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Enhancing Cowpea Productivity in the Sahel: Exploring Seed Access among Smallholder Farmers in South-Central Niger

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Abstract: Cowpea productivity in West Africa is low due to several challenges, including limited access to high-quality seeds. Despite the development of improved varieties, smallholder farmers face difficulties in accessing certified seeds. This study interviewed 634 households in south-central Niger to assess how farmers access cowpea seeds. Most farmers (94.6%) relied on informal seed systems, with local markets being the primary source (72.8%). The formal seed sector, including the private sector, had a limited role. Farmers typically stored seeds for seven months utilizing pesticides (54.9%) and hermetic methods (42.6%). Interestingly, the price of seeds of improved cowpea varieties in local markets was 1.19 times higher than that of local varieties, but only 25% of the cost of certified seeds. Interventions to strengthen informal seed systems and improve access to credit could enhance the adoption of high-quality cowpea seeds and increase productivity.

Keywords: improved cowpea varieties; certified seed; storage; supply chain; West Africa

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1. Introduction

Cowpea is an important food and cash crop in West Africa [1,2]. In Niger, cowpea is the main legume and the second most important crop after millet, with an annual production estimated at 2,629,772 tons over 5,719,499 ha in 2020 [3]. Hence, the national average cowpea yield is about 459.8 kg ha^{-1}, and 471 and 415 kg ha^{-1} in the Maradi and Zinder regions, respectively, but can be as low as 253.4 kg ha^{-1} in both regions [3,4]. These cowpea yields are extremely low due to poor soil fertility and, limited access to and use of inputs, including quality seeds, pest control methods, and fertilizers [5–7]. The use of quality seeds, particularly certified ones, can significantly increase cowpea yields, nearly doubling the overall crop productivity [8,9].

Lack of knowledge or information about the availability and benefits of quality seeds can hinder farmers' access. Awareness about and access to new, improved cowpea varieties are crucial for farmers to make informed decisions on appropriate seeds [10]. Several development and research programs have focused on increasing cowpea production and productivity in the Sahel, including Niger [8,11,12]. However, most of these programs have focused on disseminating improved cowpea varieties with little effort to build seed supply and distribution networks to sustain availability among smallholder farmers in rural areas. This has resulted in a low uptake of improved cowpea varieties among smallholder farmers [6].

Well-functioning seed systems, including robust production, distribution, and marketing channels, are essential for farmers to access seeds. Though Niger has a network of 855 registered seed actors, including farmers, seed producers, and nine private companies [13], seed access remains challenging. In 2023, 1804 tons of certified seeds of eight cowpea varieties were available [14]. However, this represented only 1.6 and 3.2% of the national need for certified seeds, based on cultivated areas, if cowpeas were planted in pure

stand or intercropped, respectively. Niger's limited capacity to produce certified seeds is a major challenge that hinders smallholder farmers' access to suitable planting materials. A low supply of high-quality planting materials may impede the adoption of improved cowpea varieties.

Farmers' access to seeds of improved varieties may vary depending on the region, socio-economic context, and specific crops. For cowpeas, the Maradi region accounts for about half (48.6%) of all certified seeds available in the country, while the Zinder region only represents 5.6% [14]. However, these improved varieties have low average adoption rates in both regions, ranging from 3.3 to 38.0% [15]. The cost of seeds can be a barrier to adoption among smallholder farmers with limited financial resources. In Niger, the price of certified seeds varies between FCFA 1500 and 2000 per kg, which is costly for most smallholder farmers [16]. The availability of affordable certified seeds, subsidies, or credit mechanisms can help improve access among resource-constrained farmers [2]. In addition, sociocultural norms and gender inequalities can influence farmers' access to certified seeds due to limited control over resources, restricted decision-making power, and unequal access to extension services and credit [17–19]. For instance, a study conducted in Mali showed that men are more likely than women to participate in trials, innovation platforms, field visits, and demonstration plot activities, making them quick adopters of newly released cowpea varieties [20].

Despite the Nigerien government's efforts to develop enabling policies to strengthen seed systems, access to certified seeds by smallholder farmers remains inadequate. Limited access can be attributed to various factors, including developing and disseminating improved cowpea varieties that do not meet the needs of smallholders. The scarcity of varieties with desired traits (e.g., drought tolerance or early maturity) can negatively impact farmers' access to and adoption of certified seeds [1,15]. Moreover, there is very little information on how farmers access cowpea seeds in Niger. To address this gap, we initiated this study to assess how smallholder farmers acquire cowpea seeds in the Maradi and Zinder regions of Niger. The outcome of this research holds the potential to make significant contributions toward establishing sustainable supply and distribution networks to enhance access to quality cowpea seeds among smallholder farmers in the Sahel.

2. Materials and Methods

Below is a summary of the materials and methods. For a more in-depth understanding of the study's implementation, additional details are available in the published research [15].

2.1. Study Area and Sampling of Farmers

The study was conducted in the Maradi and Zinder regions of Niger, which account for 31% of cultivated land and 42% of national cowpea production [3]. Cowpeas are generally grown on dune soils. Data collection involved 634 producers in 20 villages from 18 July to 29 July 2020. Given the degree of precision we wished to achieve, and due to time and resource constraints, reasoned sampling was carried out in collaboration with the regional agricultural services based on cowpea production and site accessibility. Thus, 2 departments, 2 communes (per region), and 20 villages (5 per commune) were selected in each region. At the village level, 15 to 25 respondents among cowpea producers were selected by a random draw from official household lists and the availability of heads of families during the survey.

2.2. Data Collection and Analysis

Data were collected on qualitative variables, including farmers' characteristics, cowpea varieties used (improved and local), known retail points, seed acquisition channels, suppliers of seeds, and seed storage protection methods. Quantitative data included price, quantity stored, and storage duration. To make it easier for farmers to identify improved varieties during the survey, we created an illustration guide with images and small packs of the 14 improved cowpea varieties registered in Niger. These samples were used to

cross-check information, including the variety's physical attributes. Additionally, growers brought their seeds to be compared to the samples of certified seeds provided by the enumerators. Cowpea types can be distinguished based on the seed's shape, color, size, and appearance. This information was used to assess the cowpea varieties stored or purchased by farmers from the different outlets.

Data were collected using the KoboCollect application. After completing the survey, data were downloaded as a Microsoft Excel file, cleaned, and analyzed using SPSS 27. Means and standard deviations were calculated depending on the data type. A Chi-square test and Student's t-test were used to compare the data between the two regions.

Logistic regression was performed to identify the factors influencing the purchase of seeds of improved cowpea varieties (Table 1). Only information on the type of seeds purchased or stored (improved vs. local varieties) was collected. Details on the quality of seeds stored or purchased (certified, quality-declared seeds, etc.) were not obtained. However, seeds of improved varieties were considered certified when bought from the formal seed sector (e.g., agricultural input shops, seed producers, or government agencies).

Table 1. Definition of the variables of the adoption models of seeds of improved cowpea varieties in the Maradi and Zinder regions of Niger [15].

Variables	Description	Expected Effects *
	Dependent variables	
Adoption	1 if a respondent purchased improved varieties	
	Explanatory variables	
Gender	1 if the respondent is male and 0 for a woman	±
Age	Continuous variable indicating the age of the respondent	±
Marital status	1 if a respondent is married and 0 otherwise	+
Education level	1 if a respondent is literate (knows how to read and write) and 0 otherwise	+
Agricultural assets	Continuous variable indicating the number of agricultural assets in the household	+
Family labor	Continuous variable indicating the number of people in the household involved in farming	±
Experience in farming	Continuous variable indicating the years of experience in agriculture	±
Member of farmers' group	1 if a respondent is a member of a farmers' group and 0 otherwise	+
Contact with extension services	1 if a respondent has contact with an extension agent and 0 otherwise	+
Distance to the sale point	1 if a respondent village is <10 km to the sale point of seeds and 0 if otherwise	±
Access to credit	1 if a respondent accessed a loan from financial institutions and 0 otherwise	+

* + = positive effect or ± = positive or negative effect.

Logit and Probit models are often used in most adoption studies. We used econometric modeling with a logit model as the analytical tool because it was deemed appropriate to specify the relationships between the decision to purchase seeds of improved varieties and the factors determining the purchase. Considering the hypothesis that the effect is measured by an unobservable index, I_d, for the decision maker, d, and the critical value of the index from which they adopt the technology, I_{0d}, two scenarios can arise.

If I_d is greater than or equal to I_{0d}, then the technology is adopted, and the adoption variable Y takes the value 1. The greater the index I_d is above the critical value, the higher the probability that the producer will adopt the technology. If I_d is less than I_{0d}, the innovation is rejected, and Y is equal to 0. In mathematical formulation, this is written as:

$$\begin{cases} I_d \geq I_{0d} \Rightarrow Y = 1 \\ I_d < I_{0d} \Rightarrow Y = 0 \end{cases} \quad (1)$$

For an individual d, the index I_d can be a linear combination of variables X_i that determine adoption and coefficients β_i to be estimated. If it is less than I_{0d}, it rejects the innovation, and Y is equal to 0. In mathematical formulation:

$$I_d = \sum_{i=0}^{n} (B_i X_{id}) \quad (2)$$

where X_{id} is the *i*th independent variable explaining the technology adoption by individual d, and β_i is the corresponding parameter to be estimated. The probability P_d of an individual d adopting the innovation is then:

$$P_d = P\,(Y = 1) \quad (3)$$

As the index I_{0d} is a random variable, if we denote by F its function of cumulative probability or distribution function, then:

$$\begin{cases} P\,(Y = 1) = P\,(I_{0d} \leq I_d) = F\,(I_d) \\ P\,(Y = 0) = 1 - F\,(I_d) \end{cases} \quad (4)$$

The functional form of F is determined by that of the probability density function of the random variable I_d. For the logit model, it is a logistic function of the form:

$$F(x) = \frac{1}{1 + e^{-X}} = \frac{1}{1 + e^{-(\beta 0 + \beta i Z)}} \quad (5)$$

It is assumed that the purchase of seeds by agricultural producers follows a logistic law. The empirical equation resulting from the model theory has the following form:

$$P(Y_i) = \frac{1}{1 + e^{-X}}$$

with $X = \beta 0 + \beta 1$ Gender + $\beta 2$ Age + $\beta 3$ Marital status + $\beta 4$ Education level + $\beta 5$ Agricultural assets + $\beta 6$ Family seize + $\beta 7$ Experience in agriculture + $\beta 8$ Member of farmers' group + $\beta 9$ Credit access + $\beta 10$ Contact with extension service + $\beta 11$ Distance + ei.

3. Results

3.1. Socio-Economic Characteristics of the Respondents

More details about the demographic information can be found in the published research [15]. The survey was conducted among producers with an average age of 41 and a family size of 5 people. Respondents had, on average, 25 years of experience in farming. Land ownership was 3.15 ± 5.21 ha per household, of which 1.73 ± 3.83 ha (i.e., 55% of the total field area) was allocated to cowpea production. Among the respondents, 38% were members of farmers' groups, 45.2% were in contact with public extension services, and about 5% had access to loans through financial institutions.

3.2. Awareness of the Availability of Improved Cowpea Variety Seeds

Farmers were aware of the availability of cowpea seeds in several retail outlets (Table 2). Local markets, government agricultural agencies, and cowpea farmers were mentioned by more than three-fourths, two-fifths, and one-third of respondents, respectively. Notably, there were regional variations in the awareness of seed sources. Respondents from Maradi more frequently mentioned local markets compared to those in Zinder. Fewer farmers were aware of the private sector, such as agricultural input shops (1.5%), as sources of seeds (i.e., certified) of improved cowpea varieties.

Table 2. Farmer awareness of retail outlets of seeds of improved cowpea varieties in the Maradi and Zinder regions of Niger.

Retail Outlets	Maradi (n = 318)	Zinder (n = 316)	Mean (%)	χ^2	Significance
Local market	87.2	61.2	77.7	26.4	***
Government agricultural agencies	36.2	44	40	3.92	**
Cowpea farmers	33.8	34.2	34.0	0.18	ns
Seed producers	13.5	12.2	12.8	0.11	ns
Farmers' group	9	11.2	10.3	0.4	ns
Do not know	0	5.6	3.3	7.7	**
Agricultural input shops	1.5	1.5	1.5	0.0	ns

***, **, and ns indicate significance at the 0.001 and 0.05 levels and non-significant differences, respectively.

3.3. Seed Acquisition Channels

The methods used to acquire seeds varied by region (Table 3). Farmers in Maradi (about half) relied more on their own seed, whereas those in Zinder (63.5%) acquired seed through purchases. Most respondents (72.8%) engaged in annual seed purchases (about 11.28 ± 14.15 kg) of improved cowpea varieties in local markets. Despite 40% of respondents being aware of government agricultural agencies as potential sources of improved varieties, only a small proportion (4.5%) actually purchased certified seeds from these outlets. Additionally, a few farmers obtained certified seeds from agricultural input shops (2.7%) and seed producers (5.7%).

Table 3. Mode of acquisition of seeds of improved cowpea varieties in the Maradi and Zinder regions of Niger.

	Maradi (n = 318)	Zinder (n = 316)	Mean (%)	χ^2	Significance
Mode of accessing cowpea seeds					
Purchase	42.0	63.6	52.8	29.7	***
Saved seed	47.2	77.5	62.3	37.5	***
Project/Agricultural services	3.4	3.2	3.3	0.04	ns
Family	1.9	4.7	3.3	4.07	**
Where farmers purchased improved cowpea seeds					
Local market	83.5	65.7	72.8	12.77	***
Cowpea farmers	5.3	12.9	9.9	5.29	**
Seed producers	2.3	8	5.7	4.85	**
Government Ag. agencies	3	5.5	4.5	1.13	ns
Agricultural input shops	2.3	3	2.7	0.16	ns
Farmers' groups	0.8	2.5	1.8	1.36	ns

***, **, and ns indicate significance at the 0.001 and 0.05 levels and non-significant differences, respectively.

3.4. Cowpea Seed Storage and Protection

Seed storage practices among smallholder farmers varied (Table 4). Across regions, a substantial number of respondents stored seeds of improved varieties (2.6 times) compared to local types. Households in Zinder exhibited a 2.2-fold higher likelihood of storing seeds of improved varieties than those in Maradi. Most respondents used pesticides (54.9%) such as phosphine or dichlorvos and hermetic airtight containers (42.6%) to protect their cowpea seeds. Households in Zinder (71.1%) relied on pesticides, while those in Maradi (59.7%) favored hermetic storage methods. Respondents storing seeds of local varieties were three times more likely to employ chemical control methods. In contrast, those storing seeds of improved varieties were twice as likely to use PICS compared to their counterparts.

Table 4. Type of cowpea seeds stored and protection methods used by households in the Maradi and Zinder regions of Niger.

	Maradi (n = 318)	Zinder (n = 316)	Mean (%)	χ^2	Significance
Type of seed stored					
Local variety	21.7	21.5	21.6	0.003	ns
Improved varieties	35.8	78.2	56.9	115.75	***
Do not know	42.5	0.3	21.5	167.01	***
Storage protection methods					
Pesticides	39.9	71.1	54.9	50.46	***
PICS bag	25.0	24.0	24.1	0.35	ns
Jerrycans	34.7	0.8	18.5	97.7	***
None	0.4	2.00	1.2	3.06	ns

*** and ns indicate significance at the 0.001 level and non-significant differences, respectively.

There were differences in the quantities of seed stored and needed for planting, and the prices between seeds of local and improved varieties (Table 5). There was a notable disparity in the amounts of seeds stored by households between local and improved cowpea varieties. Households stored approximately two-thirds of the quantity of local varieties compared to the improved ones, despite planting similar quantities for both types. The average price of seeds of improved cowpea varieties was 1.19 times higher than that of local varieties. The average storage duration of seven months was similar between local and improved cowpea varieties.

Table 5. Quantity of stored and planted seeds, average storage duration, and price of seeds of improved and local cowpea varieties in the Maradi and Zinder regions of Niger.

Variables	Seed Type	Mean ± SD	*t*-Test
Quantity of seeds stored (kg/year) (n = 388)	Improved varieties (n = 308) Local varieties (n = 80)	24.02 ± 19.25 16.26 ± 15.19	t = 3.34; p = 0.04; df = 2/386
Price of seeds (FCFA/kg) (n = 477)	Improved varieties (n = 352) Local varieties (n = 125)	437.81 ± 272.87 368.6 ± 210.19	t = 2.57; p = 0.09 df = 2/475
Quantity of seeds planted per year (kg) (n = 485)	Improved varieties (n = 351) Local varieties (n = 134)	13.3 ±12.43 15.46 ± 15.56	t = −1.59; p = 0.06; df = 2/483
Seed storage time (month) (n = 388)	Improved varieties (n = 308) Local varieties (n = 80)	7.48 ± 4.08 6.95 ± 1.60	t = 1.33; p = 0.02; df = 2/386

3.5. Factors Influencing Farmers to Purchase Seeds of Improved Cowpea Varieties

In our LOGIT model analysis of eleven factors, two showed significant positive correlations with seed purchases (Table 6). Notably, socio-economic factors, specifically agricultural assets and credit access, influenced the purchase of seeds of improved cowpea varieties. While gender (p = 0.069) and membership in farmers' groups (p = 0.056) are not statistically significant at the 0.05 threshold, discernable trends suggest that gender and membership in producers' organizations might influence seed purchase decisions.

Table 6. Factors influencing the purchase of seeds of improved cowpea varieties by smallholder farmers in the Maradi and Zinder regions of Niger.

Variables	Exp (B)	S.E.	Wald	*p*-Value
Gender	0.695	0.200	3.298	0.069
Age	0.982	0.012	2.361	0.124
Marital status	0.676	0.354	1.226	0.268
Education level	0.784	0.171	2.009	0.156
Agricultural assets	1.074	0.022	10.469	0.001
Family labor	1.419	0.233	2.248	0.134
Experience in farming	0.997	0.012	0.065	0.799
Member of farmers' group	0.676	0.205	3.642	0.056
Contact with extension services	1.368	0.199	2.471	0.116
Distance to the sale point	1.006	0.015	0.131	0.717
Access to credit	0.375	0.422	5.399	0.020
Constant	3.055	0.512	4.759	0.029

Note: Exp(B) = odds ratio; S.E. = standard error; Wald = the Wald test.

4. Discussion

Smallholder farmers in Niger play a vital role in ensuring food security. However, they face substantial challenges accessing suitable planting materials, leading to a heavy reliance on informal seed systems. A noteworthy 94.6% of these farmers acquire seeds through informal channels, predominantly rural markets, or save seeds. This reliance on informal seed systems reflects the community-based nature of smallholder farming. Similar to our findings, research has shown that less than 10% of seeds used by smallholder farmers is sourced from commercial seed provision [21]. Rural markets emerged as crucial hubs, encompassing 72.8% of the various channels through which farmers acquired seeds. Local markets are known as essential conduits for seed acquisition by smallholder farmers [22–24]. This is particularly pronounced for legume crops, where 89% of purchases were made in local markets [25]. They are places where farmers converge to buy and sell various goods, including seeds. The significance of rural markets in acquiring seed highlights the urgent need for targeted interventions to strengthen and streamline these informal channels [26].

The role of development partners (e.g., government services and projects) and the private sector (e.g., agricultural input shops) in facilitating access to seeds of improved cowpea varieties was limited. The formal seed sector can sometimes be non-existent, distant, cost-prohibitive, or offer limited choices to smallholder farmers [23,27]. Informal seed systems, rooted in local communities, address these issues by ensuring that seeds tailored to farmers' needs and preferences are available and accessible, especially to those in remote areas or with limited financial resources [1,15,21,23]. Furthermore, informal seed systems exhibit a notable advantage over their formal counterparts by being more responsive to local and global challenges. Factors such as political instability, armed conflicts, or global pandemics, as exemplified by the COVID-19 crisis, can disrupt formal seed markets. In contrast, the decentralized and community-oriented nature of informal seed systems allows for greater adaptability in the face of unforeseen challenges [28].

Smallholder farmers actively engaged in selecting and saving seeds, strengthening their autonomy in shaping their food systems. Farmer-saved seeds represented the primary source of seed acquisition (62.3%). Saved seeds are usually selected based on farmers' preferred traits, such as early maturing and resistance or tolerance to drought, pests, disease, etc. [15,29]. Like other smallholder farmers in West Africa, most respondents stored their seeds with chemical pesticides for 6 to 7 months [30,31]. Adequate seed protection during storage (e.g., hermetic methods) not only ensures the availability of quality seeds when needed, but also mitigates the risk of financial losses due to seed spoilage (caused by pests, diseases, or mold), promotes self-sufficiency, and contributes to the resilience of farming communities [12,32,33].

Given that smallholder farmers often operate with limited financial resources, the cost of seeds of improved varieties can hinder access. The price of seeds of improved

varieties (FCFA 438 per kg) in local markets was much lower (21.9 to 29.20%) than that of certified seeds sold by seed producers and agricultural input shops (FCFA 1500 to 2000 per kg) [16]. This price disparity may be explained by the fact that the quality of seeds of improved varieties sold in local markets is often lower than that of certified seeds [34]. This distinction underscores the trade-off between affordability and seed quality that smallholder farmers must navigate in their decision-making process. This price differential is a crucial factor influencing farmers' decisions to acquire high-quality seeds (i.e., certified seeds). Smallholder farmers turned to informal systems due to the high cost of certified seeds, which can be explained by a low supply (which only covers up to 5.27% of the national need) and unavailability due to an inefficient formal seed sector [3,15].

Smallholder farmers may be reluctant to invest in certified seeds if the potential benefits are not substantial or guaranteed [12]. Just like smallholder farmers value seeds over grain and are willing to pay more [23], they do the same when comparing seeds of improved varieties sold in local markets to those of local varieties. This preference is evident by the price differential (15%) observed between seeds of improved and local varieties within rural markets. Despite not meeting certified standards, the price difference implies that farmers recognize the benefits of seeds of improved varieties sold through informal seed systems. Their willingness to pay a premium for uncertified seeds of improved varieties indicates the economic choices made by farmers when selecting seeds for their crop production. By valuing seeds of improved varieties, smallholder farmers are signaling their openness to adopting innovations that align with their needs. This underscores the significance of tailoring interventions to align with farmers' preferences and priorities.

In smallholder farming, acquiring good-quality seeds is a pivotal step toward enhancing agricultural productivity and food security. Farmers' access to seeds of improved varieties was strongly influenced by the number of farm assets and access to credit. Additionally, though not significant, gender dynamics and farmers' group membership show noteworthy trends, suggesting the need for further investigation. Studies have shown that access to input markets (e.g., certified seeds) is likely influenced by various factors, including household wealth (livestock and land), access to finance and extension services (knowledge), distance to the nearest input market, and input source [5,9,10]. Efforts such as Cowpea Innovation Platforms (CIPs) that include financial institutions have helped smallholder farmers access loans and expand their crop production [8,20,35]. The adoption of seeds of improved varieties by smallholder farmers is not solely a matter of agronomic choice but is deeply entwined with socio-economic factors. Addressing these factors requires a holistic approach that considers the broader context of farmers' livelihoods, promotes collaboration, and leverages financial mechanisms to ensure sustained access to good-quality seeds.

4.1. Strengthening Informal Seed Systems and Improving Access to Certified Seeds

This study demonstrated that smallholder farmers in Niger relied heavily on informal seed systems (e.g., rural markets and saved seeds) to acquire seeds of improved varieties. Informal seed systems are not supplementary to the formal seed sector but are the foundation for crop production on smallholder farms. Strengthening informal seed systems involves recognizing their value, addressing challenges, and supporting practices that enhance their resilience [12,25,26]. Interventions to strengthen the informal seed systems could include the following.

4.1.1. Creating Awareness

It is crucial to raise awareness among farmers, communities, development partners, and policymakers about the role of informal seed systems in ensuring local food security. This awareness can be fostered through workshops, educational programs, and advocacy campaigns. It is essential to showcase how informal seed systems contribute to the resilience of farming communities and the preservation of local crop diversity.

4.1.2. Building Capacity

Educating and training farmers on seed management (e.g., selection, storage, disease management, and post-harvest practices) can help them make informed decisions and improve the overall quality of planting materials. This may involve imparting knowledge on recognizing desirable seed traits, understanding local agro-ecological conditions, and making informed decisions based on the specific needs of their farming practices. In addition, training initiatives should also focus on educating farmers about proper storage techniques to maintain seed viability and reduce the risk of spoilage.

4.1.3. Developing Partnerships

It is vital to establish and foster collaboration between policymakers, researchers, agricultural experts, development partners, and farmers' organizations to co-create solutions that strengthen informal seed systems. A collaborative approach is essential in creating frameworks that actively enhance the contributions of informal seed systems to agricultural sustainability and food security. By working cohesively, these stakeholders can develop interventions that improve the resilience and sustainability of the informal seed sector.

4.1.4. Implementing Research

There is a need to conduct research to understand the current and future dynamics, challenges, and opportunities of informal seed systems. Implementing research in partnership with local communities is critical to unraveling the unique needs and constraints farmers encounter within informal seed systems. By actively involving farmers in the research process, scientists and practitioners can glean firsthand insights into the intricacies of seed-saving and purchase practices and the contextual factors influencing farmers' choices and decisions.

4.2. Strengthening the Informal Seed System Can Act as a Bridge for Smallholder Farmers to Transition to Certified Seeds

The informal system, deeply rooted in local communities, offers a starting point for farmers to become familiar with certified seeds. By enhancing this system, we can create a path for farmers to gradually adopt certified seeds, build trust, share knowledge, and promote awareness. By strengthening smallholder farmers' access to certified seeds, we can boost agricultural productivity, food security, and rural livelihoods. Several key strategies must be considered to increase the use of certified seeds, outlined in the following.

4.2.1. Increasing the Quantity of Certified Seeds

Boosting the production capacity of certified seeds at the national, regional, and local levels can improve the availability. This can be achieved through investments in seed production infrastructure, research, and development programs aimed at breeding varieties that meet the needs of smallholder farmers. Collaborative efforts between governments, agricultural institutions, and private sector partners are crucial for scaling the production and distribution of certified seeds.

4.2.2. Streamline the Formal Seed Distribution Networks

Improving or adapting formal seed distribution networks can increase the availability of good-quality seeds (e.g., certified) in rural communities and markets. This entails enhancing the efficiency of seed supply chains by reducing bottlenecks, realigning the retail and distribution networks to make them more inclusive, and streamlining regulatory processes. Additionally, policies should be designed to support the inclusion of smallholder farmers in these distribution networks, ensuring they can access high-quality seeds at affordable prices.

4.2.3. Increasing Awareness and Availability of Certified Seeds

Creating awareness and improving the availability of certified seeds among farmers using informal seed systems (e.g., rural markets) can help increase adoption. Extension services, farmer-to-farmer knowledge sharing, and community-based seed multiplication/demonstration programs can be instrumental in disseminating information about certified seeds. Additionally, educating local entrepreneurs about the potential business opportunities in selling certified seeds in local communities and markets can help bridge the gap between formal and informal systems.

4.2.4. Facilitating Access to Credit and Market Opportunities

Easing access to financial services and market opportunities will empower smallholder farmers to engage actively in seed-related activities. Financial products tailored to the agricultural sector can provide farmers with the necessary capital to purchase certified seeds, while links to grain buyers ensure they have a viable market for their products. These efforts can be complemented by training farmers on the economic benefits of using certified seeds. Access to finance should also be extended to participants in the formal seed sector, including those involved in seed production and distribution.

5. Conclusions

This study illuminates the complexities surrounding cowpea seed access and utilization among smallholder farmers in Niger. Access to good-quality seeds is pivotal for enhancing agricultural productivity and food security. Despite advancements in developing and disseminating seeds of improved cowpea varieties, challenges persist, primarily due to limited access among smallholder farmers. This survey revealed smallholder farmers' heavy reliance on informal seed systems, notably local markets, and saved seeds. The minimal involvement of the formal seed sector, encompassing government agencies and the private sector, underscores a critical gap in facilitating access to certified cowpea seeds. In response to these findings, interventions targeting informal seed systems and enhancing access to credit emerged as vital strategies to increase the adoption of quality seeds of improved cowpea varieties among smallholder farmers.

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References

1. Nkomo, G.V.; Sedibe, M.M.; Mofokeng, M.A. Production Constraints and Improvement Strategies of Cowpea (*Vigna unguiculata* L. Walp.) Genotypes for Drought Tolerance. *Int. J. Agron.* **2021**, *2021*, 5536417. [CrossRef]
2. Kamara, A.Y.; Omoigui, L.O.; Kamai, N.; Wansiha, S.U.; Ajeigbe, H.A. Improving cultivation of cowpea in West Africa. In *Achieving Sustainable Cultivation of Grain Legumes*; Sivasankar, S., Bergvinson, D., Gaur, P., Kumar, S., Beebe, S., Tamò, M., Eds.; Burleigh Dodds Science Publishing: Cambridge, UK, 2018; pp. 235–252, ISBN 978-1-78676-140-8.
3. MAE. *Rapport D'évaluation de la Campagne Agricole D'hivernage 2020 et Perspectives Alimentaires 2020/2021*; Ministère de l'Agriculture et de l'Elevage: Niamey, Niger, 2021.

4. Baoua, I.; Rabé, M.M.; Murdock, L.L.; Baributsa, D. Cowpea production constraints on smallholders' farms in Maradi and Zinder regions, Niger. *Crop Prot.* **2021**, *142*, 105533. [CrossRef]
5. Adams, A. Analysing the determinants, constraints and opportunities of smallholder farmers access to input markets: Evidence from northern Ghana. *J. Agribus. Rural Dev.* **2020**, *56*, 133–143. [CrossRef]
6. Mbavai, J.J.; Shitu, M.B.; Abdoulaye, T.; Kamara, A.Y.; Kamara, S.M. Pattern of adoption and constraints to adoption of improved cowpea varieties in the Sudan Savanna zone of Northern Nigeria. *J. Agric. Ext. Rural Dev.* **2015**, *7*, 322–329. [CrossRef]
7. Salifou, M.; Tignegre, J.B.L.S.; Tongoona, P.; Offei, S.; Ofori, K.; Danquah, E. Farmers' Preferred Traits and Perceptions of Cowpea Production and Constraints in Niger. *J. Agric. Food Technol.* **2017**, *7*, 1–11.
8. Iorlamen, T.; Omoigui, L.O.; Kamara, A.Y.; Garba, U.; Iyorkaa, N.; Ademulegun, T.; Solomon, R. Developing Sustainable Cowpea Seed Systems for Smallholder Farmers through Innovation Platforms in Nigeria: Experience of TL III Project. In *Enhancing Smallholder Farmers' Access to Seed of Improved Legume Varieties through Multi-stakeholder Platforms*; Springer: Singapore, 2021; pp. 125–142. Available online: https://link.springer.com/chapter/10.1007/978-981-15-8014-7_9 (accessed on 4 October 2023).
9. Phillip, D.; Nin-Pratt, A.; Zambrano, P.; Wood-Sichra, U.; Kato, E.; Komen, J.; Hanson, H.; Falck-Zepeda, J.B.; Chambers, J. *Insect-Resistant Cowpea in Nigeria: An Ex Ante Economic Assessment of a Crop Improvement Initiative*; International Food Policy Research Institute: Washington, DC, USA, 2019.
10. Beye, A.; Diakhate, P.B.; Diouf, O.; Faye, A.; Obour, A.K.; Stewart, Z.P.; Assefa, Y.; Min, D.; Prasad, P.V.V. Socio-Economic Constraints of Adopting New Cowpea Varieties in Three Agro-Ecological Zones in the Senegalese Peanut Basin. *Sustainability* **2022**, *14*, 14550. [CrossRef]
11. Abdoulaye, T.; Lowenberg-Deboer, J. Intensification of Sahelian farming systems: Evidence from Niger. *Agric. Syst.* **2000**, *64*, 67–81. [CrossRef]
12. Biemond, C.P.; Stomph, T.J.; Kamara, A.; Abdoulaye, T.; Hearne, S.; Struik, P.C. Are investments in an informal seed system for cowpea a worthwhile endeavour? *Int. J. Plant Prod.* **2012**, *6*, 367–385. [CrossRef]
13. MAE. *Annuaire National 2021 de Disponibilité en Semences des Variétés Améliorées au Niger*; Ministère de l'Agriculture et de l'Elevage: Niamey, Niger, 2021.
14. RECA. *Les Semences Améliorées de Niébé Disponibles pour la Campagne 2023*; Réseau National des Chambres d'Agriculture du Niger: Niamey, Niger, 2023.
15. Rabé, M.M.; Baoua, I.B.; Baributsa, D. Farmers' Preferred Genotype Traits and Socio-Economic Factors Influencing the Adoption of Improved Cowpea Varieties in South-Central Niger. *Agronomy* **2022**, *12*, 2668. [CrossRef]
16. CESAO. *Rapport Étude des Chaines de Valeurs Niébé dans la Zone D'intervention du Programme Lahia (Communes de Gangara, Aguié. Tchadoua, Guidan Sory et Saé Saboua)*; CESAO: Niamey, Niger, 2014.
17. Issoufou, O.H.; Boubacar, S.; Adam, T.; Boubacar, Y. Modélisation des décisions des agriculteurs sur l'adoption et l'intensification des semences améliorées du niébé au Niger. *Mar. Sci. Agron. Vét.* **2017**, *5*, 405–413.
18. Ouédraogo, M.; Jaquet, S.; Traoré, B.; Sall, M.; Tougiani, A.; Dembélé, S.; Zougmoré, R.B. Prioritizing Value Chains for Climate-Smart Agriculture (CSA) Promotion in Mali, Niger and Senegal. Climate Change Smart Agriculture and Food Security Info Note, February 2021. Available online: https://cgspace.cgiar.org/handle/10568/111456 (accessed on 16 February 2023).
19. Ouédraogo, M.; Barry, S.; Zougmoré, R.; Partey, S.; Somé, L.; Baki, G. Farmers' Willingness to Pay for Climate Information Services: Evidence from Cowpea and Sesame Producers in Northern Burkina Faso. *Sustainability* **2018**, *10*, 611. [CrossRef]
20. Sylla, A.; Yila, J.O.; Diallo, S.; Traoré, S. Importance of the Social Structures in Cowpea Varietal Demands for Women and Men Farmers in Segou Region, Mali. *Sustainability* **2023**, *15*, 3433. [CrossRef]
21. Coomes, O.T.; McGuire, S.J.; Garine, E.; Caillon, S.; McKey, D.; Demeulenaere, E.; Jarvis, D.; Aistara, G.; Barnaud, A.; Clouvel, P.; et al. Farmer seed networks make a limited contribution to agriculture? Four common misconceptions. *Food Policy* **2015**, *56*, 41–50. [CrossRef]
22. McGuire, S.; Sperling, L. Seed systems smallholder farmers use. *Food Secur.* **2016**, *8*, 179–195. [CrossRef]
23. Sperling, L.; Gallagher, P.; McGuire, S.; March, J.; Templer, N. Informal Seed Traders: The Backbone of Seed Business and African Smallholder Seed Supply. *Sustainability* **2020**, *12*, 7074. [CrossRef]
24. Saka, J.O.; Agbeleye, O.A.; Ayoola, O.T.; Lawal, B.O.; Adetumbi, J.A.; Oloyede-Kamiyo, Q.O. Assessment of varietal diversity and production systems of cowpea (*Vigna unguiculata* (L.) Walp.) in Southwest Nigeria. *J. Agric. Rural Dev. Trop. Subtrop.* **2018**, *119*, 43–52. [CrossRef]
25. Sperling, L.; Gallagher, P.; McGuire, S.; March, J. Tailoring legume seed markets for smallholder farmers in Africa. *Int. J. Agric. Sustain.* **2021**, *19*, 71–90. [CrossRef]
26. Sperling, L.; Almekinders, C.J.M. Informal Commercial Seed Systems: Leave, Suppress or Support Them? *Sustainability* **2023**, *15*, 14008. [CrossRef]
27. CRS; BUDIKADIDI; CRF. *Seed System Security Assessment, Kasai Oriental, Democratic Republic of Congo*; Catholic Relief Services and International Center for Tropical Agriculture: Kinshasa, Democratic Republic of the Congo, 2017.
28. Sperling, L.; Louwaars, N.; de Ponti, O.; Smale, M.; Baributsa, D.; van Etten, J. Viewpoint: COVID-19 and seed security response now and beyond. *Food Policy* **2020**, *97*, 102000. [CrossRef]
29. Kansiime, M.K.; Mastenbroek, A. Enhancing resilience of farmer seed system to climate-induced stresses: Insights from a case study in West Nile region, Uganda. *J. Rural Stud.* **2016**, *47*, 220–230. [CrossRef]

30. Baributsa, D.; Lowenberg-Deboer, J.; Murdock, L. Profitable chemical-free cowpea storage technology for smallholder farmers in Africa: Opportunities and challenges. In Proceedings of the 10th International Working Conference on Stored Product Protection, Estoril, Portugal, 27 June–2 July 2010; Volume 425, pp. 1046–1052.
31. Murdock, L.L.; Seck, D.; Ntoukam, G.; Kitch, L.; Shade, R.E. Preservation of cowpea grain in sub-Saharan Africa—Bean/Cowpea CRSP contributions. *Field Crops Res.* **2003**, *82*, 169–178. [CrossRef]
32. Jones, M.; Walsh, S. *Seed Storage Brief: Economics and Promotion: Insights for Program Design*; Catholic Relif Service: Nairobi, Kenya, 2014; p. 32.
33. Baributsa, D.; Baoua, I.B. Hermetic bags maintain soybean seed quality under high relative humidity environments. *J. Stored Prod. Res.* **2022**, *96*, 101952. [CrossRef] [PubMed]
34. Bold, T.; Kayuki, K.; Svensson, J.; Yanagizawa-Drott, D. *Low Quality, Low Returns, Low Adoption: Evidence from the Market for Fertilizer and Hybrid Seed in Uganda*; International Growth Centre: London, UK, 2015.
35. Kouyate, Z.; Dao, K.M.; Togola, O.; Malle, A.K.; Malle, O.; Diakite, K.; Traore, A.; Kouyate, Z.; Dao, K.M.; Togola, O.; et al. Cowpea Seed Innovation Platform: A Hope for Small Seed Producers in Mali. In *Enhancing Smallholder Farmers' Access to Seed of Improved Legume Varieties through Multi-Stakeholder Platforms*; Springer: Singapore, 2021; pp. 143–156. [CrossRef]