriculture (Ifeanyi-Obi et al., 2022).

Additionally, in recent times, there had been several reports of social unrest involving mobile pastoralists in search of green pasture for their cattle in farming communities in Nigeria (Nwozor et al., 2021). A non-governmental organization, the Coalition on Conflict Resolution and Human Rights in Nigeria reported that over 2000 lives were lost to clashes between the herdsmen and farmers in Benue, Taraba, Plateau, Adamawa, Kogi and Nasarawa States in 2017 (Sahara reporter, 2018). There is yet a study that suggests the adoption of Napier grass as a solution to the incessant crises posed to pastoralists and farmers. Hence, this study is proposing the massive adoption and cultivation of Napier grass, a Climate-Smart Agriculture Practice (CSAP) approach to develop technical, policy and investment conditions, to achieve sustainable development that will offer all-year round feed to cattle, ameliorate farmers-herdsmen crises, and boost livestock management practices (FAO, 2021).

1.2. Objectives and hypothesis of the study

As a result of the foregoing, the study investigates the following questions.

(i) What is the knowledge level of pastoralists on Napier grass cultivation?
(ii) Can Napier grass cultivation promote social and environmental security?

Hypothesis of the study in the null form is stated thus: The socio-economic characteristic of the pastoralists do not significantly influence their knowledge of Napier grass cultivation.

2. Theoretical framework for the study

Knowledge is a social construct (Ibarra & Adorjan, 2018), through exchange of information among people and the world. Thus, everyone's perception of truth is created by social processes and interactions that an individual is involved in (Burr, 2015). The attainment of knowledge starts with the practice of receiving or obtaining new information through the auditory sense of hearing, tactile, and visual. Adesoji and Kerere (2013) added that experience is an essential tool in the process. Learning sequence is a gradual process that follows the path of simple to complex behavior, unknown to known and knowledge to application. In view of this, reinforcement, which could positively impact on learner's performance, becomes a crucial step to ensure a desirable and satisfactory behavior. According to Roger (2003), innovation-decision process starts with the knowledge stage. At this stage, an individual learns about the existence of innovation and seeks information about it. "What?" "how?" and "why?" are the critical questions in the knowledge phase. During this phase, the individual attempts to determine "what the innovation is and how and why it works" (Rogers, 2003). According to Rogers, the questions form three types of knowledge: (1) awareness-knowledge, (2) how-to-knowledge, and (3) principles-knowledge.

- *Awareness-knowledge*: Awareness-knowledge represents gaining an understanding that such an innovation exists while motivating the individual to learn more and, eventually, to adopt it. Also, it may encourage an individual to learn about the two other types of knowledge.
- *How-to-knowledge*: This type of knowledge is about detailed information on how to correctly use an innovation. An individual who has insubstantial or scanty information about an innovation may not be

able to use it correctly (Wetzel, 1993). Rogers adopted this type of knowledge as an important variable in the innovation-decision process. Adequate how-to-knowledge thus becomes a factor in increasing the rate of adoption of the innovation.

- *Principles-knowledge*: The principles-knowledge describes why and how the innovation works or functions. Even though an innovation could have been adopted regardless of this knowledge phase, the absence of this stage may result in misuse and consequently lead to the discontinuance of such innovation.

Gleaning on the learning theory, this study is based on the assumption that pastoralists need to imbibe the importance of Napier grass (knowledge), take some time to gradually change their attitude and perspective towards the cultivation of Napier grass (awareness-knowledge), inquire about 'how and when' Napier is cultivated (how-to-knowledge) and eventually apply the acquired knowledge by adopting the practices that will favor environmental and social security (principles-knowledge). We expect that they would be willing to apply their knowledge of the importance of Napier grass cultivation to feed cattle; provided that the livestock extension agents deploy the requisite training on needed practices to cultivate/grow Napier grass whilst also monitoring their performance in case there is need for corrective action.

2.1. Conceptual framework for pastoralists' knowledge level for socio-environmental security

The framework is conceptualized in three basic fragments of independent, dependent and intervening variables. The aim of this study is to examine the pastoralists' knowledge level of Napier grass cultivation to raise/feed cattle in order to ensure environmental and social security. Fig. 1 shows that certain antecedents serve as push and pull factors that guide the direction of the variables in the study. The independent variables are assumed to exert an influence on the dependent variable (pastoralists' knowledge of Napier grass cultivation to ensure social and environmental security). The intervening variables may or may not affect the pastoralists' knowledge of Napier grass cultivation to ensure socio-environmental security.

3. Materials and methods

3.1. Study area

Nigeria comprises six geo-political zones while the study was carried out in the north central zone of the country (Fig. 2). It covers latitude 7^0 00'-11^0 30′ North of the equator and longitude 4^0 00'-11^0 00′ East of the Greenwich meridian. The States found in the North Central zone are: Benue, Plateau, Niger, Kogi, Kwara, Nasarawa and the Federal Capital Territory (Abuja). According to Federal Government of Nigeria (FGN),

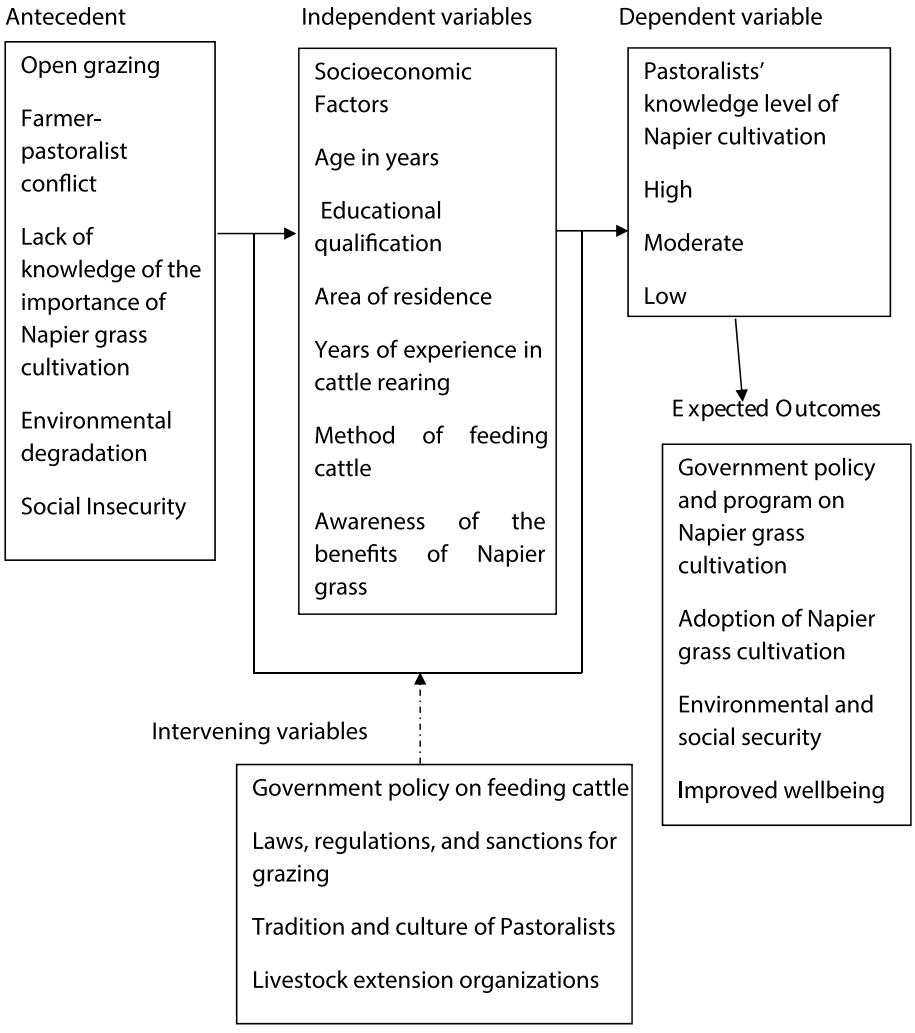


Fig. 1. Conceptual framework for Pastoralists' Knowledge of Napier Grass Cultivation for Environmental Security.
Source: Author's construct (2021)

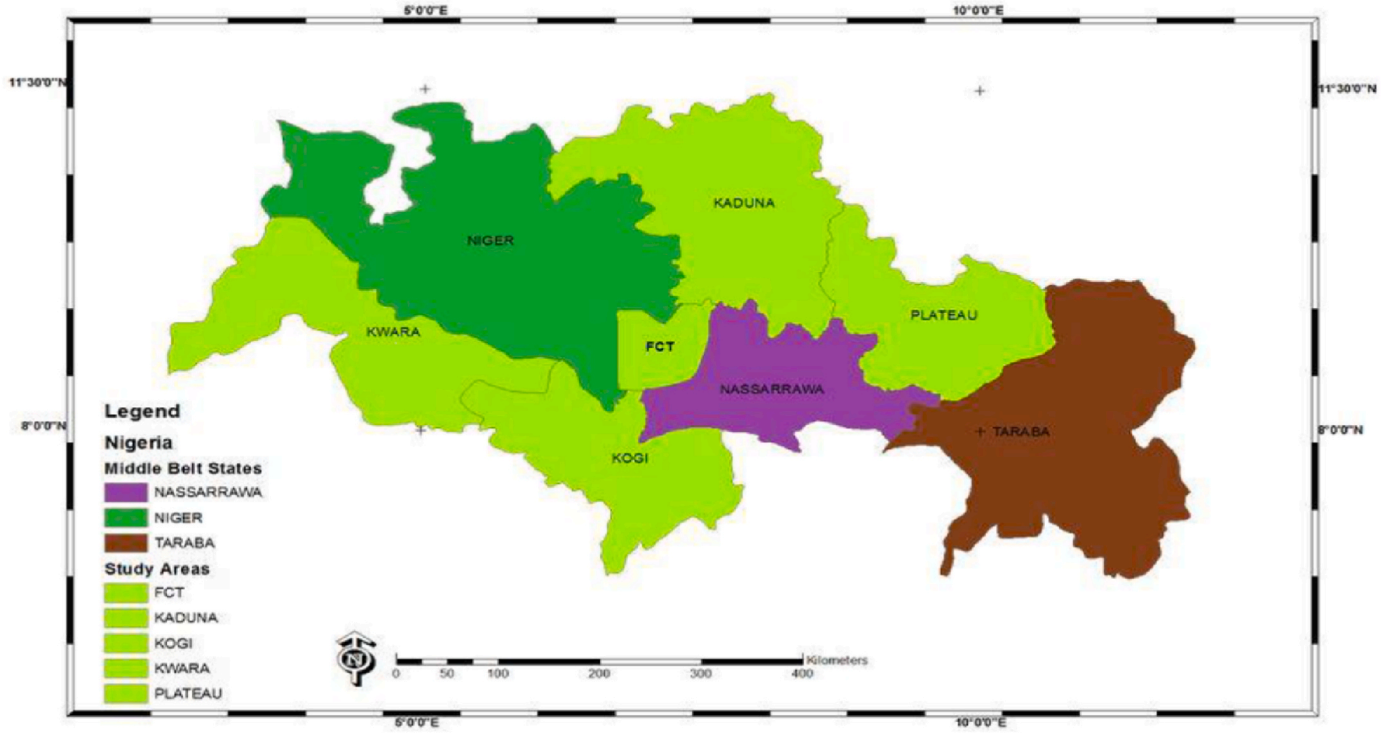


Fig. 2. Map of North-Central Nigeria showing the study area.
Source: National Space Research Development, (NASRDA, 2013).

(2006); the zone has a population of about 20, 266, 257 inhabitants. The economy is mostly agrarian suitable for growing crops such as maize, beans, and tomatoes; rearing livestock such as sheep, goat and cattle of nomadic herding by migrant herdsmen; and fisheries activities (Issa et al., 2022). Average annual rainfall ranges between 1, 200 mm and 1, 500 mm while the rainfall pattern is predicted at an increase of 0.58 mm per annum from 2013 to 2042. Temperature is high almost throughout the year except during harmattan period which begins around November and ends in February/March. Ecologically, the North Central zone is situated in the Guinea savanna region of the country, however its vegetation cuts across the three savannah belts (Guinea, Sudan and Sahel) and this is one of the reasons why both cereals and roots crops are prominent in this ecological zones.

(http://www.ombudsman.state.ny.us/Documents/Manual/Oct04-Revised5-5-05/Module5.pdf)

3.2. Population of the study and sample size

The population for this study comprises all extension practitioners and all members of herders' associations (Miyetti-Allah Pastoralists Association) in North Central Nigeria. The study employed two (2) stage sampling technique. The first stage involved a simple random selection of two states (Niger and Kwara). Given the mix of qualitative and quantitative methods, the study liaised with leaders of the Miyetti-Allah pastoralists associations in the chosen states, adopted a snowball sampling technique to select pastoralists who were willing to participate, and decided on an equal number of 100 pastoralists from each of the two states for ease of analysis. Thus, a total of 200 pastoralists were selected for the study. In this study, extension practitioners are individuals functioning in different specializations related to agriculture or environmental extension in public and private extension establishments. Therefore, one extension practitioner was drawn from each of the establishments that constituted the population of study (State Agricultural Development Project, State Ministry of Agriculture, State Ministry of Environment and one private extension organization) to make four (4) extension practitioners from each selected state. Thus, a total of 8 extension practitioners were selected for the study.

3.3. Data collection and analysis

The study relied on quantitative and qualitative methods of data collection. Primary data to achieve objective 1 was collected from pastoralists while information to achieve objective 2 was sought from extension practitioners. A relevant expert content validated and reliable (Cronbach alpha coefficient = 0.71) structured questionnaire and focus group discussions were used to collect data from pastoralists on knowledge of Napier grass cultivation while Key Informant Interview (KII) was conducted for extension practitioners to generate qualitative data on the research question 'Can Napier grass cultivation promote social and environmental security?' Descriptive statistics was used to report the results of objective 1 while content analysis (that is, presentation of direct statements which are relevant to subject matter), as adopted by (Fernandez-Gimenez et al., 2021) was employed to achieve objectives 1 and 2 of the study. The *how-to-knowledge* of pastoralists on Napier grass cultivation was measured using a self-rated test. According to Sharma et al. (2016) self-assessment has the potential to identify gaps, motivate, and increase performance. Respondents were asked to rate their knowledge of the cultivation of Napier grass for socio-environmental security on a 4-point Likert type scale of high (whole), moderate (almost all), low (some part), and zero (not at all). The scale was assigned numeral 3, 2, 1, and 0 respectively. Linear multiple regression (Ordinary Least Square) was used to test hypothesis of the study. The OLS model was expressed as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + e_i \quad (1)$$

Where.

Y = knowledge of Napier grass cultivation
X_1 = age (years)

$X2$ = educational qualification (dummy as formal educated = 1, otherwise = 0)
X_3 = area of residence (dummy as urban = 1, otherwise = 0)
X_4 = experience in herding (years)
X_5 = method of feeding (dummy as open grazing = 1, otherwise 0)
X_6 = awareness of Napier grass as feed for cattle (yes = 1, no = 0)
β_0 = intercept
e_i = error term

4. Results and discussion

4.1. Socio-economic characteristics of pastoralists in the study

Results presented in Table 1 showed that 40% of the pastoralists were aged 51–60 years, 22.5% were between 41 and 50 years while the average age was 47.4years. The implication is that most of the pastoralists in the study were above the age of 40 and less than 60 years. It thus means that the pastoralists in the study are deep-rooted in the business of cattle rearing and would have mastered the art of herding as it is expected that this is their primary occupation. It further means that the sample might have experienced different methods of grazing and have settled for a convenient one that they have used over the years. On years of experience in cattle rearing, 40.0% had 11–20 years of experience, 22.5% had 21–30 years of experience with an average of 22.3 years. Again, this is evidence that mobile pastoralism is an age-old initiative that has been in existence since time immemorial (Catley et al., 2013) as corroborated by the results on age. Majority (82.0%) of the respondents were members of Myetti-Allah cattle association. The majority (97.0%) resides in rural areas as previously reported in other studies that pastoralists live within the margins (Catley et al., 2013; Aderinoye-Abdulwahab & Chimgonda-Nkhoma, 2015; Aderinoye-Abdulwahab et al., 2019) and 94.0% of them do visit the urban areas about 4–6 times per annum. The pastoralists (40.5%) had no formal and only (36.5%) had Quran education. Again, there have been reports pointing at the low level of education for people living within the margins (Aderinoye-Abdulwahab et al., 2019; Aderinoye-Abdulwahab et al., 2022). Lack of formal education among the pastoralists may indicate poor technical knowledge of Napier grass cultivation and could also be a reason for the seemingly low knowledge of information that can encourage the cultivation of Napier grass (Fig. 3). Majority (91.0%) of the respondents feed their cattle by open grazing where they would potentially feed their cattle with wild Napier grass and thus could, subsequently over time, become aware (68.5%) (Table 1) of the importance of Napier grass cultivation to feed cattle. This is expected to support their behavior in seeking and acquisition of technical knowledge of Napier grass cultivation as a feed source for their cattle.

Table 1
Socio-economic characteristics of pastoralists.

Variables	Frequency	Percentages	Mean
Age (years)			
≤30	30	15.0	
31–40	29	14.5	47.4years
41–50	45	22.5	
51–60	80	40.0	
≥61	16	8.0	
Years of experience			
1–10	30	15.0	
11–20	80	40.0	22.3 years
21–30	45	22.5	
Above 30	45	22.5	
Membership of Myetti-Allah cattle association			
Yes	164	82.0	
No	36	18.0	
Area of residence			
Rural	194	97.0	
Urban	6	3.0	
Frequency of visit to major towns			
0	6	3.0	
1–3	6	3.0	
4–6	188	94.0	
Awareness of the importance of Napier grass			
Yes	137	68.5	
No	63	31.5	
Educational qualification			
No formal	81	40.5	
Quran	73	36.5	
Primary	16	8.0	
Secondary	12	6.0	
Tertiary	18	9.0	
Feeding system			
Open grazing	182	91.0	
Open grazing and intensive system	18	9.0	

Source: Field Survey, 2022

4.2. Knowledge of pastoralists on napier grass cultivation

A self-rated assessment of knowledge level of the cultivation of Napier grass for raising cattle was conducted. The results, as displayed, in Fig. 3 illustrate that most (76.5%) of the respondents had no knowledge or information that can encourage them to cultivate Napier grass. Only 20.5% had low knowledge, 3.0% had moderate knowledge while no respondent indicated high knowledge of Napier cultivation to feed cattle. This finding implies that pastoralists in the North Central Nigeria had no knowledge of how to cultivate Napier grass and this could also imply that the pastoralists, even though they claimed to be aware of the importance of Napier grass (Table 1), may not be aware of the benefits of Napier in ensuring socio-environmental security.

> …. .we know the grass very well and would be willing to cultivate it provided there are favorable policies that will ensure its sustainability. A similar grass was introduced to us many decades ago-during the regime of Shehu Shagari (early 1980s). It is only that we do not know how to cultivate it (FGD-5, 2021).

4.3. Hypothesis of the study

The null hypothesis: The socio-economic characteristics of pastoralists do not significantly influence their knowledge level of Napier grass cultivation. This hypothesis was rejected as the result of the regression analysis (Table 2) shows that certain socio-economic factors significantly influenced the knowledge of pastoralists on the cultivation of Napier grass ($R^2 = 0.561$, $F = 35.028$, $p < 0.01$). Overall, the socio-economic factors predict 56.1% of pastoralists' knowledge of the cultivation of Napier grass. Specifically, it was found that age, area of residence, years of experience in cattle rearing, method of feeding cattle, and awareness of Napier grass as feed for cattle have significant influence on the knowledge of pastoralists. This implies that an increase in 1 unit of age in years ($\beta = 0.009$, $p < 0.05$), years of experience in cattle

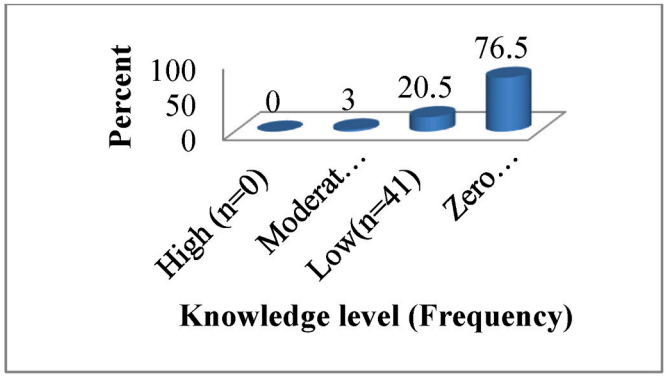


Fig. 3. Pastoralists' knowledge of napier grass cultivation.

Table 2
Linear regression showing factors that contributed to knowledge level of pastoralists on Napier grass cultivation.

Knowledge of Napier grass cultivation	B	Std. Error	t-stat.	Sig.
(Constant)	−1.752	0.261	−6.711	0.000
Age in years	0.009*	0.004	2.408	0.017
Educational qualification	−0.004	0.027	−0.131	0.896
Area of residence	1.887**	0.179	10.526	0.000
Membership of Myetti-Allah cattle breeders association	0.100	0.100	1.004	0.317
Years of experience in cattle rearing	−0.021**	0.003	−6.229	0.000
Method of feeding cattle	−0.142*	0.06	−2.386	0.018
Awareness of Napier grass as feed for cattle	0.316**	0.058	5.466	0.000

R Square = 0.561.
Adj. R Square = 0.545.
Std Error of the Estimate = 0.341.
F stat. = 35.028.
P = 0.000.
**Significant at 1%; *Significant at 5%.

rearing ($\beta = 0.021$, $p < 0.01$), area of residence ($\beta = 0.887$, $p < 0.01$) and awareness of cultivation of Napier grass as feed for cattle ($\beta = 0.316$, $p < 0.01$) will lead to increase in the knowledge level of pastoralists by 0.009 units, 1.887 units and 0.316 units respectively. This means that the older a pastoralists is, the more experienced they are, and the more information a pastoralist should have, then the more knowledgeable they will become in Napier cultivation. Meanwhile, a level increase in knowledge of Napier grass cultivation leads to decrease in the existing method of feeding cattle (i.e. open grazing) by 0.142 units. By implication, once the knowledge of Napier cultivation increases, pastoralists will tend to cultivate more Napier to feed their cattle and by extension, this can make them desist from open grazing, ultimately resulting in less scarcity/shortages of all year round feed, reduced conflicts, cleaner and a more secured environment.

4.4. Napier grass cultivation for social and environmental security: the extension practitioners' perspective

The section presents results from the data generated through the qualitative methods. Extracts from the key informant interviews (KII) which were conducted among extension practitioners on the potential benefits of Napier grass cultivation for environmental security as well as the focus group discussions (FGD) that were held with the pastoralists were analyzed. Four themes were explored and they included: knowledge of the benefit of Napier grass, willingness of pastoralists to cultivate Napier grass, whether Napier cultivation can guarantee feed security for all year-round consumption, and whether the cultivation of Napier can translate into socio-environmental security. The data was explored using content analysis and results are as presented.

4.4.1. Theme one: knowledge of the benefits of napier grass

1. According to an extension practitioner in one of the in-depth interviews, he described the importance of growing the grass thus:

   "… … …deliberate and copious cultivation of grass such as Napier which is indigenous to us will add to the existing natural grassland area. With the rising impacts of climate change, such deliberate effort is urgently required to increase our grassland area (*KII-3, 2021*).

   … … …Napier grass, like other plants, inhales carbon-dioxide and releases oxygen which detoxifies the air in the environment. Massive cultivation of Napier grass can thus cleanse or improve the quality of air we breathe in … …(KII-9, 2021).

   In one of the FGDs, pastoralists hinted that Napier cultivation will reduce long distance trekking for pasture especially if the grass fields are not too far away from their homes. They also believe that their cattle will be better-fed, hence meat and milk production and by extension, their incomes will increase. Pastoralists are optimistic that Napier grass cultivation will minimize other social vices such as cattle rustling and banditry (FGD- 4, 2021).

   … Napier grass can be cut and dried into hay ….which can then be kept for later use (KII-4, 2021).

   …. .If we can cultivate this grass in large quantity, it will help to assuage the conflicts between pastoralists and farmers. Our cattle can also have more pasture to feed on and this will make them grow bigger in size and produce more milk. We will also travel less and our children will be able to go to school. Up until now, our sons are the ones who help to graze the cattle from one village to another. My only worry is, how do we get the land to cultivate this grass in large quantity?(FGD-3, 2021).

4.4.2. Theme 2: willingness of pastoralists to cultivate napier grass

2. On willingness to cultivate Napier, respondents were of the opinion that they would happily cultivate the grass provided the resources are available. It has previously been reported that pastoralists hoped on government to create grazing reserves in order to be able to feed their stock (Aderinoye-Abdulwahab & Chimgonda-Nkhoma, 2015). Among the required resources are: land, seedlings, water, and political will in form of appropriate implementable policies. A 52 year old extension practitioner, with 20 years of experience in the field stated that:

   " …. ..*cultivation of Napier grass is an excellent initiative. If government can provide relevant policy on suitable environment, it will definitely enrich the green land area and contribute immensely to grassland intensification; hence Napier cultivation can curb or at least reduce the impact of climate change and detrimental effect on our environment can be assuaged*" (*KII- 7, 2021)*.

   …. We are more than willing to accept and cultivate this grass, but where is the land and where are the other resources to achieve this? (FGD-1, 2021)

   …. Napier grass beautifies the environment. It offers a good scenic (KII-3, 2021).

   …. pastoralists will be willing to cultivate the grass, although that may not prevent them from relocation. Mobility is part of them. In as much as they may accept to cultivate Napier, I believe they will not rely on the grass as the sole source of feed for cattle. However, Napier cultivation will go a long way in resolving much of the challenges that come with the current system of livestock management (KII-3, 2021).

4.4.3. Theme 3: can Napier cultivation guarantee feed security?

3 . Extension practitioners were also asked to give their opinion on the cultivation of Napier grass for an all year-round livestock feed security. A 39 year old with 12 years of experience as agricultural extension agent emphasized, during an in-depth interview, that:

   "… ….if the pastoralists are well informed and trained on how to cultivate the grass in large quantity, I believe it can serve them. Although it may be difficult for pastoralists with large herds to settle for cultivated grass, because a cow can consume up to an acre of grass per day depending on the density of the grassland field (KII-3, 2021).

   …. .it can adequately serve for the year because the grass can be kept in form of hay and silage. Moreover, it takes only three months to

harvest hence, this will make it available all the time. However, pastoralists will need support from government to be able to afford cultivation at a level that will ensure all year-round feed security (KII-6, 2021).

… of course, Napier has a rapid turn-around period as it takes only 3 months to maturity. The grass can also be cut and re-propagated. It can offer feed security in the sense that the cattle can be fed with other fodder crops even when Napier is not readily available (KII-7, 2021).

Another extension officer also expressed the following:

"… … *its ability to serve pastoralists all year-round depends on their knowledge level, as well as the availability and the amount of access they have to necessary resources. If they are able to cultivate large expanse, they can be able to feed their cattle all year-round. Most of the pastoralists are itinerants from desert encroached states and they own no land to cultivate the grass. However, if all of these issues can be addressed, and the pastoralists are able to cultivate on large area of land, it will surely serve them during the raining and dry season* (KII, 2021).

4.4.4. Theme 4: Can napier grass cultivation ensure social and environmental security

4 Reports from the in-depth interviews further showed that cultivation of Napier grass can guarantee social and environmental security as evidence has shown that efforts such as grassland intensification can forestall altercations between farmers and herders. Regarding the extended effect of Napier grass cultivation among the pastoralists, a livestock advisory officer stated her position thus:

…. *search for green grass to feed their livestock has been one of the main reasons for the rising clashes between the pastoralists and crop farmers. So, if the pastoralists are well informed of the benefits and are imparted with the practical knowledge (know-how) of Napier cultivation while presenting the grass as a better alternative, it is expected that mobile pastoralists in search of grass will settle in particular locations where the pasture (Napier grass) is readily available. Reduced movement in search of pasture is capable of minimizing the rising conflicts involving pastoralists and farming communities and this can translate to enhanced social security (KII-1, 2021*).

An agroforestry extension expert noted that Box 1:

…. .Napier cultivation would afford pastoralists the opportunity to be more settled. The main reason they migrate from one place to another is the search for pasture, if the pasture becomes domiciled within the geographical space, they would relocate less. The fact that Napier reaches maturity in 3 months presents with a great advantage for the pastoralists to get up to four harvests within a year (KII- 9, 2021).

…. .In addition, Napier cultivation will allow for a reduction in the amount of atmospheric carbon-dioxide thereby causing cooling. Again, it will make the livestock healthier and make the soil better aerated (kII-9, 2021).

5. Implication for theory, policy, and practice

5.1. Theoretical implication

Even though Roger (2003) has noted that - *how-to-knowledge* is an important factor in increasing the rate of adoption of an innovation, in principle and based on the findings of this study, learning to improve *how-to-knowledge* of innovation (Napier grass cultivation) is a function of awareness, experience, age, and area of residence (cosmopoliteness) of the learner (pastoralists). Moreover, findings from this study show that principles-knowledge (this is how an innovation works and functions) was absent, even though an innovation could have been adopted regardless of this stage. Nonetheless, the absence of the stage may result in misuse or lack of use, and consequently, lead to non-adoption or discontinuance of such innovation (Napier cultivation). It is only when pastoralists are well informed and imparted with the practical know-how of Napier cultivation, that mobile pastoralists will become more sedentary and remain in locations where the pasture (Napier grass) is being cultivated. Thus, these considerations are required to guide and possibly influence; when designing extension packages aimed at building the capacity of pastoralists on the knowledge of how to cultivate Napier grass for feeding cattle and safeguarding the environment.

5.2. Policy implication

There is an urgent need for the formulation and implementation of appropriate extension policies and programs that will address the key problems highlighted (social unrest and climate change impact). For example, it has been established that movement in search of green pasture, which can normally contribute to social and environmental insecurity, heightens the conflicts involving pastoralists and farming communities, thus policies that will favor sustainable livestock management need to be well disseminated and enforced amongst pastoralists. Therefore, policy makers at all tiers of government should, as a matter of necessity, formulate proactive extension policy that support the establishment of artificially grown pasture (Napier) to feed livestock as this is necessary to abate the lingering social unrest/conflicts as well as promote environmental security.

Box 1
Summary of the four themes

Napier grass cultivation for socio-environmental security

1. First, extension agents can educate pastoralists on the knowledge of Napier cultivation. Moreover, they can be enlisted to inform, train, and educate pastoralists on the advantages, disadvantages and other benefits that are accruable from Napier cultivation.
2. Incidences such as farmers/herdsmen conflicts, cattle rustling, banditry, kidnapping among other vices can be curtailed with the introduction of Napier cultivation.
3. Pastoralists will require government intervention in the cultivation of Napier grass. This is because Napier cultivation at the level that can resolve the identified challenges associated with the current grazing system would require more efforts and resources than the pastoralists can manage on their own. By implication, pastoralists will no longer need to graze on farmers' plots.
4. Policies that will support environmental security through Napier cultivation should be promoted and implemented without delay. For example, there should be restriction laws that will regulate pastoralists' grazing and sanctions should be enacted for non-compliance.

KII- (1–9), 2021

5.3. Implication for practice

Napier grass cultivation is a form of CSAP that can help to boost grassland intensification through ecosystems management as this will mitigate climate change challenges. Not only did the study establish that most (76.5%) of the pastoralists had no knowledge or information of how to cultivate Napier grass, but it also showed that they are not aware of the importance of Napier grass in ensuring socio-environmental security. It thus becomes highly crucial for extension practitioners to impart on pastoralists-the knowledge and information on how to massively cultivate the grass to further contribute to resolving the alarming rate of global release of greenhouse gases thereby preventing them from polluting the environment. It will also guarantee all-year round feed for raising cattle and empower pastoralists on skills related to the practical cultivation of Napier grass.

6. Conclusion

The study found that most of the pastoralists previously had no knowledge of the importance of Napier grass cultivation in ensuring all year-round feed for cattle, but they are willing to adopt its cultivation to guarantee feed and environmental security. The awareness of benefits of Napier grass to pastoralists, their years of experience, their ages, and their areas of residence are crucial in determining smooth adoption of Napier grass for feed, social and environmental security. Extension practitioners, on the other hand, are of the opinion that Napier grass can alleviate the social problems associated with the current grazing system. This suggests that if pastoralists are fully aware and have the requisite knowledge of the importance of Napier grass cultivation, they will be motivated to adopt its cultivation for feeding their livestock; thereby resulting in an eventual solution of the social and environmental challenges as occasioned by the current grazing system and the insufficient resources (land, water and grazeland).

It is therefore recommended that the extension practitioners need to deploy the requisite training on needed practices to cultivate/grow Napier grass whilst also monitoring pastoralists' performance in case there is need for corrective action. It would be necessary to carry out further studies to determine whether pastoralists would be willing to be permanently settled even when Napier grass is readily available all year round rather than remaining mobile.

CRediT authorship contribution statement

Sidiqat Aderinoye-Abdulwahab: Writing – review & editing, Writing – original draft, Validation, Project administration, Conceptualization. **Tawakalitu Abiola Dolapo:** Writing – review & editing, Data curation. **Sola Emmanuel Komolafe:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis. **Fadlullah Olayiwola Issa:** Writing – review & editing, Validation, Supervision. **Emmanuel Bamidele Tologbonse:** Writing – review & editing, Visualization, Supervision.

Declaration of competing interest

We hereby declare that we are interested in publishing in your journal and will look forward to favorable response from you. Thank you.

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