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Typology of Farming Storage Systems in Zou Department (Benin, West Africa)

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Abstract: ***The present research aims to make the typology of peasant systems of storage of agricultural products in the Department of Zou. The typology of peasant systems for the storage of agricultural products has been possible thanks to socio-anthropological surveys. AFC (Factorial Correspondence Analysis) and the Chi-square test (chi²) respectively made it possible to establish the factorial map of the storage structures in relation to the arron dissements and to search for a possible relationship between the variables and the factors using the Chi-square test (Chi2). From the results obtained, it can be seen that in the study area there are traditional, semi-modern and modern storage. The traditional one is governed by the use of Agogranaries (48.73% of users), Djago (6.8%), the use of the ceiling of houses (34.4%) and wool bags (69.6%). The use of cans (8.7%) and casks (8.2%) constitutes the bulk of semi-modern storage. Modern storage that is governed by the use of modern stores. Modern storage is not implemented by any individual farmer. Since one system is a set, a total of sixteen (16) farmer commodity storage systems have been identified in the study area.***

Keywords: Zou Department, Typology, peasant systems, storage, agricultural products

1. Introduction

Throughout the world, the agricultural sector is of strategic importance in the post-2015 development era (FAO, 2014a) because it is not only a major provider of jobs, but also an engine of economic growth and poverty reduction (FAO and WFP, 2012). But in developing countries, the last decades of the twentieth century have been marked by a worsening of the food situation (FAO, 2011, UNDP, 2001).Thus, the studies carried out by FAO (1997) and the IPCC (2001) on the African continent call out the major difficulties in terms of food.

A dozen years later (in 2010), agricultural production has significantly increased in Africa in general and in its western part in particular (Hodges et al., 2011). This inflation has its roots in the increase of the sown area, but also in the awareness of the leaders of the agricultural sector in many countries (ACFI, 2014). Despite this agricultural production's growth, Africa remains the region with the highest prevalence of undernourishment, as it is estimated that more than one (1) out of five (5) people are undernourished (FAO, 2013). In fact, sub-Saharan Africa has the highest level of undernourishment (USAID, 2013). Overall, the region is still far from the Millennium Development Goal (MDG) on hunger reduction (FAO, 2014b).
Like those sub-Saharan countries where agriculture appears to be the most important business and economic center (Offin, 2010), Benin has an economy essentially based on agriculture, characterized by the production of food crops and rents (Yabi et al., 2011). It represents the key link in the Beninese economy with a rate of 35 to 40% of GDP (Hounsou, 2004) and the entire rural sector contributes at a rate of 40%, provides 75% of employment and more than 80% export earnings (CAPE, 2002). It provides food and cash crops for both domestic and export consumption (APRM, 2001). As a result, it remains the main source of food and income for Beninese.

For agriculture to be food secure, the infrastructure for storing agricultural products must not only be improved, but must also be enhanced (UNEP, 2013). An importance must be given to the farmer storage systems of agricultural products in order to avoid food shortage and also to valorize the efforts of the rise of the agricultural production and thus of the availability and the access to food (Maboudou, 2003). To attain this goal, it is imperative to question oneself on the current infrastructure used for storing crops in Zou Department (Figure 1).

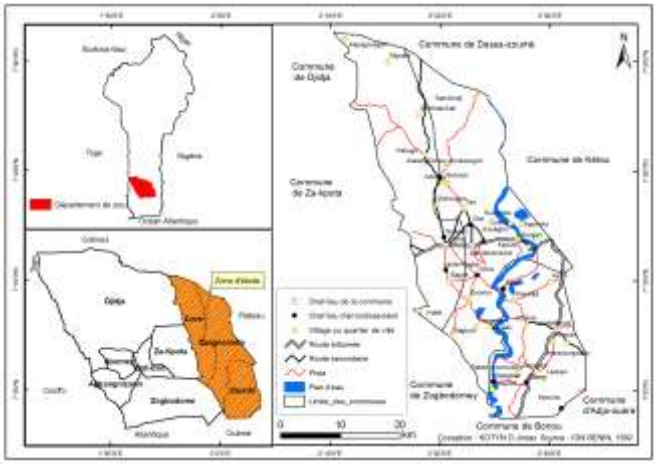

Figure 1: Geographical location and administrative division of the study area

The study area is located between 6 ° 57' and 7 ° 34' of north latitude and between 2 ° 10 ' and 2 ° 33' of east longitude in Zou Department. The Department of Zou is part of the twelfth (12) departments in Benin. It occupies an area of 5243 km2 and is composed of nine (9) communes namely: Abomey, Agbangnizoun, Bohicon,

Covè, Djidja, Ouinhi, Zagnanado, Za-Kpota and Zogbodomey (INSAE, 2004). In the framework of this research, Zou Department is composed of three (3) communes such as Covè, Ouinhi and Zagnanado forming Agonlin block.

1. Data, methods and crops' choice

This part deals with the criteria of crops' choice, data, methods and data processing.

1.1. Crops' choice

The choice of crops is based on their importance on the farms and in the eating habits of the populations. Thus, crops such as maize (Zeamays), groundnut (Arachishypogea) and cowpea (Vignaunguiculata) were chosen.

Thus, the term "agricultural product" refers to the crops mentioned above. Table I presents the ecology of crops.

Table I: Thermal and rainfall preference of crops

Cultures		Requirements	
Common name	Scientific name	Températures in °C	Water requirement (mm)
Maize	Zeamays	+18 à +30	500 à 1000
Cowpea	Vignaspp	+18 à +25	400 à 800
Peanut	Arachishypogea	+24 à +33	400 à 1200

Source: Ogouwalé, 2006

1.2. Data and methods used

The collected data are relative to the shape of the storage structure, the capacity of each structure across its dimensions (height, storage capacity, length, width, etc.), the different inputs (biological and conventional) used to reinforce storage, the different materials used for the construction of storage structures. These data were obtained thanks to the socio-anthropological information's.

1.3. Data processing

The Correspondence Factor Analysis (CFA) was the first used to process data on the typology of farmer storage systems in the Zou Department. It operates on the basis of a definite principle.

AFC Principles

The Correspondence Factor Analysis (CFA) is an analysis for the processing of data tables where the values are positive and homogeneous as the contingency tables. The principal components are always obtained from the distance between the different points of the multidimensional clouds, but the points have coordinates which have undergone a preliminary transformation allowing to keep a metric identical to that of the ACP to compute the distances. The main goal of the AFC therefore remains the same; read the information in a multidimensional space by reducing the size of this space while retaining a maximum of the information contained in the starting space.

The contingency table is an establishment table containing zij individuals at the intersection of line i and column j. This is the breakdown of a whole population M according to any two (2) characters X in line and Y in column. In the context of this research, the contingency table is summarized in two (2) characters: the lines representing the types of storage structure and the columns of the districts of the sampled municipalities in the Department of Zou. They are therefore ordinal qualitative characters. It is a double-entry table consisting of eighteen (18) rounds and six (6) types of agricultural product storage structures. The study of such a table focuses most often on the dependence or independence between the two (2) characters, eighteen (18) rounds and six (6) types of storage structures. Thus, a statistical test is done in order to be able to estimate the strength of the relationship between the studied variables.

Statistical test

The chi-square test (chi²) makes it possible to establish relationship between the variables. This is the analysis of the relationship between the types of storage structures of agricultural products and the sampled districts in the Department of Zou. In this case, the null hypothesis (H_0) is that the types of storage structures of agricultural products and districts are independent. The decision of the test is based on a level of statistical significance, the value p. If p is less than 0.05, H_0 is disallowed. The conclusion is that, if p is less than 0.05, there appears to be a link between the typical storage structure variables and the sample districts in the Zou Department.

2. Results and Discussions

Several types of storage of agricultural products are developed in the study area. This is traditional, semi-modern and modern storage.

2.1. Traditional storage

The storage of agricultural products is of paramount importance in food security. It is largely provided by rural producers in the villages. In Benin, rural localities show up as the primary food reservoir of urban areas. The main traditional storage structures used in the study area are: "Ago" loft, "Djago" loft, the use of house ceiling and the use of wool bags.

✓ **Loft of type "Ago"**

Two (2) forms of this type of attic are used by 48.73% of the producers in the study area. It is the "cylindrical" shape with a woven wall using palm leaves (Elaeis guineensis) and a rectangular shape. These are built using branches whose texture could promote small good ventilation diameter. Their structure is generally broken into four (4) parts: the support, the floor, the body and the roof. Whether rectangular or cylindrical, the body is made up of vertical uprights that make up the skeletal frame of the loft. They are braided with leaves of quackgrass (Imperatacylindrica). These lofts are formerly built in the fields. But for reasons of security and increased theft

cases, 95% of respondents abandoned their use at the expense of the ceilings of their home. Such a practice allows them to better secure their crops. According to 83% of them, this type of loft can be exploited for 2 to 3 years if the straw roof is renewed periodically. They are sometimes built with stand, the base not resting directly on the ground, can limit the attack of insects and rodents as well as the development of molds. Plate 5 illustrates the two (2) forms of attic "Ago". Plate 1 illustrates the two (2) attic shapes described above.

Plate 1: "Ago" at Tan-Adja and at Agongbodji

Shooting**:** Kotyn, november 2013

Plate 1 illustrates the " ago " loft in the villages of Tan Adja and Agongbodji. Photos 1.1 and 1.2 show two (2) cylindrical lofts. The outside of these lofts are built with different materials. One is made up with palm branches (Elaeis guineensis) and the other with reed (Phragmites australis). Photo 1.3 shows the same type of loft, but of rectangular shape. The outside of the latter is built with the same material as those used to build the one shown in photo 5.1 with the difference that the roof is made of sheet metal. The floor-to-floor height varies from 0.68 m to 0.84 m. The floor is usually circular and is made with small beams arranged in the wooden forks that serve as a support. The role of pickets is to avoid easy access to rodents (rats and mice) and runoff. They receive the cobs of corn husk and millet or of sorghum not yet beaten. Table II summarizes the characteristics of "Ago" loft.

Table II: Characteristics of "ago" loft

Characteristics	Dimensions	
	Cylindrical shape	Rectangular shape
Inner diameter	2,6 m	Length = 4, 6 m width = 3, 40
Height of the loft body	2,2 m	3,16 m
Floor-floor height	0,84 m	0,68 m
Opening of the load	Length = 1,45 m width = 0,67 m	Length = 1,80 m width = 0,88 m
Storage capacity	17 à 20 or even 25 bags of corn of 100 kg in grain depending on the building dimensions	35 à 40 bags of corn of 100 kg in grain according to the dimensions of construction

Source: Field Survey, October 2016

The analysis of table II shows that the storage capacity of the cylindrical loft varies from 17 to 20 or even 25 bags of corn of 100 kg according to the dimensions of construction. When the storage capacity of the rectangular shaped loft varies from 35 to 40 bags of 100 kg corn according to the dimensions of construction; then this type of attic does not receive in shell peanut according to the practices of the environment. The "ago" loft is used for its adaptation to the storage of spath corn. Beyond the role of storage on the social level, the "ago" loft is of easy access to children compared to the ceilings whose rise sometimes causes significant damage to them.

✓ **"Djago" loft**

This type of loft is used by 6.8% of the producers in the study area. Photo 1 illustrates this.

Photo 1: "Djago" loft containing peanut-husk in Zingon

Shooting: J. Kotyn, January 2014

Photo1 shows a "djago" loft, specially designed to preserve peanut hull according to 100% of the farmers who use it. Table III shows the characteristics of "Djago" loft.

Table III: Characteristics "Djago" loft

Characteristics	Dimension
Internal diameter	0,94 m
Loft height	1,59 m
Circumference	3,53 m
Storage capacity	24 basins husks or 408 Kg of seed peanut

Legend: According to the peanut producers and processors of the medium, three (3) "togolo" peanut husks gives on average one (1) "togolo" groundnut seed. However, one (1) "togolo" peanut seed gives 1 kg.

Source: Field Investigations, November 2016

The results in table III show that the inside diameter is 0.94 m, the height is close to 1.59 m, the circumference is approximately 3.53 m and the storage capacity is around 60 kg of peanut husks. It is adopted by growers to store inshell peanuts only because of its adaptability and for its safety.

✓ **The use of wool bags**

The storage in wool bags is a practice implemented by 69.6% of the producers in the Zou Department. It receives corn grain like corn and spathe, peanut-husks or seed, cowpea-husks, etc. They are generally used by farmers in addition to the main structures that are the ceiling and the "Ago". Plate 2 illustrates stocks of agricultural products in wool bags.

Plate 2: Groundnut (5.1) at Athogon and Corn (5.2) at Zonmon stored in wool bags

Shooting: J. Kotyn, November 2013

The results in Plate 2 show that groundnuts (2.1) and maize (2.2) are stored in wool bags. According to 98% of those surveyed, wool bags are more suitable for storing peanut-husks. 91.5% of producers use the bags not only for the storage of peanut husks, but also and especially for the storage of grain corn; an unusual practice in the domain. Table IV shows some characteristics of the wool bags used by the peasants.

Table IV: Characteristics of the wool bag

Charactéristics	Dimensions
Height	About 1,37 m
Circumference	1,79 m
Storage capacity	3 peanut husks and about 2 untreated corn pans

Legend: According to the peanut producers and processors of the medium, three (3) "togolo" peanut husks give on average one (1) "togolo" of groundnut seed. One (1) "togolo" measures exactly one (1) kg.

Source: Field investigations, October 2013

The results in table IV show that the wool bags used for the conservation of agricultural products are about 1.37 m high and have a circumference of 1.79 m. Wool bags may contain two (2) or three (3) basins of corn or peanut. According to 69.6% of the farmers, the reasons that account for this choice of wool bags are its reduction cost compared to other storage structures; its adaptability for grain storage and the fact that its use facilitates the application of protection.

✓ **Ceiling storage**

The agricultural production growth has led to new types of storage of agricultural products. In fact, the use of the ceilings requires storage means adapted to each speculation. In addition, it is quite important to choose a good site for grain storage. This explains the choice of the home ceilings by the producers of the Department of Zou to store certain speculations. This is practiced by 65.6% of the producers in the study area. Plate 3 is an illustration of the storage technique using the ceiling.

Plate 3: Voli corn and peanut in Houégbo-Aga shell stored on the ceiling

Shooting: Kotyn, November 2016

Plate 3 shows corncobs (3.1) and peanut-husks (3.2) which are respectively in Voli and Houégbo-Aga using house ceiling. This corn and peanut storage technique is adopted by producers and is the most observed practice in the study area. 99% of the producers use it for the storage of corn and peanut husk. Stored products are obviously savings because the largest number (86.8%) of producers sells a portion of their harvest during the lean season.

2.2. Semi-modern and / or modern storage

Despite the existence of traditional storage structures for agricultural products, a modernization is observed through the use of semi-modern storage. The semi-modern structures are characterized by the use of cans and barrels to store agricultural products in Zou Department.

✓ **Storage in cans**

This consists in storing corn kernels, cowpeas, etc. harvested after an agricultural companion in cans. The latter are poorly used by farmers (8.73%) in the study area. Some examples of storage in cans are illustrated in Plate 4.

Plate 4: storage in cans at Covè (7.1) and Houégbo (7.2)

Shooting: J. Kotyn, November 2016

Plate 8, in picture 4.1, shows two (2) cans respectively of 5 kg and 0.5 kg in which are stored corn grain. These small volumes of cans are used for self-consumption. There are 25 kg of corn cans and 50 kg cans in photo 4.2. These large storage volumes are intended for marketing and also for self-consumption during the lean season. This type of storage is used by farmers after a good drying of corn. Barrels are also used in the study area.

✓ **Storage in barrels**

The plastic barrels of 200 kg make it possible to preserve corn kernels and cowpeas harvested during a farming season. The stored products are intended for sale and self-consumption during the lean season. Eight percent two (8.2%) of farmers use this device to store their production. The reasons for using barrels and the rigor of drying that are required are the same as those that justify the use of cans. The types of barrels in the study area are shown in Photo 2.

Photo 2: Storage system in barrel in the village of Bamè

Shooting: J. Kotyn, October 2016

Photo 2 shows a 200 kg barrel filled with corn kernels. The volume of agricultural product preserved in this type of barrel is intended for most of the time for sale and part for consumption during the lean season.

2.3. Modern storage

Modern large capacity structures are almost non-existent in the study area. No producer has a modern type to store his production. Those encountered are stores of public interest or the work of an agricultural development association. The construction of these stores is financed by the groups of farmers with the support of the town hall, the national budget and TFPs such as PUASA / APRM, EUROPEAN UNION, IFAD, UEMOA, ADB, etc. Only rice producer groups put their stocks there after having sold them to the managers of these stores for their use during the lean season by ONASA for the supply of the populations and this at a low price during the lean season. Figure 2 shows the distribution of modern storage warehouses in this sector.

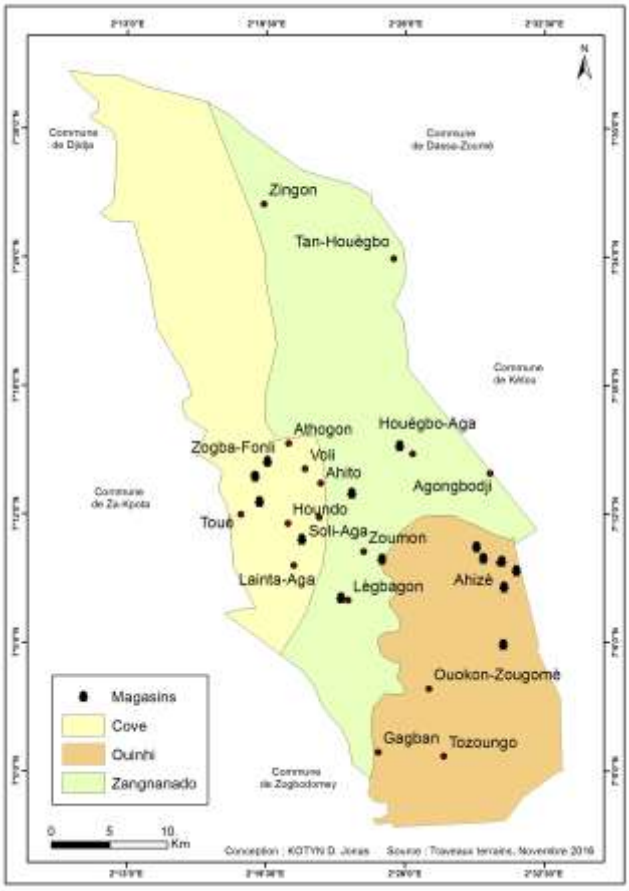

Figure 2: Distribution of modern storage warehouses in the study area

Figure 2 shows that modern stores are in diverse proportions in all municipalities in the study area. It also shows that there were fourteen (14) modern farm product storage stores in the study area, four (4) respectively at Covè and at Zagnanado, six (6) in Ouinhi. According to field surveys, 100% of the farmers do not use and have no knowledge of the modern system (store) to keep their agricultural product. Only groups of rice producers benefit from it. This type of conservation structure is used by the MAEP, NGOs and major agricultural institutions. Plate 5 shows some of the aforesaid magazines.

Plate 5: Some modern agricultural products storage stores in the study area
Shooting: J. Kotyn, October-November 2016

Plate 5 clearly shows four (4) separate stores. The first (5.1) shows Zounnou store; the one located in the dreg of Bamè in the district of Agonlin-Houégbo (Municipality of Zagnanado) presented in photo 5.2. The third and fourth store (5.3 and 5.4) show respectively the shop located on the yard of the SCDA of Covè and that of the court of the SCDA of Zagnanado. All these stores are built just for storing rice. These stores are used by MAEP, the town hall and the major agricultural production companies. The products stored in these stores are intended exclusively for sale within the country during the lean season.

2.4. Assignation of farmers according to the storage structures

The importance of foodstuffs reflects the role these products play in the production of financial capital and household feeding. Farmers use several storage structures depending on their ability and the requirements of each speculation. Table V shows the assignation of farmers according to the storage systems.

Table V: Assignation of farmers according to the types of storage used in the study area

storage Structures	Communes	Number of peasants	Proportion per Commune (%)	Proportion in the study area (%)
Ceiling only	1	46/83	55,42	32,03
	2	05/134	3,73	
	3	51/138	36,95	
“Ago” only	1	00/83	00	27,70
	2	91/134	67,91	
	3	21/138	15,21	
Ceiling + loft type "Ago ”	1	02/83	2,40	11,61
	2	26/134	19,40	
	3	18/138	13,04	
Ceiling + loft type “Djago”	1	02/83	2,40	2,49
	2	00/134	00	
	3	07/138	5,07	
Ceiling + wool bags	1	33/83	39,76	26,14
	2	12/134	8,95	
	3	41/138	29,71	
Total	Area of study	355	100	100

Legend: 1 = Covè; 2 = Ouinhi; 3 = Zagnanado
Sources: Field Investigations, November 2016

It can be seen from Table V that out of the four (4) types of traditional structures, only the ceiling and the loft "Ago" are object of a single use and this respectively by 32.07% and 27.70% of producers. The wool bags and the loft "Djago" often come as a complement to the two (2) main structures listed above as soon as the harvest is significant enough.

2.5. Analysis of storage measures of agricultural commodities

The independence test between conservation structures (variables) and districts in the Department of Zou (factors) is recorded in Table VI.

Table VI: Independence test between variables and factors

Khi² (observed value)	**304,0897**
Khi² (Critical value)	107,5217
DDL	85
p-value	< 0,0001
Alpha	0,05

Source: Data Processing, November 2016

The results in Table VI reveal that the Khi² independence test applied to the storage structures and districts shows an associated P-value probability lower than the Alpha threshold probability (P-value = 0.0001). Since the p-value is less than the level alpha = 0.05, the hypothesis of independence between the districts and the storage structures is rejected. From this point of view, the AFC

must therefore be applied to these two (2) qualitative variables (boroughs and types of storage structures).
The AFC on the matrix of 18 districts (Covè x Zagnanado x Ouinhi) and the six (6) types of storage structures give a total inertia of 89.17. Table VII presents the own values and cumulative percentages of the variance of the first two (2) factor axes.

Table VII: own value, inertia and cumulative percentage of axes F1 and F2

Axes	F1	F2
Own value	0,2775	0,0904
Inertia (%)	67,2645	21,9063
% cumulative	67,2645	89,1708

Source: Data Processing, November 2016

The AFC results show that the first two (2) axes account for 89.17% of information contained in the initial variables (Table VII). The first two (2) factorial axes thus show a strong dispersion of information at the level of the factorial axes. The analyzes are therefore focused on the two factorial axes. Figure 3 shows the factorial map of the 18 districts and 6 types of storage structures in the factorial plane of axes 1 and 2.

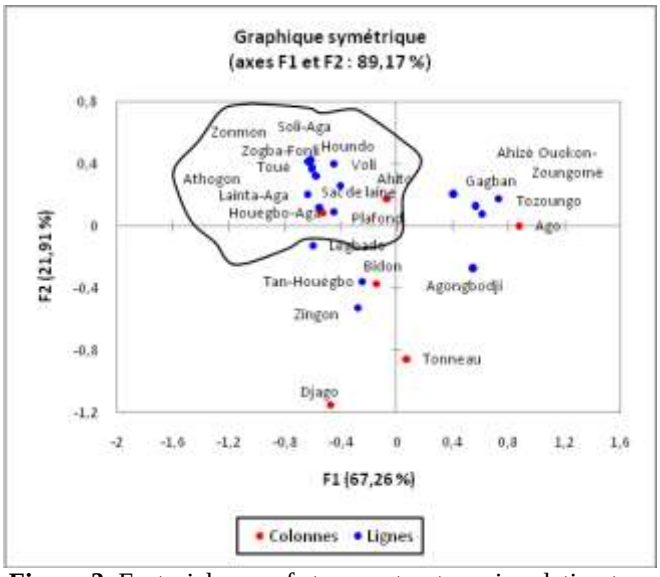

Figure 3: Factorial map of storage structures in relation to the boroughs in the study area
Source: 2016 Field Investigations and XLSTAT Statistical Processing, 2017

It appears from Figure 3 that the variables and factors are divided into three (3) major groups:

- Group G1 connects the districts of Soli-Aga, Houndo, Voli, Zogba-Fonli, Toué, Zonmon, Athogon, Lainta-Aga, Houégbo-Aga, Ahito with the storage structures such as ceiling and wool bags;
- Group G2 meanwhile connects the districts Ahizè, Gagban, Tozoungo and Ouokon-Zoungomé with the loft Ago;
- Group G3 connects the districts like Agongbodji, Zingon and Tan Houégbo and the barrel, can and Djago factors.

As such, groups G1 and G2 constructed the factorial axis F1. This factorial axis therefore opposes the group G1 consisting of storage structures such as ceilings and the wool bags in group G2 taking into account Ago loft. The factorial axis F1 could thus be considered as the gradient axis of the traditional storage structure. Group3 is negatively correlated with the factorial axis F2. It alone allowed the construction of the F2 axis. This group highlights the storage structures such as barrel, can and Djago. The factorial axis F2 could therefore be interpreted as a gradient of traditional storage structure and modern sowing. It then appears from the above results that no peasant makes use of modern type structures in the Zou Department.

2.6. Conservation measures for agricultural products

There are several methods to protect agricultural products. Traditional methods, such as the use of certain natural materials (plants and fruit residues) are still very effective. The introduction of chemicals has often overshadowed these traditional methods of protecting stocks.

2.6.1. Traditional measures of conservation of agricultural products

The producers know local plants whose leaves, leaf or seed solutions, fruits or bark have insect control properties in the Zou Department. Farmers use traditional methods for a good conservation of agricultural products. The endogenous conservation products used by farmers are: the aqueous solution of neem, the orange peel, the neem leaves, the lemon peel, the pepper, etc. Figure 4 shows the traditional measures of conservation of agricultural products.

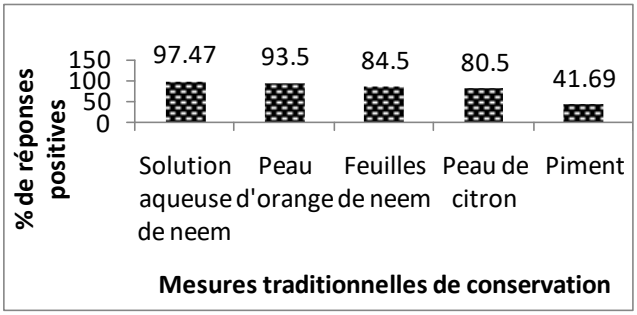

Figure 4: Traditional measures of conservation of agricultural products
Source: Field Investigations, October to December 2016

Several traditional measures are used by farmers to conserve agricultural products for a long time in the visited villages (Figure 4). In fact, in these villages, the aqueous solution of neem is classified as the first traditional product of agricultural products conservation (97,47%). Then follow orange peel (93.5%), neem leaves (84.5%), lemon peel (80.5%) and chilli (41.69%). These additives have a protective effect. In fact, these methods are only effective for small-scale storage.

The whole neem leaves are triturated in water and then the mixture is scattered over the stored products. The spreading of products stored in jute or wool bags is done

before bagging. But, it is more common to crush the leaves and mix the powder with the stored product. The effectiveness of this method depends not only on the plant and the quantity used, but also on the conditions under which the plant is cultivated and the time of its harvest. The amount needed to protect 1 kg of product varies from one plant to another. 3 g of dried and crushed Azadirachtaindica leaves are sufficient to protect 1 kg of product against cowpea shrub (Collosobruchus macalatus) [SCDA / Zagnanado, 2011].

In some cases, farmers use not only neem leaves but also the whole branches to protect the products against insects. The walls and floors are covered with neem branches before being put in stock. The product is covered with a layer of branches once stored. This method has many fluctuations according to local habits.

The amount of plant material needed is usually determined by trial and error. The dosage is not often taken into account by farmers. Some plants or plant extracts can have a toxic effect on human health. A product from basic commodity is not necessarily harmless. So, one need to be very careful while using plants as insecticides. New measures are added to the former for the conservation of agricultural products.

2.6.2. New conservation measures for agricultural products

The conservation measures introduced involve the use of chemicals to conserve agricultural products. Thus, other types of non-recommended chemicals such as cotton insecticides are used for the conservation of agricultural food crops. Modern processing methods used by farmers are shown in Figure 5.

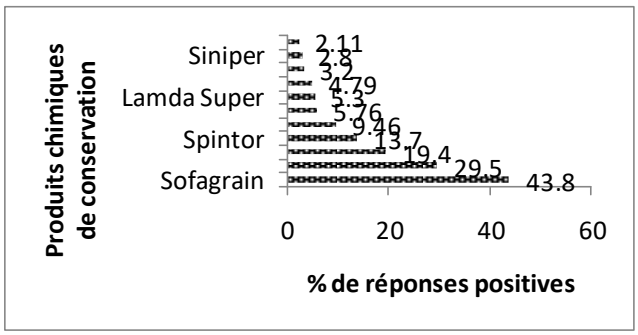

Figure 5: Chemicals used for the conservation of agricultural products
Source: Field Investigations, December 2016

It results from figure 5 that Sofagrain (43.80%), Percal (29.5%), Temaphos (19.40%) and Spintor (13.70%) are the main chemicals used by village producers to keep their capital goods. They are almost constantly cited as products of conservation of agricultural products by producers. Chemicals such as DD force, Protect DP, Super Lamda, Push Out, Conquest Plus, Sniper and Pacha are also used in small proportions by producers to store agricultural products.

Only four (4) of the identified chemicals are marketed by SCDA in the surveyed villages. These are: Sofagrain, Percal, Spintor and Protect DP. These products are mostly used by farmers (Figure 25). The doses recommended by the SCDA agents correspond to 1 sachet of 50 g per 100 kg of grain. Farmers give more confidence to products marketed by state-approved structures. However, other chemicals are sold by the informal sector. Some producers have adopted them because of their ability to reduce post-harvest losses, availability and relatively low cost. Plate 6 shows some chemicals used by farmers to conserve crops.

Plate 6: Some chemicals used by farmers
Shooting: Kotyn, December 2016

Plate 6 shows that there is a variety of chemicals for crops conservation. The different products shown here are proficient to kill insects; but in developing countries, farmers use very poor conservation products for storing grain (Montet et al., 2014).
The combination of existing storage structures with different natural and chemical treatment products made it possible to obtain storage systems. Since a system is a set, what are the peasant systems of storage of agricultural products in the Department of Zou?

2.7. Summary of the Farming Systems for the Storage of Agricultural Products

The storage systems in the study area are still traditional and are in precarious structures with low capacity. Several storage systems are used by farmers. The main ones are summarized in Table VIII.

Table VIII: Farming systems implemented in the study area

Types of system	No users
Traditional loft (“Ago” ou “Djago”) + traditionnel product	6,1
Traditional loft (“Ago” ou “Djago”) + PV- SCDA	7,5
Traditional loft (“Ago” ou “Djago”) + other chemical products	7,4
Traditional loft (“Ago” ou “Djago”) + sans produits	8,3
House ceilings + traditional products	9,2
Houses ceilings + PV-SCDA	6,4
House ceilings + other chelical products	5,1
House ceilings + without product	7,6
Can or barrel + traditional product	0,6
Can or barrel + PV-SCDA	1,2
Can or barrel + other chemical products	1,4
Can or barrel + without products	5,8
Wool bag+ traditional products	9,9
Wool bag + PV-SCDA	11,6
Wool bag + other chemical products	7
Wool bag + without products	5,5
Total	100

Source: Fieldwork, November 2016

It appears from table VIII that the system of traditional loft with PV-SCDA treatment is the most used storage system. It is therefore considered as a core system. About 11.6% of the farmers use this system. Then come the wool bag with treatment to other chemicals (9.9%), the ceiling system with traditional products (9.2%), the traditional loft without treatment products (8.3%). Producers use more traditional systems (91.6%) and generally process stored agricultural products (72.8%). Farmers have therefore cornered almost the entire technological package to effectively combat the constraints related to the storage and preservation of agricultural products.

3. Discussion

The diagnosis of the different types of agricultural storage systems of agricultural products in the Department of Zou made it possible to highlight the practices related to the storage of agricultural products and situate the level of technicality of the producers as regards the storage and the conservation of their harvest. Thus, three (3) storage systems for agricultural products are developed in the study area. These are traditional, semi-modern and modern systems for storing agricultural products. Traditional and semi-modern systems are the two (2) main modes of storage of agricultural products that are practiced by farmers in the Zou Department. These different systems are divided into six (6) types of storage structures such as: the lofts "Ago", the "Djago" type lofts, the use of the houses ceiling, the use of the wool bags, cans, barrels and modern stores. The traditional systems include the loft "Ago", the loft "Djago", the use of the houses ceiling and the use of wool bags. Modern sowing systems include: cans and barrels. The modern system is limited exclusively to storage warehouses built with final materials.

These results are similar to those in eastern and southern Senegal by Gueye et al., (2012). These results reveal that in this part of Senegal, farmers also use six (6) types of storage structures divided into two (2) storage modes that are storage spikes and spathe. In 1991 in Burundi, the report of the Department of Defense of Cultures (DDC) showed that only the traditional system of storage of agricultural products is used by farmers. It turns out that this system is inefficient according to the peasants. Producers, who do not have more sophisticated storage facilities, have found that in southern Benin, the inefficiency of the traditional system of storage of agricultural products induces the increase of post-harvest losses. This led them to look into the acceptability of improved maize storage structures in southern Benin. At the end of this research, the authors found that the low adoption rates of the modern storage system are chargeable to the constraints that are as specific to the structures themselves as to the socio-economic conditions of the producer. Arouna and Adégbola (2011) analyzed the financial profitability of maize storage and conservation systems in southern Benin. The results of these authors showed that nine (9) storage systems for agricultural products are used by producers. These systems are: traditional loft + traditional product; the traditional loft + sofagrain; the traditional loft + other chemicals; the traditional loft without product; the improved loft with plant materials + traditional product; the improved loft with vegetable materials + sofagrain; the improved loft in plant materials + other chemicals; the improved loft with plant materials without product and the improved closed earth loft + sofagrain.

4. Conclusion

All in all, it appears that farmers use five (5) main storage structures of agricultural products in the Department of Zou. These are loft "Ago", loft "Djago", houses ceilings, wool bags and cans or barrels. In order to maintain the quality and quantity of the stocks, they make use of the products of treatment. Thus, two (2) conservation measures for stored agricultural products are identified in the study area: traditional methods and new methods. Traditional methods include the use of the aqueous solution of neem, the use of orange peel, the use of neem leaves, the use of lemon peel and pepper. The new methods deal with the use of PV-SCDA and other chemicals provided on the informal market to protect foodstuffs. The combination of storage structures with different natural and chemical treatment products made it

possible to obtain storage systems. Thus, sixteen (16) agricultural product storage systems are identified in the study area: traditional loft system with traditional product, traditional loft system with PV-SCDA, traditional loft with other chemicals, traditional loft without treatment products, house ceiling with traditional products, house ceiling with PV-SCDA, house ceiling with other chemicals, house ceiling without treatment products, can or barrel with traditional products, can or barrel with PV-SCDA, can or barrel with other chemicals, can or barrel without treatment products, wool bag with traditional products, wool bag with PV-SCDA, wool bag with other chemicals and wool bag without treatment products.

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