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Use of tools and products for storing Cowpea and Bambara groundnut seeds against *Callosobrochus maculatus* (Fab.) according to social categories in Niger.

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Abstract:
In Niger, the use of cowpea and Bambara groundnut storage methods against Callosobruchus maculatus (Fab.) depends on social categories. In total, 404 households were interviewed in 16 villages (Mallé, Matankari, Goubawa, Sabarou, Tchito, Kamreye, Kaiwa Ganwo, Goubaye, Badiffa, Issakitchi, Barbousaye, Wande Beri, Rougaguin Nakikarfi, Doromawa, Gazobi and Ido Bissa) belonging to Tillabéri, Dosso and Maradi. Thus, from this study it emerged that 95% of each social category uses the seed to the detriment of the pod for storage. In fact, for cowpea storage, PICS bags are used more by the better-off (61%) and the middle (61%) than the poor (38%) and very poor (24%). In the same idea, PICS bags are used more by the Better-off (43%) than the middle (39%), poor (24%) and very poor (24%) in the storage of Bambara groundnut seeds. This study also showed that more than 50% of each social category (Very Poor (60%), Poor (60%), Middle (62%), Better-off (52%)) use Phostoxin to prevent the damage of Callosobruchus maculatus (Fab.) on cowpea and Bambara groundnut seeds in storage. It was revealed that the better-off (6.93 ± 2.214) store their cowpea seeds for an average period (months) longer than the average (6.07 ± 2.313), poor (5.52 ± 3.111) and very poor (5.52 ± 3.111). Thus, the analysis of variances (ANOVA) indicates a significant difference at the 5% level (P = 0.014; F = 3.587) between social categories. In the same way, the analysis of the average duration (months) of storage of Bambara groundnut shows that the well-off (4.64 ± 3.544) store their seeds for a longer period than that of the means (4.21 ± 3.407), poor (4.42 ± 3.264), very poor (3.4 ± 3.708). Analysis of variance (ANOVA) indicates a significant difference at the 5% level (F = 0.840, P = 0.473) between social categories. The better-off (140.27 ± 203.100) store more Cowpea seeds in quantity (kg) until the lean period more than the means (38.66 ± 67.587), the poor (13.88 ± 23.242) and very poor (6.92 ± 10.801). Likewise, the better-off (95.52 ± 183.022) store Bambara groundnut seeds more than the average (25.44 ± 52.178), poor (15.91 ± 39.314) and very poor (2.88 ± 6.366). The tools and products most used by farmers generally depend on social categories with risks to consumer health and the environment.

Key Word*: tools; products, storage; social categories; Callosobruchus maculatus (Fab.)*

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I. Introduction

Legumes are easily accessible sources of vegetable protein [1]. the problems encountered in Africa by producers during the post-harvest phase of agricultural products have long been neglected, confused with those linked to production [2]. Whereas, more than 70% of all undernourished people live in rural areas [3]. The causes and severity of household food insecurity differ from one geographic area to another and from one household to another. Thus, the problem is not insufficient production but uneven distribution of food and / or poor storage of post-harvest surpluses. [2]. In fact, *Callosobruchus maculatus* is a formidable pest that attacks stocks of Cowpea and Bambara groundnut seeds leading to rapid crop degradation. But, aren't the practices for protecting stored seeds a function of social categories? This study will seek to verify whether there is a significant difference between the social categories (the better off, middle, poor and very poor) in the adoption of storage techniques in order to prevent the damage of *Callosobruchus maculatus* in the study area.

II. Material And Methods

Study Location: The prospected study area is made up of 16 villages (Mallé, Matankari, Goubawa, Sabarou, Tchito, Kamreye, Kaiwa Ganwo, Goubaye, Badiffa, Issakitchi, Barbousaye, Wande Beri, Rougaguin Nakikarfi, Doromawa, Gazobi and Ido Bissa) belonging to 3 Regions (Tillabéri, Dosso and Maradi) of the Country. Thus, the following map shows the location of the study area:

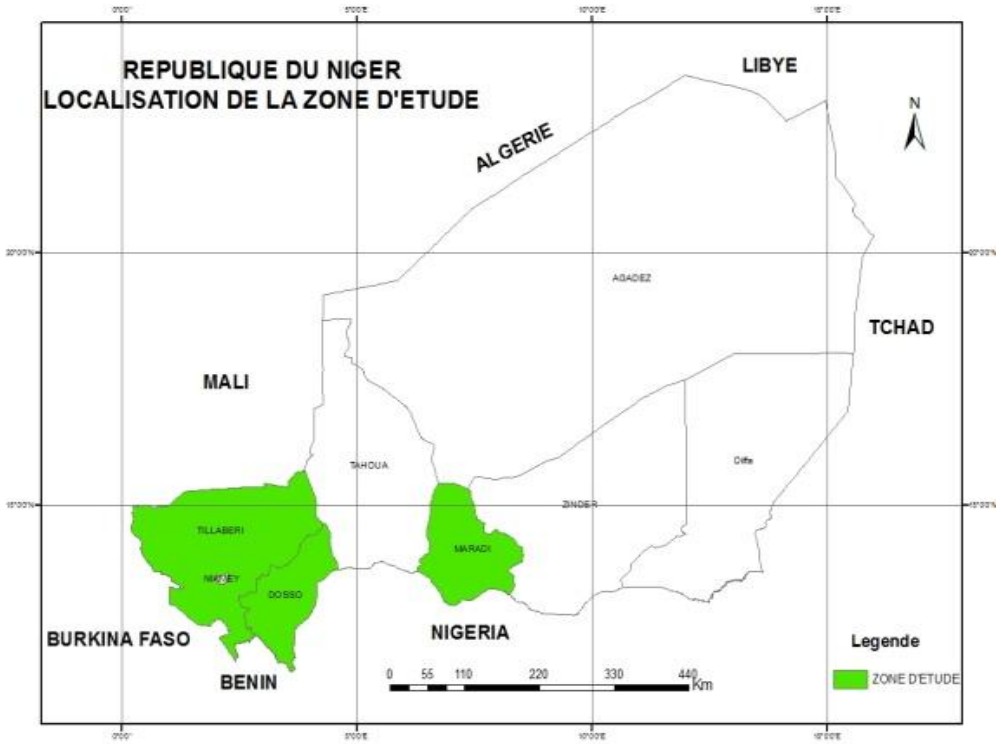


Figure 1: Location maps of the Study Sites.

Indeed, the region of Maradi is located to the south and lies between the parallels 13 ° 00 'and 15 ° 26' North latitude; 6 ° 16 'and 8 ° 33' Longitude East. It has an area of 41,796 km2, or 3% of the national territory. According to INS-Niger estimates, the population of the Maradi region is 4,160,231 with a growth rate of 4.16% in 2017 [4]. As for the Dosso region, it is also located in the southern part of Niger, and is limited to the east by the Tahoua region, to the north-west by the Tillabéri region, and to the south by the Republic of Benin and the Federal Republic of Nigeria. It covers an area of 33,844 km², or 2.7% of the total area of Niger. According to INS-Niger estimates the population of the Dosso region is 2,368,651 [4]. The growth rate was 3.71 in 2017 [4]. Indeed, the region of Dosso is located between the North latitudes 11 ° 50 and 14 ° 40 and the East longitudes 2 ° 30 and 4 ° 40. On the other hand, the region of Tillabéri is located in the extreme west of the Nigerien territory between 11 ° 50 and 15 ° 45 of North latitudes and 0 ° 10 and 4 ° 20 of East longitude. It covers an area of 97,251 km2 or approximately 7.7% of the national territory. In 2017, it had 3,280,333 inhabitants and a growth rate of 3.80% in 2017 [4].

Study Duration: June 2018-August 2018.

Sample size: 404 surveyed.

Sample size calculation: From the p values from the results of the exploratory phase of the study, the size of the sample in each of the 16 Villages was defined by a normal approximation of the binomial distribution according to [5]. according to the formula: n = 1.962 * 0.5 (1-0.5) / (0.05) 2 = 384.20 sample households, z: standard value associated with the required confidence level; p: degree of variability (estimated prevalence rate); e: level of precision. 5% of the sample was taken as a percentage of non-response which gives a sample of N = 384.20 + 5% * 384.20 = 403.41 households.

Subjects & selection method: Thus 404 households were chosen during the sampling. Thus, the first level of sampling concerns the selection of villages and the second concerns the selection of households to be surveyed. The economy of the households surveyed was analyzed using the HEA (Household Economy Analysis) approach, designed by Save The Children UK in the 1990s.

Board 1: Sample size by social categories

Social Categories / Regions	**Totals**	**Totals (%)**
Better-off	44	10,9
Middle	183	45,3
Poor	152	37,6
Very poor	25	6,2
Totals	404	100

Inclusion criteria:
1. Households supporting the 16 target villages
2. All sexes combined
3. Head of household,
4. Producers of Cowpea and / or Voandzou

Exclusion criteria:
1. Non-heads of households
2. Non-producers

Procedure methodology

Apart from informal surveys, individual interviews sanctioned this research. Thus, a total of 404 households were interviewed during the lean period May-June 2018. The study dwelled on the characterization of the social categories surveyed according to the target regions, adoption rate of the different forms of stored seeds (seeds, pods) according to social categories. Adoption of closed seed / pod storage tools, types of insecticides used, average seed storage time, quantity of stocks according to social categories.

Statistical analysis

Thus, the answers to all the questions were processed on CSPRO.7 and then codified. Excel and SPSS 20.0 software subsequently made it possible to make tables of frequencies and figures. A comparison of means was made at a significance level of 5% using analysis of variance (ANOVA). Duncan's test or multiple comparisons test was used to determine significant differences between group means in an analysis of variance.

III. Results

3.1. Distribution of the study sample by prospected region according to social categories.

The figure 2 below shows the distribution of the study sample by region

Figure 2: Distribution of the sample according to regions and social categories

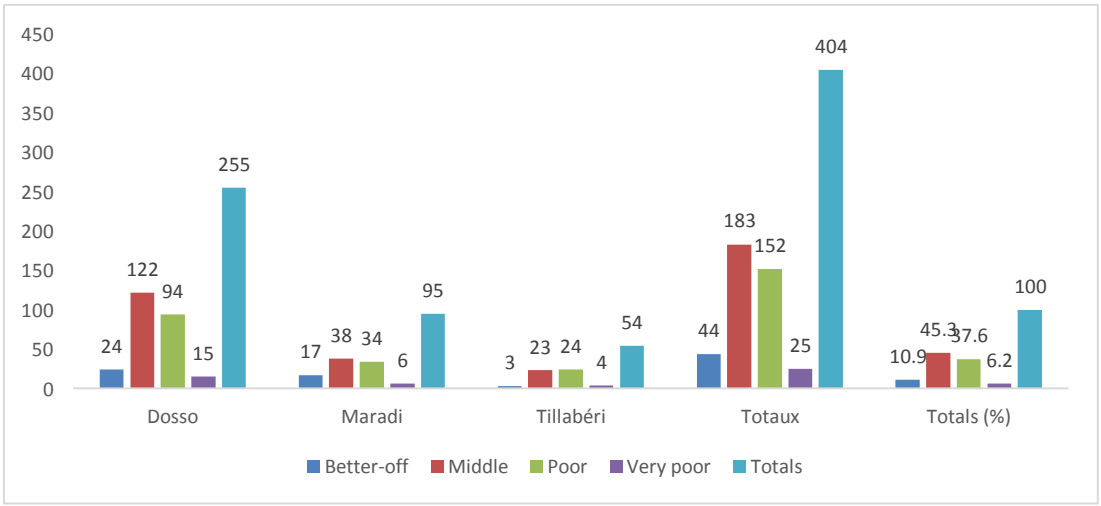


Figure 2 shows that the proportion of the means (45.3%) is greater than that of the poor (37.6%), better-off (10.9%) and very poor (6.2%).

3.2. Characterization of social categories according to their level of wealth

Board 2 below shows the characteristics of the social categories according to the number of children in charge and hectares of cultivated land.

Board 2: Average children in care and cultivated hectares according to social categories

Social Categories / Regions	Averages ± Standard deviation Dependent children	Number hectares (ha)
Better-off	10,98±5,928	15
Middle	9,05±5,349	10
Poor	7,68±4,350	6
Very poor	6,72±5,856	2
Totals	8,60±5,200	

Board 2 above shows that the better-off (15 ha) and the middle (10 ha) own more cropland than the poor (6 ha) and the very poor (2 ha). In the same sense, it is observed that the haves (10.98 ± 5.928) and the means (9.05 ± 5.349) have more children in charge than the poor (7.68 ± 4.350) and the very poor (6.72 ± 5.856). In Nigeria, according to (Ibrahim et al., 2009), the result of the study shows that the average size of agricultural holdings of food-insecure agricultural households (1 ha) was lower than that of agricultural households in a situation of food insecurity. food security (2.1 ha).

3.3. Adoption rate of different forms of seeds (seeds, pods) according to social categories.

Board 3 below illustrates the use of cowpea and Bambara groundnut seed form types for storage according to social categories

Board 3: Seed shape and social categories

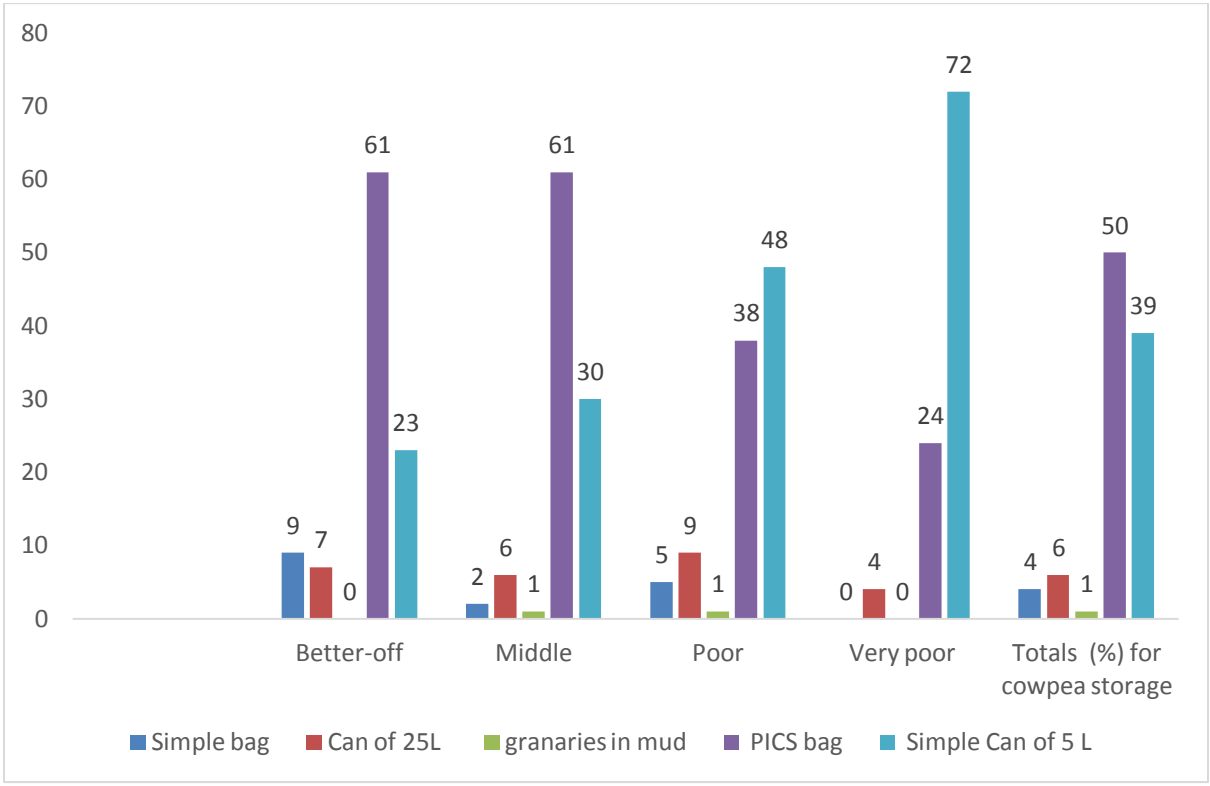
Social Categories / Regions	Cowpea		Bambara groundnut	
	Seeds (%)	Pods (%)	Seeds(%)	Pods (%)
Better-off	97,7	2,3	97,7	2,3
Middle	99,5	0,5	95,6	4,4
Poor	100,0	0,0	93,4	6,6
Very poor	96,0	4,0	96,0	4,0
Totals	99,3	0,7	95,0	5,0

The analysis in Table 3 above shows that more than 93% of each social category uses the seed in storage. However, the poor (6.6%) store more pods than the Better Off (2.3%), the Middle (4.4%), and the Very Poor (4%).

But Board 3 also shows that cowpea pods are only and poorly stored by the better-off (2.3%), the means (0.5%), and the very poor (4%).

3.4. Adoption of closed tools for storing seeds / pods of Cowpea and Bambara groundnut against *Callosobruchus maculatus* according to social categories.

Figure 3 below shows the main storage tools for protecting Cowpea and Bambara groundnut seeds against *Callosobruchus maculatus* according to social categories.



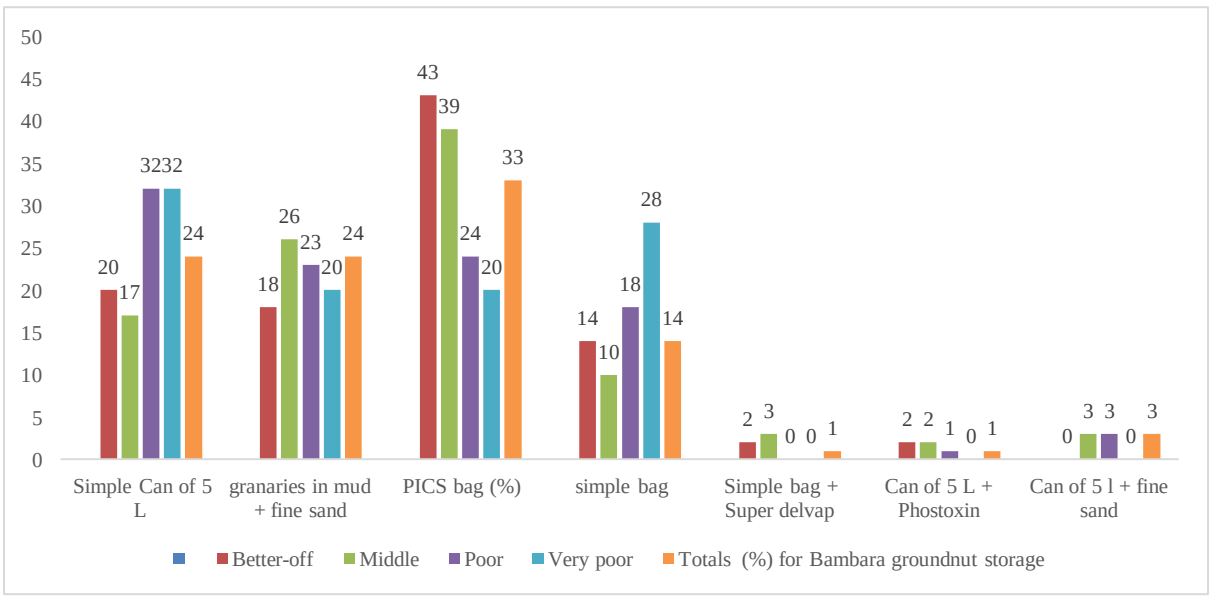


Figure 3: Tools for storing Cowpea and Bambara seeds according to social categories.

The analysis of Figure 3 above shows that the better off (61%) and the middle (61%) use PICS bags more than the poor (38%) and very poor (24%) for the storage of cowpea seeds. Likewise, PICS bags are the most used for storing Bambara groundnut among the better-off (43%), followed by means (39%), the poor (24%) and the very poor (20%). On the other hand, the simple 5-liter cans are used more among the very poor (72%) and poor (48%) compared to the Better-off (23%) and middle (30%) for storing cowpea seeds. Thus, the Simple can is more used among the very poor (32%) and poor (32%), well-off (20%) and middle (17%) in the context of storage of Bambara groundnut.

The use of the mud granary for the storage of cowpea against *Callosobruchus maculatus* is observed only among the poor (1%) and the middle (1%). It is also noted that the poor (9%), the better off (7%), the middle (6%) and the very poor (4%) make little use of the 25-liter cans for the storage of cowpea seeds in a peasant environment. in order to deal with the damage caused by *Callosobruchus maculatus*. The analysis in figure 3 also shows that only the better off (9%), the middle (2%) and the poor (5%) use simple bags

(propylene). On the other hand, 24% of users of granaries in mud + fine sand, the means (26%) are slightly more important than the poor (23%), the very poor (20%) and the Better-off (18%). But of the 14% of simple bag users, the proportion of the very poor (28%) is higher than those of the Poor (18%), Better off (14%) and Average (10%) for the storage of Bambara groundnut seeds. But, the simple bags + Superdelvap are only used by the haves (2%) and the middle (3%). In the same sense, the simple can + Phostoxin is only and weakly used by the better off (2%), the middle (2%) and the poor (1%). Finally, 3% of users

store Bambara groundnut seeds using the can + fine sand.

3.5. Types of insecticides used on cowpea and Bambara groundnut stocks according to Social Categories.

Figure 4 shows the proportions of the types of insecticides used against *Callosobruchus maculatus* on Cowpeas and *Bambara groundnut* according to social categories.

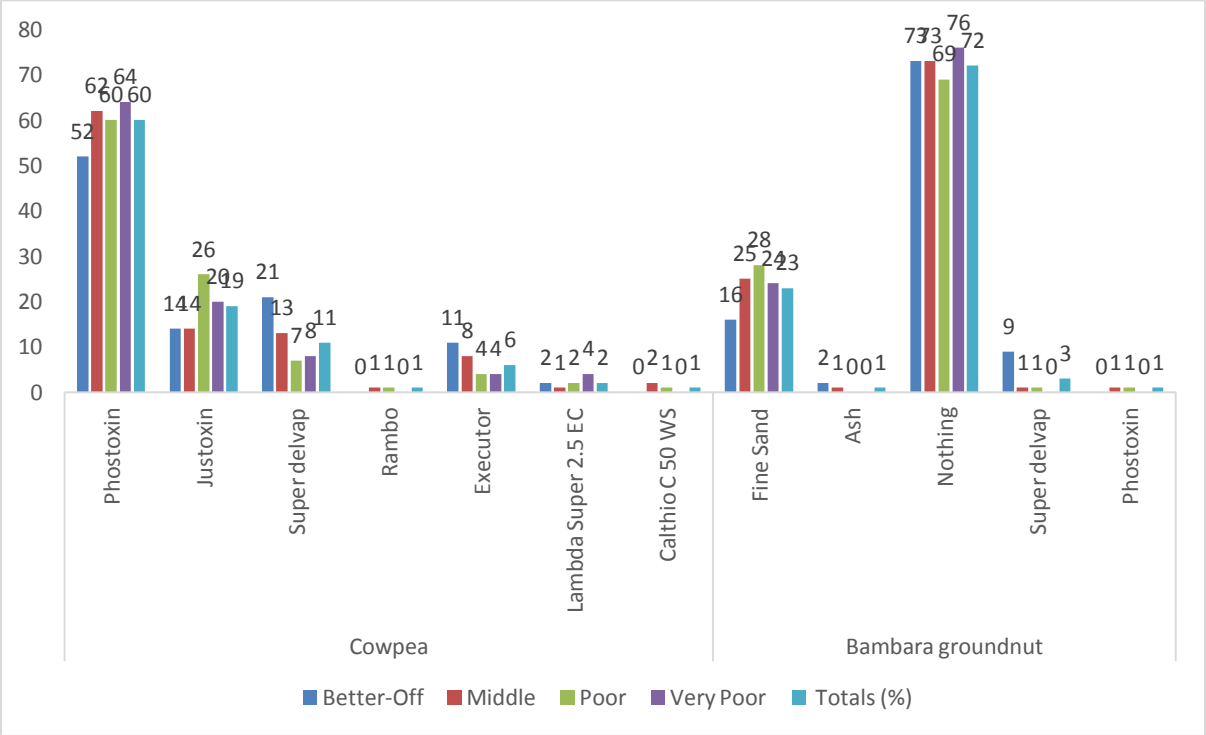


Figure 4: Proportion of Types of insecticides applied to Cowpea and Bambara groundnut according to social categories

The Figure 4 shows the proportions of the types of insecticides used against *Callosobruchus maculatus* on Cowpeas and *Bambara groundnut* according to social categories.

The analysis of the figure above illustrates that more than 50% of each social category (Very Poor (60%), Poor (60%), Middle (62%), Better off (52%)) use Phostoxin for prevention stored cowpea seeds against Callosobrochus maculatus. Yet the uptake of Phostoxin in the Bambara groundnut stock is low among all social categories (Better off (0%), middle (1%), poor (1%) and very poor (0%). The figure also shows that local products such as fine sand are only used in the storage of Bambara groundnut seeds. The sand is used successively by the poor (28%), the Middle (25%), the poor (24%), the better off (16%). The figure also shows that Justoxin (19%) is the second most used chemical by producers after Phostoxin (60%). Indeed, the poor use justoxin (26%) on seeds. cowpea more than the very poor (20%), the middle (14%) and the better off (14%). On the other hand, super delvap is used more successively by on cowpeas and Bambara groundnut by the better off (21%, 9%) than the middle (13%, 1%), the poor (7%, 1%) and very poor (8%, 0%). Rambo is an insecticide used very weakly only by the middle (1%) and poor (1%) on cowpeas generally. Out of a proportion of 6% of users, the better off (11%) and the middle (8%) use the Executor insecticide more than the poor (4%) and the very poor (4%) on cowpea seeds. In a proportion of 2% of users, Lambda Super 2 EC is used more by the very poor (4%), than by the poor (2%), middle (1%) and rich (2%). On the other hand, Calthio is the insecticide the least used by producers, in particular the well-to-do (0%), the middle (2%), the poor (1%) and the very poor (0%). Finally, it is noted that 72% of producers do not use any chemicals on the Bambara groundnut in storage.

3.6. Average storage time of cowpea and Bambara groundnut seeds according to social

The Board 4 shows the average storage time of cowpea and Bambara groundnut seeds according to social categories at the 5% threshold.

Board 4: Average storage time of cowpea and groundnut seeds according to social categories at the 5% threshold.

Social categories	Cowpea			Bambara groundnut		
	Averages ±Standard deviation (Month)	N	Variance	Averages ±Standard deviation (Month)	N	Variance
Better-off	6,93±2,214 [a]	44	4,902	4,64±3,544 [a]	44	12,562
Middle	6,07±2,313 [a]	183	5,352	4,21±3,407 [a]	183	11,605
Poor	5,61±2,702 [b]	152	7,3	4,42±3,264 [a]	152	10,656
Very poor	5,52±3,111 [b]	25	9,677	3,4±3,708 [a]	25	13,75
Total	5,96±2,534	404	6,42	4,28±3,386 [a]	404	11,465
ANOVA	F= 3,587, P=0,014			F= 0,840, P= 0,473		

The means in the same column followed by the same letters are not significantly different at the threshold of P = 5% using Student Newman Keuls (SNK) grouping.

The analysis of the table above shows the average storage time of Cowpea in farm tools and products. Thus, the analysis of the mean comparison test (ANOVA) shows that the better off (6.93 ± 2.214) store their seeds for an average period longer than the average (6.07 ± 2.313), poor (5.52 ± 3.111) and very poor (5.52 ± 3.111).

Analysis of variances (ANOVA) indicates a significant difference at the 5% threshold (P = 0.014; F = 3.587) between social categories in the use of cowpea seeds. In the same sense, it is noticed that the average duration of storage of Bamabra groundnut among the better off (4.64 ± 3.544) is done over a longer period than that of the Middle (4.21 ± 3.407), poor (4.42 ± 3.264), very poor (3.4 ± 3.708). Thus, the analysis of variances (ANOVA) indicates a significant difference at the 5% level (F = 0.840, P = 0.473) in the use of Bamabra groundnut stocks.

3.7. Quantity of Cowpea and Bambara groundnut stocks according to social categories

The board 5 below shows the quantity of seeds stored in farmer storage tools and products according to social categories in Niger.

Board 5 Average quantity of stocks (lean period) of Cowpea and Bambara groundnut in farm tools and products according to social categories at the 5% threshold (ANOVA).

Social categories	Cowpea			Bambara groundnut			
	Averages ± Standard deviation (kg)	N	Variance	Averages ± Standard deviation (kg)	N	Variance	% of Total N
Better-off	140,27±203,100 [a]	44	41249,459	95,52±183,022 [a]	44	33496,906	10,90
Middle	38,66±67,587 [b]	183	4567,994	25,44±52,178 [b]	183	2722,556	45,30
Poor	13,88±23,242 [b]	152	540,198	15,91±39,314 [b]	152	1545,594	37,60
Very poor	6,92±10,801 [b]	25	116,66	2,88±6,366 [b]	25	40,527	6,20
Total	38,44±89,972	404	8094,957	28,09±77,332	404	5980,232	100,00

ANOVA	F=28,397, P=0,000	F=14,733, P= 0,000

The means in the same column followed by the same letters are not significantly different at the threshold of P = 5% using Student Newman Keuls (SNK) grouping.

The analysis of this table shows that the better off (140.27 ± 203.100) store Cowpea seeds more than the means (38.66 ± 67.587), the poor (13.88 ± 23.242) and very poor (6.92 ± 10.801). The analysis of variances (ANOVA) indicates a significant difference at the 5% level (F = 28.397, P = 0.000) in the use of cowpea seeds. Likewise, the well-off (95.52 ± 183.022) store more Bambara groundnut seeds than the average (25.44 ± 52.178), poor (15.91 ± 39.314) and very poor (2.88 ± 6.366). Analysis of variance (ANOVA) indicates a significant difference at the 5% level (F = 14.733, P = 0, 000) in the use of Voandzou seeds. Similarly, Save the Children (2009) in Niger (Dosso) found that poor and very poor households only cover 30% of their annual food needs by their production of millet and cowpea mainly. Income from agricultural products comes mainly from the sale of peanuts and small quantities of cowpeas, sorrel and Bambara groundnut.

III. Discussion

The study showed that the better-off (15 ha) and the middle (10 ha) own more cropland than the poor (6 ha) and the very poor (2 ha). Thus 62% of respondents have sufficient land for agricultural production. The majority of respondents (72.8%) have secure land tenure because they acquire their farmland by inheritance. Other respondents (27.2%) rented or rented the land. In Nigeria, according to [6], the result of the study shows that the average farm size of food insecure agricultural households (1 ha) was lower than that of food insecure agricultural households (2, 1 ha).

The study found that 95% of each social category uses the cowpea seed form for storage. However, for Voandzou seeds, 6.6% of the poor use the pod as a form of seeds.

As part of the use of cowpea storage tools, PICS bags are used more among the better off (61%) and the middle (61%) compared to the poor (38%) and very poor (24%). In the same sense for Voandzou seeds, PICS bags are the most used among the better off (43%) followed by the means (39%) and the poor (24%).

On the other hand, [7] showed that large farmers use jute bags and granaries, small farmers use drums and jars for their stocks. In Nigeria, according to [6], smallholder farmers often store crops at home (54%) or in an attic (31%).

To cope with the damage caused by *Callosobruchus maculatus* (Fab.), The study showed that more than 50% of each social category (Very poor (60%), poor (60%), Middle (62%), Better-off (52%)) use Phostoxin on Cowpea and Voandzou seeds.

The average storage time of Cowpea in farm tools and products according to the analysis of the mean comparison test (ANOVA) shows that the well-off (6.93 ± 2.214) store their seeds for an average period longer than the Means (6.07 ± 2.313), poor (5.52 ± 3.111) and very poor (5.52 ± 3.111). Analysis of variances (ANOVA) indicates a significant difference at the 5% level (P = 0.014; F = 3.587) between social categories. In the same sense, the analysis of the average storage time of Bambara groundnut shows that the well-off (4.64 ± 3.544) store their seeds for a long time more than the Average (4.21 ± 3.407), poor (4.42 ± 3.264), very poor (3.4 ± 3.708). Analysis of variance (ANOVA) indicates a significant difference at the 5% level (F = 0.840, P = 0.473) between social categories. Similarly, [8] in Niger (Dosso) finds that poor and very poor households cover only 30% of their annual food needs through their production of millet and cowpea mainly. Income from agricultural products comes mainly from the sale of peanuts and small quantities of cowpeas, sorrel and Bambara groundnut. According to [2] in Nigeria, 36% of households did not have enough food to survive until the next harvest despite preserving their post-harvest surplus. However, a good number of households (64%) had enough food to consume until the next harvest season. This has been attributed to the preservation of post-harvest surpluses.

The better-off (140.27 ± 203.100) store more cowpea seeds in quantity until the lean season more than the means (38.66 ± 67.587), the poor (13.88 ± 23.242) and very poor (6, 92 ± 10.801). Using the appropriate products and tools for their preservation against Callosobrochus maculatus (Fab.). In the same way, the better off (95.52 ± 183.022) store more Bambara groundnut seeds than the average (25.44 ± 52.178), poor (15.91 ± 39.314) and very poor (2.88 ± 6.366). In Nigeria, according to [6], based on the recommended daily farm household (2470 kcal), 41.1% of farm households were food secure while 58.9% of farm households were food insecure. Thus, more than half of households consumed significantly less than the daily calorie intake per capita.

IV. Conclusion

This study showed that the use of tools and products for storing Cowpea and Bambara groundnut seeds against *Callosobruchus maculatus* (Fab.) Varies according to social categories in Niger. Indeed, modern tools like PICS bags are used more by the better-off and the middle than by the poor and very poor. Despite the probable risk it presents to the health of consumers, Phostoxin is used for the prevention of cowpea stocks against *Callosobruchus maculatus* in more than half of every social category in Niger. However, the Bambara groundnut is very weakly treated with chemicals. Unlike Bambara groundnut, the storage period of Cowpea also varies according to social categories. Thus, this research has shown that the better-off store their seeds for an average period longer than that of the Middle, poor and very poor. It was also found that the quantity of cowpea seeds stored varies according to social categories. Thus, the better-off store more cowpea seeds in quantity until the lean period than the middle, the poor and the very poor.

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