

Methods of conservation of agricultural by-products in the Maradi region: Case of departments of Madarounfa (Safou and Bargaja), Guidan Roudji (Karazomé, Karo Sofoua) and Dakoro (Baban Kori and Akora Idi)

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World Journal of Advanced Research and Reviews, 2022, 16(03), 419–425

Publication history: Received on 27 October 2022; revised on 04 December 2022; accepted on 07 December 2022

Article DOI: <https://doi.org/10.30574/wjarr.2022.16.3.1312>

Abstract

This work was carried out in the departments of Guidan Roudji (Karazomé and Karo Sofoua), Madarounfa (Safou and Bargaja) and Dakoro (Baban Kori and Akora Idi) in the Maradi region. The objective was to identify the different methods of conservation of agricultural by-products in rural areas. In order to achieve this objective, a sample of 296 farmers was surveyed out of the 300 planned, chosen on the basis of the simple random type probabilistic method. The results show that 98.64% use the conservation of agricultural by-products. These residues are mainly cowpea haulms (96.29%), sorghum straw (91.55%), groundnut haulms (85.82%) and millet straw (80.4%). The most dominant conservation methods are the hayloft (78.38%), on the open-air shed (58.11%) which are observed in all the villages. It appears from this work that the smallholder farmers attach great importance to the conservation of crop residues in the study area. Nevertheless, this conservation of agricultural by-products is done in a traditional way. It is therefore necessary to train smallholder farmers on the conservation of crop residues used in animal feed. This will allow more rational management and better conservation of the nutritive value of crop residues.

Keywords: Conservation; Crop residues; Smallholder farmers; Nutritive value; Maradi

1. Introduction

In Niger, animal feed is mainly based on natural pasture and crop residues [1]. The analysis of the fodder balance from 2000 to 2014 shows that on average one year out of two is in deficit with extreme values ranging from 1,387,964 tonnes of dry matter (DM) in 2002 to 16,137,329 tonnes of DM in 2009 [2].

The use of crop residues in livestock farming is a known and common practice. But increasingly, there is a strong demand for agro-industrial by-products with the aim of intensifying animal production to cope with the high growth rate of demography and urbanization.

The nature of crop residues available obviously varies according to the agro-ecological zones, in relation to the types of crops [3]. The places of supply and the methods of storage of certain residues such as cowpea haulms are diversified and often depend on the proximity of the source of supply (producers, semi-wholesalers, markets or itinerant transporters) and the means of transport available storage [4].

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Also, for agricultural products, there are certain fundamental principles of storage and conservation such as the preparation of the store and its environment before storage, the reception of the stock before storage in the store, the storage of the stock, the permanent maintenance of the store and regular monitoring of cereals during storage.

Feeding livestock therefore constitutes a major technical and economic challenge for livestock farming systems in Niger and in particular in the Maradi area since the animal feeds absorb more than 50 percent of production costs. It is therefore necessary to find alternatives to usual feeding practices [3]. Ousseini [5] demonstrated that certain crop by-products can be used differently than usual with the transformation of cowpea by-products (pods and haulms) into plugs for better conservation.

Indeed, the issue of crop residues link to their management, mode of use and their low nutritional value [6]. In the pasture restoration, several techniques exist [7], however, the techniques of management or rational use of natural grazing are on the other hand very little tested.

According to Banoin [8], Amole and ayandunde [9], crop residues are an important source of animal feed that can be stored and used after a long shelf life. Therefore, the main constraints related to the use of these residues are technical in the sense that the well-known technologies to improve their nutritional value are still not a widespread practice in West Africa (Niger) [3].

This study was conducted to identify the different methods of conservation of agricultural by-products in the six (6) villages of three departments of the Maradi region.

2. Material and methods

2.1. Material

2.1.1. Study zone

The study was conducted in the three departments (Dokoro, Guidan Roumji and Madaroumfa) of the Maradi region. The Maradi Region is located in the Southern Center of Niger and is included between the following geographical coordinates: parallels 13° and 15° 26' North and meridians 6° 16' East.

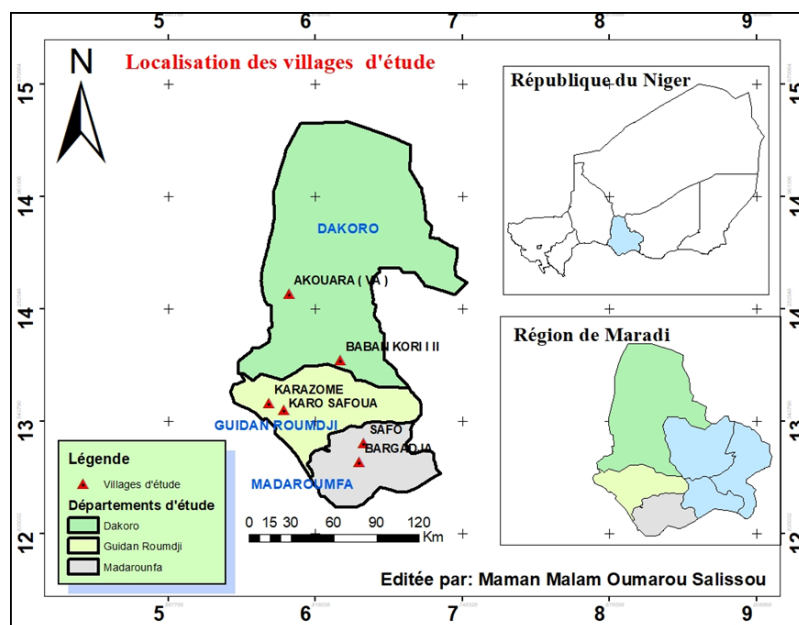


Figure 1 Location of the study area

It is bordered to the East by Zinder Region, to the West by Tahoua Region, to the North by Tahoua and Agadez Regions and to the South by the Federal Republic of Nigeria. The area of the region is estimated at 41796 km² or 3% of the national territory. This area is distributed as follows: 71.5% agricultural land, 25% pastoral land and 3.5% forest land [10].

2.2. Methods

2.2.1. Collection of data

The method used for data collection is the classic survey method.

Individual interview

The personal interview made it possible to collect the essential data. For this phase, which took place in June, the data was collected by means of an individual interview using a structured questionnaire. The survey sheet includes several parts: the civil status of farmers, the agricultural production systems, the types of agricultural by-products, the conservation practices for these by-products.

Focus groups

Then, the second phase in November, the interview brought together all the people concerned by the first interview forming focus groups according to the mode of conservation. This opportunity is taken to measure the credibility of the results of the individual interviews and identify the process of different modes of conservation and the reason for the practice.

Sampling

The sample was chosen on the basis of the probability method of simple random type from the established list. In principle, the list is numbered according to the number of people registered. Then we skipped two numbers and took the third one as we went down the list, and this until we had the desired numbers. Finally, a final list of respondents was established.

A sample of 50 people per village was retained, i.e. 300 people for all six villages. However, the investigation focused on 296 people distributed as follows: 50 people in Karazomé, 49 people in Karo Sofoua, 50 people in Safo, 50 people in Bargaja, 47 people in Baban Kori and 50 people in Akora Idi. The sample is composed of men and women. In each village we had either the village Chief or his delegate as a guide.

Data processing and analysis

To process the information collected in the field, we first carried out a manual count. Then, the data was codified and entered into a model produced on the SPSS software. Descriptive statistics were performed between the variables, and the proportions are reported in percentage (%). Some data from this database was exported to the Excel spreadsheet for the production of tables and figures. Finally, we used Word 2013 for text entry.

3. Results

3.1. Conservation of residues

Farmers surveyed give great importance to the conservation of agricultural by-products. A total of 98.65% farmers practice the conservation of agricultural by-products. Nevertheless, this practice is more important in Karo Sofoua (100%), Safo (100%), Bargaja (100%) and Akora Idi (100%) (Table 1).

Table 1 Practice of conservation of agricultural by-products according to the village

		Village						Total
		Karazomé	Karo Sofoua	Safo	Bargaja	Baban Kori	Akora Idi	
preservation of harvested agricultural by-product	Yes	96%	100%	100%	100%	95.74%	100%	98.65%
	No	4%	0%	0%	0%	4.26%	0%	1.35%
Total		100%	100%	100%	100%	100%	100%	100%

3.2. Storage of by-products

Cowpea haulms (96.29%), sorghum straw (91.55%) are the most kept by farmers, followed by groundnut haulms (85.82%) and millet straw (80.4 %) (Table 2).

However, the conservation of cowpea haulms is more interesting in Safo (100%) and Bargaja (100%) while for sorghum straw, it is more frequent in Safo (100%). Also, groundnut haulms are more conserved in Safo (98%) and Karo Sofoua (98%), on the other hand that of millet straw is more encountered in Safo (100%) and Bargaja (92%) (Table 2).

Table 2 Preservation practice according to preserved by-products

		Villages						Total
		Karazomé	Karo Sofoua	Safo	Bargaja	Baban Kori	Akora Idi	
by-products	millet straw	86%	65.31%	100%	92%	78.72%	60%	80.41%
	Sorghum straw	88%	95.92%	98%	88%	85.11%	94%	91.55%
	Corn Straw	0%	0%	6%	8%	0%	0%	2.36%
	rice straw	0%	0%	4%	8%	0%	0%	2.03%
	Cowpea haulms	92%	97.96%	100%	100%	93.62%	96%	96.62%
	Groundnut haulms	82%	100%	98%	62%	76.60%	96%	85.81%

3.3. Method of storage of agricultural by-products

The methods of storage of by-products are very diversified. Some are encountered depending on the localities and others are observed in all the study areas. In total, 9 methods of conservation of agricultural by-products were observed during the survey. However, two or more methods of conservation of by-products are associated by smallholder farmers.

The hayloft (78.38%), on the open-air shed (58.11%) are the most dominant modes of storage. The hayloft is more practiced in Karazomé (90%) and Akora Idi (90%) while on the hangar is more observed in Bargaja (78%) and Karo Sofoua (77.55%). (Table 3).

Table 3 Practice methods of storage agricultural by-products according to the village

Storage method	Karazomé	Karo Sofoua	Safo	Bargaja	Baban Kori	Akora Idi	Total
hayloft	90%	87.76%	52%	60%	91.49%	90%	78.38%
On the you	12%	12.24%	50%	52%	2.13%	16%	24.32%
Even on ground	12%	46.94%	68%	22%	57.45%	4%	34.80%
on the trees	4%	61,22%	2%	6%	0,00%	8%	13.51%
Open-air shed	52%	77.55%	46%	78%	51.06%	44%	58.11%
Enclosure	0%	4.08%	2%	2%	0%	28%	6.08%
Crushed stems	4%	8,16%	4%	0%	0%	0%	2.70%
on the bricks	0%	0%	8%	2%	2.13%	0%	2,03%
around trees	0%	2.04%	0%	14%	0%	2%	3.04%

3.4. Method of storage according to the agricultural by-product

The conservation methods found in the area are most often practiced according to agricultural by-products. Only the open-air shed, on the trees and the enclosure concern all agricultural by-products. However, the hayloft concerns sorghum straw (72.97%), cowpea haulm (75.34%) and groundnut haulms (72.30%) (Table 4).

Table 4 Methods of storage according to agricultural by-products

Preservation method	Millet stalks	Sorghum stalks	Cowpea haulm	Peanut haulm
hayloft	0%	72.97%	75.34%	72.30%
On the you	0%	0%	23.65%	20.61%
Even on ground	32.43%	33.78%	0%	0%
on the trees	10.14%	13.51%	13.51%	13.51%
Open-air shed	48.65%	55.41%	57.09%	48.99%
Enclosure	3.72%	5.41%	5.74%	5.74%
Crushed stems	2.03%	2.70%	0%	0%
on the bricks	2.03%	2.03%	0%	0%
around trees	2.70%	2.70%	0%	0%

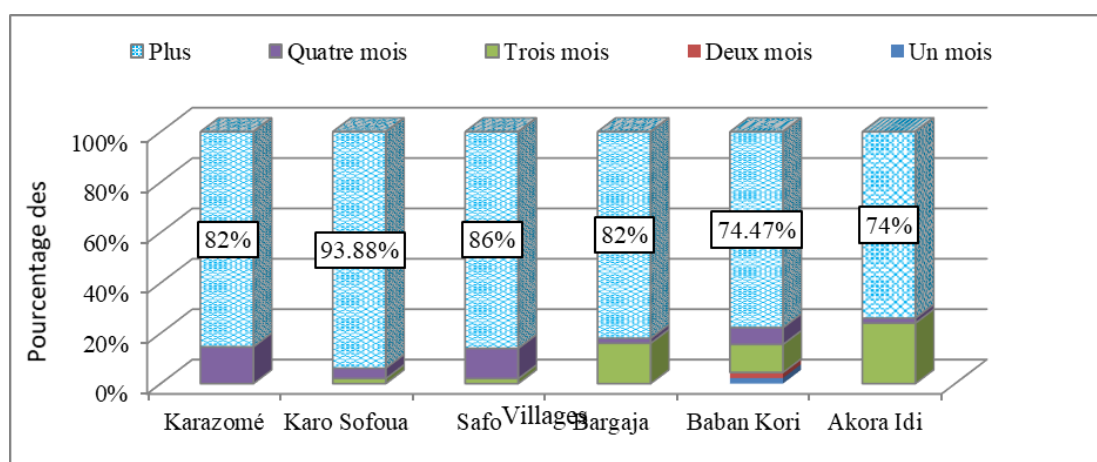
3.5. The storage period of agricultural by-products

The survey data reveals that the storage period of crop residues for all farmers (100%) and in all villages is the cold dry season or the post-harvest period. This period is between September and November.

The shelf life of agricultural by-products

The shelf life of agricultural by-products is determined in number of months.

Generally speaking, the shelf life of agricultural by-products is more than five (5) months for all the villages (Figure 1).

**Figure 2** Shelf life of agricultural by-products by village

4. Discussion

The majority of farmers (98.64%) practice the conservation of agricultural by-products. This result is different from those of Laouali et al. (2017) who showed that the storage of crop residues is practiced in peri-urban areas (66.7%) and in urban areas (57.8%) of Niamey. This practice is more important in Karo Sofoua (100%), Safo (100%), Bargaja (100%) and Akora Idi (100%). This could be explained by the importance of livestock farming systems and the trade in animal feed in the area. A study conducted by André et al. [11] showed that in terms of collection and conservation of fodder, the results of surveys showed that a significant number of producers (61.8%) practice mowing and conservation of fodder, while the collection and conservation of residues harvest concerns an average of 88.2% of smallholder farmers. This is how mowing has an impact on the dynamics of vegetation [7]. Conservation concerns all crop residues including sorghum stover (91.55%), millet stover (80.4%), cowpea haulms (96.29%) and groundnut haulms (85.82%).

The high proportion of sorghum stover and cowpea haulms is explained on the one hand by the fact that these residues are generally not sold during the post-harvest period and on the other hand by their importance in animal feed. Crop residues are stored in different ways, the most important of which are: storage in the hayloft (78.38%) and storage in the sheds (58.11%). The research results conducted by Ousseini [4] showed that in terms of storage, the most stored foods in households are the vines according to 61.3% of respondents. This observation is different from that of Manman et al [12] in a study conducted in the urban community of Niamey, which reported that the stock of crop residues is conserved under different techniques, the most important is the conservation on sheds with more than 45% of cases. This difference can be linked on the one hand to the practice of the area and on the other hand by the concern to preserve the market value of agricultural by-products because most of these residues (cowpea haulms and groundnut haulms and sorghum stover) kept in the hayloft are intended for sale. Other studies have shown that labour, material availability and animal resources are also factors that determine forage collection and storage, as observed by [13]. The other conservation methods are on the ground (34.80%), on the roof (24.32%), on trees (13.51%), enclosure (6.08%), around trees (3.04%), crushed stems (2.70%) and on bricks (2.03%). Along the same way, FAO, (2014) reported that, if feed is intended for livestock feed, storage is done above rooftops, on trees, or in a corner of the field, otherwise on the floor. The hayloft is more practiced in Karazomé (90%) and Akora Idi (90%). This same observation was made by Ousseini et al. [7] where it was shown that the period of which the stocks of cowpea by-products are found is the period from October to December, the period following the cowpea harvest. This was due not only to the importance of livestock feed trade but also to the awareness raised by various NGOs working on livestock sector. It also appears that only the conservations on the open-air hangar, on the trees and the enclosure concern all the agricultural by-products. However, storage in the hayloft concerns sorghum stover, cowpea haulms and groundnut haulms. This could be explained not only by their great importance in animal feed but also their commercial values in the market. The conservation period of agricultural by-products in the study area is the cold dry season. This could be explained by the fact that the cold dry season is the post-harvest period when all the residues are harvested. In another study, it has been shown that years of poor rainfall lead smallholder farmers to carry out more stocks than in less abundant years [14,15]. Also, it is generally noted that the shelf life of agricultural by-products is more than five (5) months for all the villages. This was due to the large quantity of stored residues and to the predominance of small ruminants which consume little millet and sorghum stovers.

5. Conclusion

This study highlights the practice of storing agricultural by-products, the different types of storage crops residues, the methods of storage according to the agricultural by-product, the period of storage and the duration of storage. The majority of farmers surveyed practice the conservation of agricultural by-products. The most conserved types of by-products in the area are sorghum stover, millet stover, cowpea haulms and groundnut haulms. The most common storage methods are the hayloft and the open-air shed. The results also show that only the open-air shed, on the trees and the enclosure concern all the agricultural by-products. The other methods of storage are used according to the type of by-products. The storage period is between the months of September-October. The shelf life is five (5) months or more.

Compliance with ethical standards

Acknowledgments

The authors thank the actors, in particular the farmers of Madarounfa, Guidan Roudji and Dakoro, for being available, facilitating the collection of data.

Disclosure of conflict of interest

No conflict of interest has been reported.

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