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Traditional Seed Production and Processing Method for *Urochloa* Grass Employed by Farmers in the Adamawa Region of Cameroon

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Authors' contributions

This work was carried out in collaboration among all authors. Authors OAN, EEA, EETB and KAE designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors MCT and CM managed the analyses of the study. Authors OAN, EEA and EETB managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To investigate the traditional / local seed processing system employed by farmers in the Adamawa region, examine the practices and techniques used in seed production and processing.
Study Design: A purposive random sampling technique was used.

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Place and Duration of Study: This study was carried out at seven localities (Ngaousai, Youkou, Wakwa, Darang, Mbidjoro, Beka and Bini) in Adamawa region, Vina division (Ngoundere) between September and October 2019

Methodology: The research included a combination of phone calls interviews, focus group discussion (FGD) and use of semi-structured questionnaires. The views of 16 farmers were sampled focusing on socioeconomic characteristics, the benefits of *Urochloa* grass, perception of Urochloa grass and seeds production system as well as cost of production of *Urochloa* seeds. The economic return in terms of benefit/cost ratio was calculated taking into consideration the current prices of various inputs.

Results: Male-headed families made up 81% of the respondents. Most of the respondents were within the productive ages of 31-40 years (31%) and 41-50 years (31%). Majority of respondents (75%) owned their farms and most of them (63%) have been farming for more than 10 years, with (44%) of them farming on areas between 5 and 10 hectares. 68.7% of the respondents get their seeds from past harvest. Most of the farmers (86.7%) harvest seeds using direct heading. Over all, the majority of respondents (81.25%) prepare their seeds by sun drying. In terms of economic value, results showed a Benefit: Cost ratio of more than 1.

Conclusion: The study contributes to the preservation and dissemination of indigenous knowledge related to *Urochloa* seed processing method. Thereby reducing the dependence of importing seeds to enhance livestock production. These findings underscore the potential of *Urochloa* seed production as a profitable agricultural activity that can contribute to the economic well-being of farmers in the region.

Keywords: Urochloa grass; traditional seed production; seed processing; benefit/cost ratio.

1. INTRODUCTION

Development of the agricultural sector is essential to boosting economic growth and eradicating poverty in many sub-Saharan African nations [1,2]. Increasing agricultural output and productivity is essential for ensuring food security since it gives smallholder farmers a source of income. Growth in other economic areas is stimulated by increases in agriculture production. One of the major barriers to raising production and productivity levels is frequently viewed as the infinite supply and accessibility of high-quality seed at the right place and at the right time combined with poor promotion system. Given the importance of seeds to food security, seeds are a fundamental component of all crop and forage production [3,4]. Additionally, seeds are essential to the survival plans used by farming communities all over the world [5,6,7]. *Urochloa* grass is a valuable forage crop that plays a crucial role in livestock production and sustainable agricultural systems [8]. In the Adamawa region of Cameroon, *Urochloa* grass holds significant importance for farmers who rely on its seeds for propagation and forage production. However, due to the nation's (Cameroon) seed systems' inefficiencies, there are not enough seeds available for its production. More attention is geared towards food crops as compared to seeds of forage crops. Consequently, some farmers have been relying on imported seeds and rooted tillers for *Urochloa* grass production over the years [9], which are quite expensive and sometimes not accessible timely. Nevertheless, in Adamawa region of Cameroon, most farmers have taken the initiative to produce their own *Urochloa* seeds locally. However, traditional methods of seed production and processes have been used globally by farmers for centuries to produce high-quality seeds that are adapted to local conditions. These systems are deeply rooted in the knowledge, practices, and cultural traditions of farmers in the region. They differ from modern methods in several ways. According to Wu et al. [10], in traditional methods, seed processing is highly empirically dependent, with parameters adjusted based on experience while modern methods utilize machine vision technology for rapid analysis and determination of processing parameters. Another study by [11] showed that traditional seed production and processing techniques involve manual or mechanical emasculation and male gametocide chemicals, while modern methods utilize biotechnological approaches such as genetic means of male sterility and genomics-assisted breeding.

One of the most important aspects of traditional seed production is the selection of parent plants. Farmers carefully select plants that are healthy, productive, and have the desired traits. These plants are then used to produce seeds for the

next planting season. A study by Mahadevappa [12] revealed that traditional seed production and processing techniques involved selecting the healthiest plants, saving their seeds, and storing them under special conditions while modern methods involve formal seed certification procedures and standards. Similarly, a study by Yamaguchi and Okamoto [13] discusses the traditional seed production methods for daikon in Kyushu, Japan, where seeds are harvested from selected plants and stored for future use.

Traditional seed production methods are often more labor-intensive than modern methods. However, they offer a number of advantages. They are readily available,affordable, more sustainable and environmentally friendly than modern methods and they can help to maintain crop diversity. A study by Bèye and Wopereis [14] focuses on the seed sector in the context of rice cultivation and highlights the importance of local traditional seed systems in ensuring seed quality, crop diversity, and food security. Traditional seed processing systems play a crucial role in the overall seed production cycle, encompassing seed production, seed processing, and seed marketing. Recognizing the importance of local/ traditional systems in preserving crop diversity and seed quality, as well as devising means to make better use of them, has become crucial.

Investigating the traditional/local seed processing system employed by farmers in the Adamawa region is essential for understanding the dynamics of seed production, processing, and marketing, as well as identifying opportunities and challenges associated with these practices. Therefore, this study has as objectives to investigate the traditional/local seed processing system employed by farmers in the Adamawa region, examine the practices and techniques used in seed production and processing. By conducting a thorough investigation of the traditional/local seed processing system, this research aims to provide insights into the strengths, challenges, and opportunities associated with these practices as well as cost of production.

2. MATERIALS AND METHODS

2.1 Experimental Site

This study was carried out during the global Covid 19 out break between September and October 2019 in Vina division (Ngaoundere1, 2 and 3) of Adamawa region Cameeroon. This area represents hotspots for cattle marketing in the region. Ngaoundere is located between 6° 40’0 ‘’ and 7° 30’0 ‘’ north latitude and between 13° 20’0 ‘’ and 14° 10’0 ‘’ east longitude (Fig. 1). Its climate is of the Sudano-Sahelian type and is characterized by a dry season (from November to March) and a rainy season (from April to October). The average rainfall is 1496.7 mm per year. The average minimum temperature recorded is 15.2°C and the maximum temperature is 29°C [15].

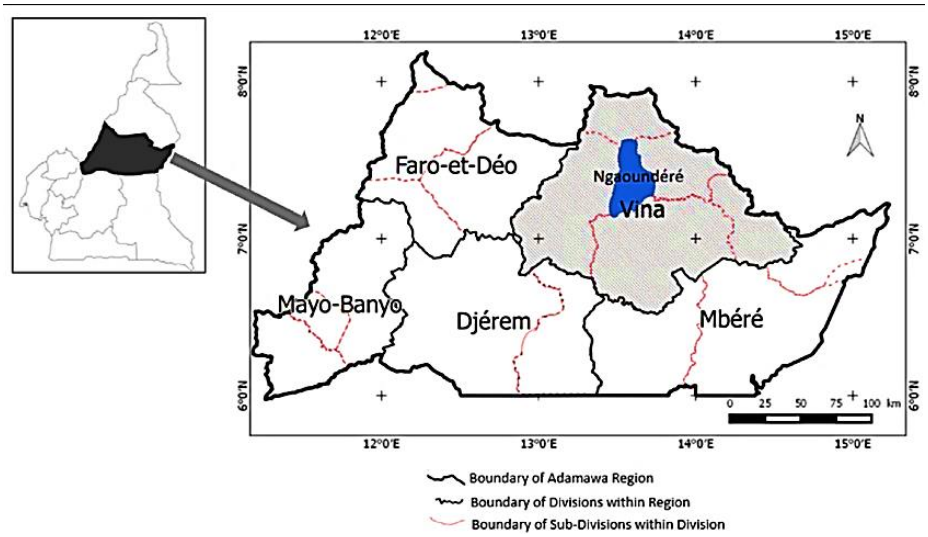

Fig. 1. Map showing study area (Ngaoundéré) in Vina Division of the Adamawa Region in Cameroon

(Source: Ngaoundéré City Council for map of Adamawa Region, Cameroon

2.2 Data Collection

The research included a combination of phone calls interviews, focus group discussion (FGD) and use of semi-structured questionnaires with both open and closed ended questions. This study was carried out at seven localities (Ngaousai, Youkou, Wakwa, Darang, Mbidjoro, Beka and Bini) in Adamawa region, Vina division (Ngoundere). The questionnaires focused on socioeconomic characteristics (age, gender, education, family size, farm characteristics,) the benefits of *Urochloa* grass (animal feed, income generation from sales of hay and seeds), perception of Urochloa grass and seeds production system (harvesting, processing, storage and marketing) as well as cost of production of *Urochloa* seeds in Adamawa region, Cameroon. The economic return in terms of benefit /cost ratio was calculated taking into consideration the current prices of various inputs. This includes costs of buying seeds, fertilizers, pesticides, labor costs for land preparation, planting, weeding and harvesting of seeds. The incomes from production was calculated based on the benefits from sales of the produce (seed). Benefit/ cost ratio was calculated using the formula employed by Thang et al. [16]. The questionnaire further recorded production challenges, including access to planting materials, crop management (planting densities, fertilization regime). Farmers experience with pest and diseases were also recorded. This was captured by asking the respondents whether they had noticed the infestation of pests and diseases, severity of infestation (rated on a four-point scale, where 0 = no problem, 1 = moderate problem, 2 = severe problem, and 3 = very severe problem) and how they managed the pests. Similarly, the discussions covered the strength/ benefits, weakness, opportunity and threats of *Urochloa* traditional seed production system. A purposive random sampling technique was used to sample the views of 16 farmers regarding *Urochloa* seed production technics. Furthermore, focus group discussions were conducted in other to back up individual interviews. Farmers were encouraged to use a language that they were most familiar with (FULFULDE) and discussions were led by a member of each group who spoke their language. Data was cleansed by correcting inaccurate or inconsistent data entries and organized for analysis.

Gross return = Total revenue – Total Production cost……..…… (1).

Benefit/cost analysis = Total revenue/ Total cost ……..…... (2).

2.3 Data Analysis

Data was keyed into and analyzed using Excel version 16. Descriptive statistics (frequency and percentages) were used to summarize the data and results were presented in tables and figures.

3. RESULTS

3.1 Respondent's Demographic Information

Table 1 displays the demographic data of *Urochloa* farmers. It was noted that male-headed families made up 81% of the respondents. Most of the respondents were within the productive ages of 31-40 years (31%) and 41-50 years (31%) while the least represented (19%) were those between 20-30 and above 50 (elderly). In terms of respondent's educational level, results showed that most of them had attained primary education and secondary education (44% and 31%) respectively and so were able to read and write. In terms of marital status, there were more married respondents (75%) than there were single respondents (25%). Overall, the majority of respondents (75%) owned their farms, whereas only a small percentage (25%) rented farmland. Also, the majority of respondents (63%) have been farming for more than 10 years, and majority of respondents (44%) farm on areas between 5 and 10 hectares.

3.2 *Urochloa* Seed Production and Processing

The results of *Urochloa* seed production and processing are presented on table 2. The result showed that 68.7% of the respondents get their seeds from past harvest. In view of planting period and planting method, 60% plant in June while 40% plant in July and 81.2% of respondents plant in row. In terms of fertilizer application, majority of the respondents (53.3%) use both organic and inorganic fertilizers during seed production. As concerns weeding, most of the respondents (73.3%) use manual technics. When it comes to harvesting times and techniques, the majority of respondents (60%) harvest seeds in November, and the majority (86.7%) harvest using direct heading. Over all, the majority of respondents (81.25%) prepare their seeds by sun drying them to lower the moisture level for appropriate storage.

Table 1. Distribution of respondents according to demographic information in Adamawa region

Parameter	Category	Count	Percent count	Cumulative count	Cumulative percent
Gender	Male	13	81	13	81
	Female	3	19	3	19
Age group	20-30yrs	3	19	3	19
	31-40 yrs	5	31	5	31
	41-50 yrs	5	31	5	31
	51-60 yrs	3	19	3	19
Level of	No formal	2	13	2	13
Education	Primary	7	44	7	44
	Secondary	5	31	5	31
	Tertiary	2	13	2	13
Marital	Single	4	25	4	25
status	Married	12	75	12	75
Land status	owned	12	75	12	75
	Rented	4	25	4	25
Farm size	< 5Ha	5	31	5	31
	5-10Ha	7	44	7	44
	>10 Ha	4	25	4	25
Longevity	< 5yrs	5	31	5	31
	5-10yrs	1	6	1	6
	>10yrs	10	63	10	63

Table 2. *Urochloa* seed production and processing

Parameter	Category	Count	Percent count	Cumulative count	Cumulative percent
Seed Sources	Past harvest	11	68.7	11	68.7
	Buy	9	56.3	9	56.3
	Gift	1	6.3	1	6.3
Planting	June	9	60.0	9	60.0
period	July	6	40.0	6	40.0
Planting	Rows	13	81.2	13	81.2
method	Broadcasting	5	31.3	5	31.3
	Squad	4	25	4	25
Fertilizer type	Organic	4	26.7	4	26.7
	Inorganic	3	20	3	20
	Both	8	53.3	8	53.3
Weeding	Manual	11	73.3	11	73.3
	chemical	5	33.3	5	33.3
Harvest	November	9	60	9	60
periods	December	6	40	6	40
Harvest	Knocking	5	33.3	5	33.3
methods	Ground sweeping	1	6.7	1	6.7
	Heading	13	86.7	13	86.7
Moisture	Refrigerate	0	0	0	0
content	Shade dry	3	20	3	20
reduction	Sun dry	13	81.25	13	81.25

3.3 Constraints to *Urochloa* Seed Production

Result of the study revealed that, in the Adamawa region, major problems with *Urochloa* seed production included a shortage of labor, a lack of storage facilities, pests and diseases, and an open/ready market. Pests and diseases and a ready market were the two problems with the least frequency (27%) and (20%), respectively.

Of these, the problem of a shortage of labor was the most prevalent, as evidenced by the frequency of 93%, and it was followed by a lack of storage facilities (47%) (Fig. 2).

3.4 SWOT Analysis

3.4.1 Strength

The study's findings showed that among the elements called out by farmers as concerns strength were a good climate, local expertise, a rising market for *Urochloa* seeds, and ecological benefits. In light of this, the majority of respondents (37.50%) believed that a rising demand for seeds in the Adamawa region was their biggest strength, as shown in Fig. 3a. Fig. 3b shows that the majority of respondents (31.25%) identified their main shortcoming as being a lack of knowledge and awareness of *Urochloa* species and their potential benefits. The majority of respondents (43.75%) believed that the expansion of the livestock industry represents their greatest opportunity, figure 3c while the majority of respondents (37.50%), listed climate variability in the Adamawa region as their greatest threat, Fig. 3d.

3.5 Benefit /Cost (B:C) Analysis of *Urochloa* Seed Production for one Hectare of Land

The results of the economic study of the *Urochloa* traditional seed production system in the Adamawa region are shown in tables 3 and 4 as gross return, net return, and B:C ratio. Results showed a B:C ratio of more than 1.

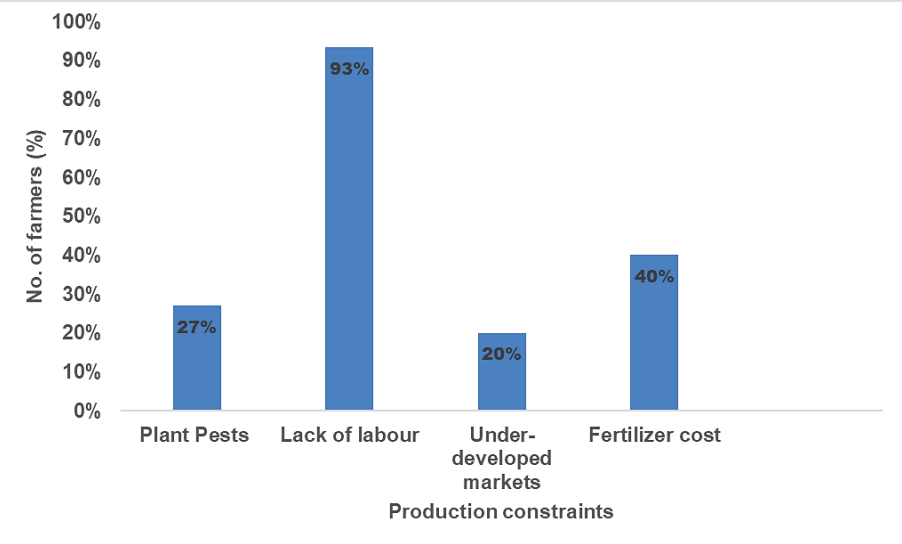

Fig. 2. Constraints to *Urochloa* seed production

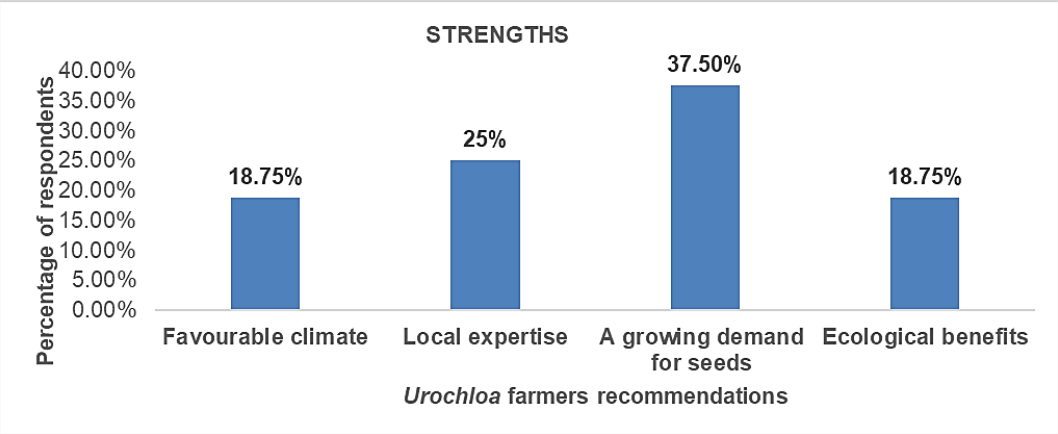

Fig. 3a. Strength factor of *Urochloa* seed producers in Adamawa region

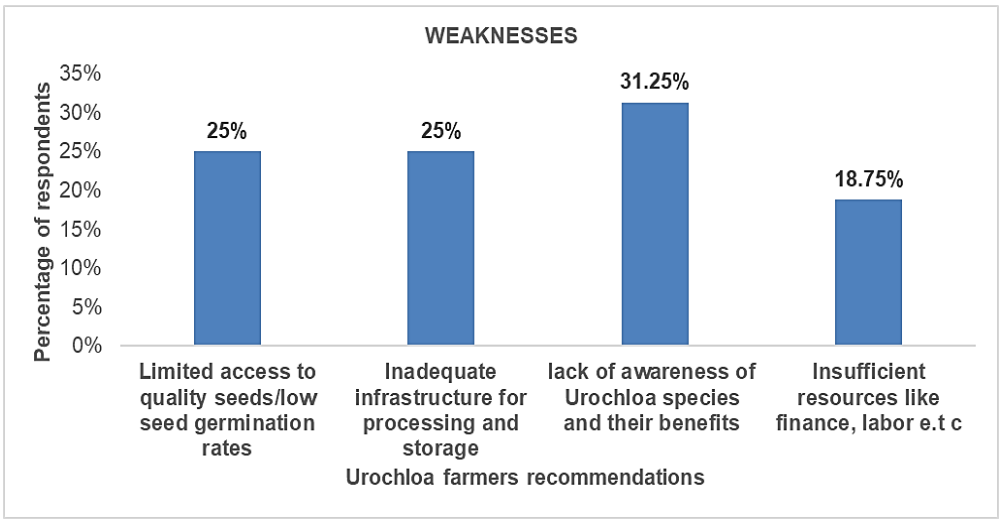

Fig. 3b. Weakness factor of *Urochloa* seed producers in Adamawa region

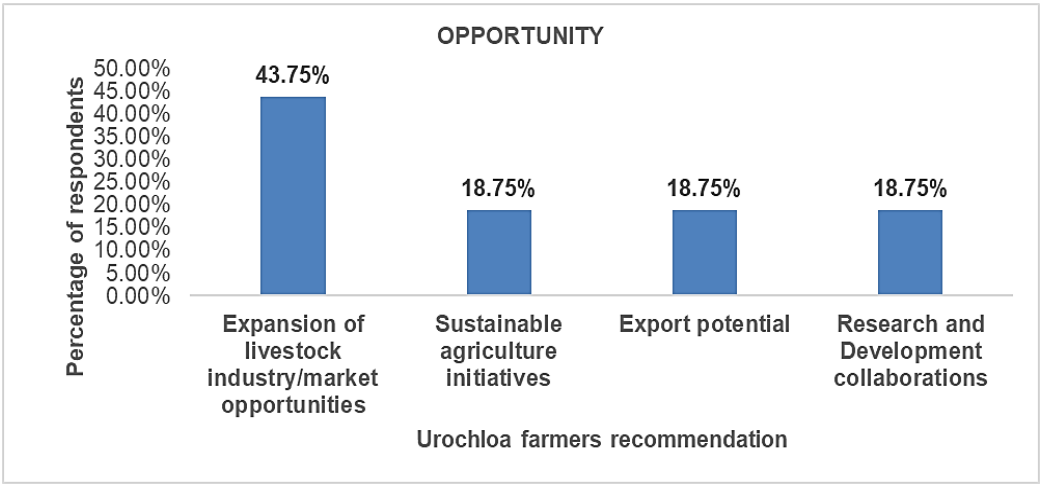

Fig. 3c. Opportunity factor of *Urochloa* seed producers in Adamawa region

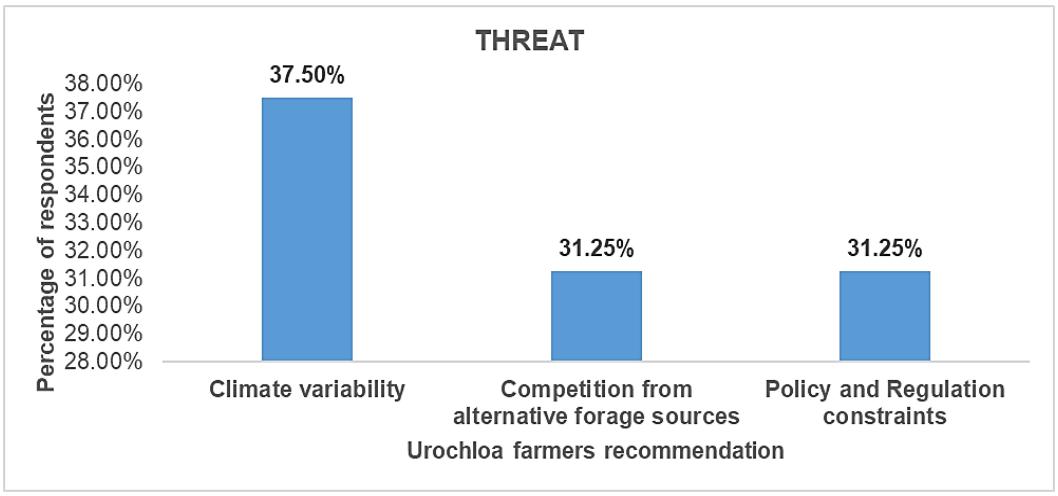

Fig. 3d: Threat factor of *Urochloa* seed producers in Adamawa region

Table 3. Cost of producing Urochloa seeds on 1Ha of land in Adamawa region

Description	Quantity	Unit cost	Total cost
Labour			
Bush clearing	1 man day	50000/Ha	50000/Ha
ploughing	1 man day	75000/Ha	75000/Ha
planting	1 man day	50000/Ha	50000/Ha
Weeding	1 man day	50000/Ha	50000/Ha
Fertilizer application	1 man day	2000/50kg bag x 4	8000/200kg
Herbicide application	1man day	10000/L/Ha	10000/Ha
Harvesting	1man day	50000/Ha	50000/Ha
Materials			
Seeds	50kg	2000	100000
Planting string	1 Bag/50 ropes	12500	12500
Hoes	4	2500	10000
cutlasses	4	4000	16000
Spraying cans	2	25000	50000
sickle	5	2000	10000
Plastic basins	5 /3x2cm	1500	7500
Jute bags	5/50kg	1000	5000
Drying badges	5/ 10mx10m	8500	8500
Inorganic Fertilizer	4 bags (2 NPK &2 UREA)	30000	120000
Herbicide	1L	10000	10000
Total production cost			642500

Table 4. The Benefit/Cost ratio analysis for producing *Urochloa* seeds in Adamawa region

	Gross Margin Analysis	Risk Analysis	
Yield	500kg	10% Yield Decrease	500kg – (10% of 500) = 450kg
Selling price per kg	2000frs/kg	10% Price Decrease	2000frs – (10% of 2000frs) = 1800frs
Gross return/ Expected Revenue	500kg x 2000frs/kg =1000000frs		450kg x 1800frs/kg = 810000frs
Total production cost	642500	10% Production Cost Increase	642500frs + (10% of 642500frs) = 706750frs
Net revenue/return	1000000frs – 642500frs =357500frs		810000frs - 706750frs =103250frs
Benefit/cost ratio	1000000/642500 =1.56		

4. DISCUSSION

The demographic data of *Urochloa* farmers, provides valuable insights into the characteristics and profiles of the respondents. The finding suggests that men play a significant role in *Urochloa* farming activities in the surveyed area. This observation may be influenced by cultural or gender dynamics prevalent in the community, which can impact decision-making and resource allocation within farming households. Similar findings were reported by Joshi and Kalauni [17] who found that men in rural Nepal were dominantly involved in land preparation and had more control over farm resources and decision-making.

In terms of age distribution, this finding indicates that the *Urochloa* farming sector is predominantly composed of individuals in their prime working years. The high representation of respondents in the 41-50 age range suggests that farmers in this age group have a long-standing experience and may have accumulated valuable knowledge and skills in *Urochloa* cultivation. Interestingly, the data highlights a relatively low representation of younger and older farmers. Respondents between the ages of 20-30 and those above 50 (elderly) were the least represented. This finding raises considerations about generational succession and the potential challenges associated with attracting younger individuals to engage in *Urochloa* farming. A similar finding by

Mahawar et al. [18] reported a decline in youth participation in India. However, the authors emphasize the importance of youth involvement in revitalizing the agriculture sector and suggests strategies for attracting and retaining youth in agro-based rural enterprises. The present study also emphasizes the importance of supporting and involving older farmers to ensure knowledge transfer and continuity. Regarding educational attainment, the majority of respondents have completed primary education and secondary education. This suggests that a significant portion of *Urochloa* farmers possess basic literacy skills, enabling them to read and write. This level of education can positively contribute to their ability to access information, adopt improved farming practices, and engage in business-related activities such as marketing and record-keeping. Similarly, [19] found that better-educated farmers make greater use of information, advice, and training, and are more proactive in adjusting to change and planning for the future. In terms of marital status, the data indicates that the majority of respondents are married, while single respondents make up 25% of the sample. This finding aligns with the notion that family-based farming systems are prevalent in the area, where married individuals often engage in agricultural activities as a household unit. The high proportion of married respondents may reflect the collaborative nature of *Urochloa* farming, with family members contributing to various aspects of the production process. Ownership of farmland is also an important aspect of farming, and the data reveals that the majority of respondents own their farms. This ownership status provides farmers with more control over their agricultural practices and long-term investment in the land. In line with a study by Feder [20] who found out that secure legal ownership of land leads to higher productivity and increased use of variable inputs in Thailand. Conversely, a relatively smaller percentage of respondents rent farmland. This finding suggests that access to land may be a constraint for some farmers, potentially limiting their ability to expand or scale up *Urochloa* production. Lastly, the data indicates that a significant proportion of respondents have been farming for more than 10 years, highlighting their long-standing experience in *Urochloa* cultivation. This experience can contribute to their expertise in managing *Urochloa* forage and adapting to local farming conditions. Additionally, the majority of respondents farm on areas between 5 and 10 hectares, indicating a moderate scale of farming operations.

In terms of *Urochloa* seed production and processing, the data reveals that a significant proportion of respondents obtain their *Urochloa* seeds from past harvest. This finding suggests that farmers rely on saving seeds from their own previous crops, highlighting the importance of seed saving and seed management practices within the *Urochloa* farming system. Similarly seed saving has been reported by other studies. Mngoli et al. [21] found that small-scale farmers in rural Malawi use various traditional seed saving methods, which are cost effective. This self-sufficiency in seed sourcing may contribute to cost savings for farmers and promote the use of locally adapted seed varieties. Regarding planting methods, the data indicates that a significant majority of respondents plant *Urochloa* seeds in rows. Row planting allows for better plant spacing, weed control, and ease of management during subsequent stages of crop growth. Similar results were reported by Dusabumuremyi et al. [22]. This finding suggests that farmers recognize the benefits of row planting and adopt this technique to optimize *Urochloa* establishment and growth. When it comes to harvesting times and techniques, the majority of respondents harvest *Urochloa* seeds in November. This timing aligns with the maturity of the crop and the seed's readiness for harvest. Additionally, the data indicates that most of respondents employ direct heading as the harvesting technique. Direct heading involves cutting the seed heads directly from the plants. This technique is commonly used for *Urochloa* seed production and is suitable for large-scale harvesting operations. Regarding seed processing, the majority of respondents prepare their *Urochloa* seeds by sun drying them to lower the moisture level for appropriate storage. Sun drying is a common and cost-effective method for reducing seed moisture content, which helps prevent deterioration and fungal growth during storage. This practice indicates a practical approach to seed processing and highlights the importance of proper seed handling and storage practices among farmers.

As concerns production constraints, the data reveals that the most prevalent problem faced by *Urochloa* farmers in the Adamawa region is shortage of labor. This could be attributed to the fact that many young individuals migrate to other regions in search of better economic opportunities, education, and improved living conditions. This outmigration of the working-age population can result in a shortage of labor for agricultural activities, including *Urochloa* farming.

Also, The lack of familiarity with *Urochloa* farming practices can make it challenging to find individuals willing to engage in its cultivation, leading to labor shortages. This finding suggests that farmers struggle to find an adequate workforce to carry out various tasks associated with *Urochloa* seed production. The shortage of labor can have significant implications for farm productivity, as it may result in delayed operations, compromised crop management, and reduced overall efficiency. Another prominent problem identified in the study is a lack of storage facilities. This finding indicates that farmers face challenges in effectively storing *Urochloa* seeds after harvest. Inadequate storage facilities can lead to seed deterioration, loss of quality, and reduced viability, affecting subsequent planting seasons. This study is in line with studies by Gebeyehu [23], who emphasizes the importance of maintaining seed quality and vigor during storage to preserve viability. Also, a study by Vitis et al. [24] underscores the criticality of effective seed storage for maintaining seed viability and avoiding wastage of resources.

As regards SWOT analysis, the study's findings reveal the perceptions of *Urochloa* farmers in the Adamawa region regarding their strengths, shortcomings/ weaknesses, opportunities, and threats. The rising demand for *Urochloa* seeds, a lack of knowledge and awareness, the expansion of the livestock industry, and climate variability emerged as key elements in the assessments. This finding suggests that farmers perceive a growing market opportunity for *Urochloa* seeds, indicating potential profitability and economic benefits associated with seed production. The rising demand for *Urochloa* seeds could be attributed to factors such as increasing human population, expanding livestock industries, or government initiatives promoting sustainable agriculture. Furthermore, the expansion of the livestock industry presents an opportunity for *Urochloa* farmers to meet the increasing demand for livestock feed and forge stronger linkages with the livestock value chain. However, the study also highlighted climate variability in the Adamawa region as the greatest threat, with majority of respondents expressing concern. This finding indicates that farmers are aware of the challenges posed by climate variability, including unpredictable rainfall patterns, droughts, or extreme weather events.

The results of the economic study indicate that the *Urochloa* traditional seed production system in the Adamawa region is a financially viable venture, as evidenced by a B:C ratio greater than 1. These findings underscore the potential of *Urochloa* seed production as a profitable agricultural activity that can contribute to the economic well-being of farmers in the region. Similarly, [9]) assessed the quality of *Urochloa* seeds produced in Cameroon and highlighted the potential for developing *Urochloa* grass seed business in the Northern, Adamaoua, and Western regions of Cameroon, suggesting a market for *Urochloa* seeds.

5. CONCLUSION

In conclusion, the study investigating traditional seed production and processing methods for *Urochloa* grass in the Adamawa region of Cameroon sheds light on the existing practices employed by farmers. The findings provide valuable insights into the traditional techniques used for seed production and processing, which have been passed down through generations. By understanding and documenting these traditional practices, the study contributes to the preservation and dissemination of indigenous knowledge related to *Urochloa* seed processing. Furthermore, the study highlights the potential strengths of traditional seed production and processing methods as evidenced from its benefit/cost ratio. This shows that it is a profitable venture and should be encouraged. Further research can build upon these findings to explore opportunities for enhancing traditional seed production and processing techniques through the integration of modern approaches, ultimately benefiting farmers and promoting sustainable *Urochloa* seed production in the region. Also, a comprehensive value chain analysis of *Urochloa* seed production and processing could be conducted, considering aspects such as market demand, distribution channels, processing facilities, and economic viability. This research could identify potential bottlenecks and opportunities for value addition, market linkages, and income generation along the entire *Urochloa* seed value chain.

CONSENT

As per international standards or university standard, respondents' written consent has been collected and preserved by the author (s).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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