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RESEARCH ARTICLE

ANALYSIS OF THE EFFECTS OF ANIMAL AND PLANT PRODUCTION SUPPORT PROJECTS ON BENEFICIARY HOUSEHOLDS: THE CASE OF THE PROJECT FOR THE OPENING UP OF PRODUCTION ZONES IN SUPPORT OF THE NATIONAL LOCAL DEVELOPMENT PROGRAM (POPZ/NLDP)IN THE KAOLACK AND KAFFRINE REGIONSIN SENEGAL

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ABSTRACT

In Senegal, the agricultural sector constitutes a key sector for economic and social development. One in two households is active in agriculture. However, it is characterized by low productivity with an insufficient contribution of 9.6% to GDP (in 2022). To better boost the sector, the State is implementing several programs and projects. This research aims to evaluate the effects of support for animal and plant production on households benefiting from the Project for the Opening up of Production Zones in support of the National Local Development Program (POPZ/NLDP). The "before-after" method is used. It is based on the comparison of results recorded by key variables during and after a project, with those before the project. The targeted regions are those of Kaolack and Kaffrine, with two municipalities in each region. The questionnaires are administered to individuals chosen randomly, distributed in several villages and belonging to farmer organizations benefiting from project support. For the choice of non-beneficiaries, the "nearest neighbor with the same characteristics as the beneficiary" method is adopted.The results revealed a decline in the areas sown with millet and corn. This regression did not prevent the increase in the production of these crops, compared to the results obtained before the intervention of the project, in 2020. Household income, linked to these crops, has seen an absolute increase of 161,188 CFA franc, a relative increase of 391%. Poultry incomes decreased by 21.8% but those from sheep farming increased by 150%.

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INTRODUCTION

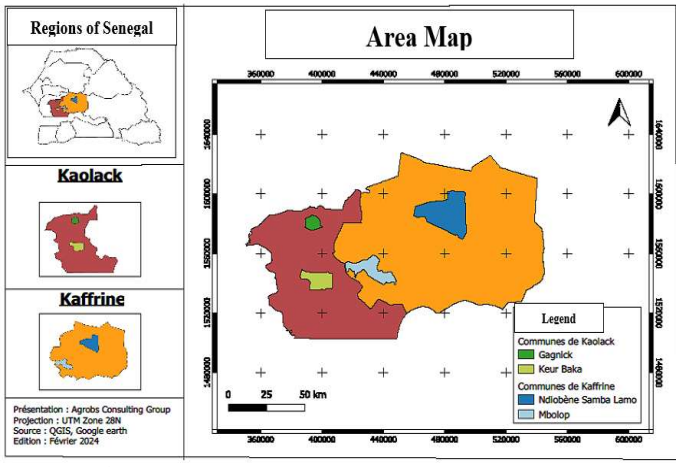
In Senegal, agriculture occupies an important place in public policies because it remains the main activity in rural areas. According to the National Agency of Statistics and Demography (NASD, 2024), more than 909,638 households are active in agriculture, the equivalent of one in two households. However, its contribution to the Gross Domestic Product (GDP) is low, despite its significant weight in the primary sector. In 2022, according to the NASD, agriculture represents 9.6% of the GDP and contributes 65.8% to the added value of the primary sector. To revitalize the agricultural sector, the State of Senegal had set up, in 2012, after several development programs in the sector since 1960, the Program for Accelerating the Pace of Senegalese Agriculture (PAPSA). This program, had the strategic objective of promoting competitive, diversified and sustainable agriculture in order to achieve food security. In terms of agricultural production, cereals reached a production level of 3,640,545 tons, including 1,144,855 tons of millet and 761,883 tons of corn. As for animal production, the number of ruminants is around 14,645,872 heads, including 6,777,334 sheep. For poultry, the number is estimated at 80,733,000 heads, with a majority made up of chickens (NASD, 2022). However, in 2014, according to NASD (2017), cereal production was 1,253,427 tons and millet and corn production were 408,993 tons and 178,732 tons respectively.

Over the same period, the livestock population was estimated at 16,565,842 heads. Sheep were counted at 6,294,000 heads and poultry at 54,512,000 heads. These results still fall short of the objectives of sovereignty and food security. The agricultural population still faces challenges of agricultural productivity and production. The latter is linked to access to quality inputs, access to markets, use of products and stability. In addition, the sector faces high vulnerability to climate shocks and low resilience of rural populations to food and nutritional insecurity, which contrast with the role that the agricultural sector. Thus, the State implements, support programs in various areas to boost the development of the agriculture sector. It is within this framework that the Project for the Opening Up of Production Zones in support of the National Local Development Program (POPZ/NLDP), in force for the period 2018-2023, is part of it. It aims to stimulate, recover and support economic growth while adopting an inclusive approach. Specifically, the project promotes the strengthening of the productivity of agricultural areas by developing value chains and production infrastructure. In this article, we focus on the regions of Kaolack and Kaffrine (Senegal). Thus, the objective is to evaluate the effects of support for animal production and plant production on households benefiting from the POPZ/NLDP. Authors such as Duflo and *al.*, (2011) and Mokili and *al.*, (2019) have shown that support in agricultural inputs (improved seeds and fertilisers) significantly increases agricultural yields and the income of beneficiary households. A study conducted by Duflo and *al.*, (2011)

on the use of improved seeds in India revealed a significant increase in cereal yields. The work of Barret and *al.*, (2001) indicates that support can increase household income by increasing the quantities of products sold on local markets. However, the effects vary depending on the economic and social contexts. The results of Mokili 's work Lilal and *al., (2019) in* Isangi territory in the Democratic Republic of Congo showed that the use of improved seeds increased from 45.1% to 57.9% for households benefiting from agricultural projects co-financed by development aid partners and from 14.9% to 17.0% for non-beneficiaries, while the latter was estimated at 13% before the project. The authors also noted a significant increase in rice and corn yields among beneficiaries of 602.5 kg/ha and 835 kg/ha respectively, compared to a slight increase among non-beneficiaries of 26.6 kg/ha and 47.0%. In terms of monetary income from agricultural production, in 2016, beneficiaries improved their income by $347.0, compared to 2010 (reference year). In Senegal, according to Feed the Future and UGB [1](2019), the impact evaluation of the Senegal project "NaatalMbay[2]" with the double difference method has shown significant improvements between 2014 and 2018. Indeed, in the Senegal River Valley, the yield of irrigated rice increased from 3342 kg / ha to 4646 kg / ha, an increase of 38%. In the center of the country, the yield of rainfed rice increased from593 kg / ha to 2550 kg / ha, an increase of 330% and that of the south experienced a recovery of 116%.

MATERIALS AND METHODS

Study Area: This study concerns two regions of Senegal: Kaolack and Kaffrine. The first is located in the central zone of Senegal at 14°30 mn and 16°30 mn West longitude and 13°30 mn and 14°30 mn North latitude. It has an area of 5,357 km2 (2.8% of the national territory). The second occupies approximately 5.6% of the national territory (an area of 11,181 km2) and is located at 14°07 North latitude and 15°32 West longitude. It is part of the central zone (the peanut basin) which is made up of the regions of Diourbel, Fatick, Kaolack and Kaffrine. According to NASD (2022), more than half of the populations of Kaolack and Kaffrine are active in agriculture, with 74.8% and 75% respectively.



Source: Authors, 2024

Fig.1 . Location of the study area

Data Collection Method: In this article, the "before-after" design method is used in this research. This approach is based on comparing the results recorded by key variables during and after a program (or intervention), with those before the program (or intervention). For the purposes of this research, the year 2020 is considered as the reference year. The targeted regions are those of Kaolack and Kaffrine (in Senegal). For each region, two communes were selected. The communes of Gagnick, Keur Baka, Mbeuleup and NDiobène Samba Lamo were selected randomly, respectively for the regions of Kaolack and Kaffrine. From the database, a sample was drawn with the Fisher formula for each type of support. As a result, the questionnaires will be administered to randomly selected individuals, distributed in several villages and belonging to peasant organizations benefiting from project support. The number of individuals to be surveyed for each commune is proportional to the total number of beneficiaries in the commune. For the selection of non-beneficiaries, the "nearest neighbor with the same characteristics as the beneficiary" method is adopted.

The study sample consists of beneficiary and non-beneficiary households of the POPZ/NLDP project. The procedure for constituting the sample of households to be surveyed is as follows:

- The first phase was to randomly select the municipalities to be studied. In total, four municipalities were selected, two of which were in each region (Gagnick and Keur Baka in Kaolack, Mbeuleup and NDiobène Samba Lamo in Kaffrine);
- the second phase consisted of administering questionnaires to beneficiary individuals grouped in Peasant Organizations (POs) of the project, randomly. Using the Fisher formula, and from the project database, a sample was drawn for each type of support to know the number of individuals to be surveyed;
- The third phase was to identify non-beneficiaries. The nearest neighbor method with the same characteristics as the beneficiary was adopted.

The determination of the sample size for each type of support (input support, donations of improved breed roosters and breeding sheep) was developed using the Fisher formula. Thus, we obtained a sample of 24 individuals for plant production, 27 and 16 individuals respectively for recipients of roosters and sheep. The formula used by this method is as follows:

$$nf = \frac{n}{1+\frac{n}{N}}$$

With nf corresponds to the sample obtained with the Fisher formula; n. $1/d^2$; n the degree of representativeness given by its own formula; d represents the threshold for which errors are tolerated, it is set at 10% for sampling.The following table distributes the beneficiaries according to the targeted municipalities in the regions of Kaolack and Kaffrine.

Table 1. Distribution of beneficiaries according to the targeted municipalities

Munici-pality	Keur Baka	Gagnick	Ndiobène Samba Lamo	Mbeu-leup	Total
Beneficiary of plant production	15	5	19	15	54
Animal prod. Beneficiary	15	15	17	15	62
Total	30	20	36	30	116

Source: Authors

For the four municipalities included, members of the beneficiary and non-beneficiary Producer Organizations (POs) were selected for a total of 58 people each, making a total of 116 individuals to be surveyed. Thus, the sample is composed of 116 individuals distributed equally between the two groups.

RESULTS AND DISCUSSION

Identification of project support: The project's support mainly concerns batches of poultry, breeding sheep and agricultural inputs. For the latter, it concerns in particular seeds of improved varieties for millet (thialack 2 and souna 3), corn (early Thai hybrid), fertilizer and

[1]Geston Berger University of Saint Louis (Senegal)
[2]Wolof expression (local Senegalese language) which means "development of agriculture"

urea. Each beneficiary received between 4 and 8 kg of millet, for a total of 72 kg, and between 16 and 32 kg for corn, for a total of 134 kg distributed and divided between the different beneficiary municipalities. The distribution of fertilizer and urea is done at a rate of 3 bags per hectare. In addition to the seeds allocated to the beneficiaries, the package also includes a training session in seed multiplication techniques. To ensure the popularization of this new technology, the beneficiaries must give 25% of their harvest to the members of the PO (not yet beneficiaries). For seed certification and crop protection, services such as the Regional Directorate of Rural Development, the Departmental Service of Rural Development and the Plant Protection Directorate are requested by the project to provide their support. In total, the beneficiaries received 74 breeding roosters of the Dutch Blue and Brahman breeds and 20 breeding sheep of the "Ladoum[3]" breed. To facilitate their adaptation to the area (where the temperature is sometimes high), the project financed the construction of chicken coops and enclosures for each beneficiary. In order to strengthen the beneficiaries' capacity in livestock management and the manufacture of poultry feed, training sessions were organized.

Effects of project support

Effects of project supporton plant production

	2020			2022		
	Non-benef-iciary	Benefi-ciaries	Varia-tion	Non-benefi-ciary	Benefi-ciaries	Varia-tion
Total annual income	143,750	630 700	486,950	-1,019,000	6,444,317	5,425,317
Income per capita	1,641	41 224	39,584	-32,980	202 412	169,433

Table 1. Evolution of production and yield of millet and corn

	2020		2022	
	MIL			
	Non-beneficiaries	Benefi-ciaries	Non-beneficiaries	Benefi-ciaries
Production (kg)	1,463.89	1,772.2	1,172.78	2,290.32
Yield (kg/ha)	515.54	512.76	486.94	732.41
BUT				
Production (kg)	750	1,762.5	206.59	1,037.5
Yield (kg/ha)	466.67	838.59	172.14	925

Source: Authors (surveys, 2023)

Table 2. Income from crop production

	2020			2022		
	Non-benef-iciary	Benefi-ciaries	Varia-tion	Non-benefi-ciary	Benefi-ciaries	Varia-tion
Total annual income	143,750	630 700	486,950	-1,019,000	6,444,317	5,425,317
Income per capita	1,641	41 224	39,584	-32,980	202 412	169,433

Source: Authors (surveys, 2023)

The use of improved seeds: The respondents mainly cultivated (before the project) three crops: millet, corn and peanuts. Among them, 25.5% used seeds of improved varieties (millet or corn) with purchase as the method of acquisition. With the arrival of the project, this rate increased to 64.7%.By carrying out the before/after comparison, we note that the rate of use of seeds of improved varieties of households benefiting from the project in 2022 has significantly improved compared to the baseline situation, while among non-beneficiaries, this improvement is less. The work of Mokili and *al.*, (2019) reached the same result (45.1% to 57.9%).

Millet and corn production: For millet, among beneficiaries, the yield increased from 515.34 kg/ha to 732.41 kg/ha between 2020 and 2022, an increase of 217.07 kg/ha, and production increased by 129.23% (1,172.78 kg to 2,290.32 kg). The areas for millet production have not changed, because the project intervention covers 1 to 2 ha depending on the quantity of seeds received (seeds of improved varieties for thialack2 and souna 3, fertilizer, urea). Non-beneficiaries saw their production, over the same period, increase from 1,463.89 kg to 1,172.78 kg, a decrease of 124.82%. Similarly, the yield per hectare fell from 515.54 kg to 486.4 kg, a decrease of 10.59% (Table 1). The beneficiaries saw their average corn production drop by 725 kg (production went from 1,762.5 to 1,037.5 kg). This decrease in production is partly due to the reduction in the areas cultivated for this crop. Paradoxically, yields increased by 110%. Among non-beneficiaries, production and yield fell from 750 to 206.59 kg and from 466.67 to 172.14 kg/ha, respectively. At the same time, their areas decreased by 31% (Table 2). The yield gap between beneficiaries and non-beneficiaries with the implementation of the project is 245.47 kg/ha for millet. The latter is quite similar to the millet yield gap which is 211.74 kg/ha found by Issoufou and *al.*, (2017). Our surveys revealed that poor soils and the high cost of mineral fertilizers limit the plots dedicated to growing corn, this observation was highlighted in the work of Ollagnier and al., (1970).

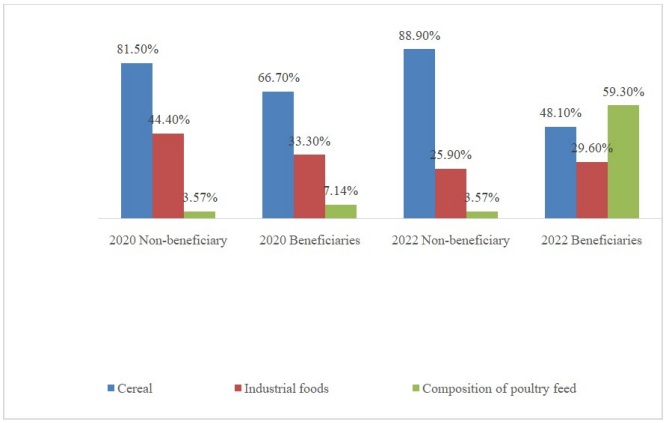
Income evolution: The average annual income of agricultural households has experienced different trends. That of beneficiaries increased from 41,224 to 202,412 CFA franc (income per capita), an increase of 391%. Non-beneficiaries recorded a loss of 32,980 CFA franc. On the beneficiaries' side, this increase is explained by the increase in production as well as the increase in sales. Indeed, the project collaborates with commercial seed sales organizations. These commercial organizations are responsible for the sale of production with much more remunerative prices. A kilogram of millet and corn of local varieties costs between 200 and 400 CFA francwhile a kilogram of millet and corn of improved varieties costs between 500 and 600 CFA franc. In addition, millet and maize seeds of improved varieties are sold in 8 and 16 kg bags respectively, which speeds up sales and increases revenue.

Effects of project support on animal production

Evolution of poultry breeds: The surveys revealed that all poultry beneficiaries are previously selected poultry farmers. Among the latter, only 29.6% claimed to have only crossbred poultry before the project was implemented, compared to 44.4% in 2022, with a loss of 55.6% of the introduced subjects that occurred. As for non-beneficiaries, the situation remains the same after the project intervention; only 11% claimed to have crossbred subjects. Among the beneficiaries, 0.14% had Brahman roosters well before the project arrived with a large number (354 subjects). In the meantime, the latter recorded a high mortality rate of their subjects. After the introduction of the breeds, almost half of the beneficiaries claimed to have lost their subjects (55.6 %). These events led to a drop in the number of poultry of 33.61%. A slight increase in the number of purebred poultry was noted among non-beneficiaries (13 subjects). Among the

[3]Sheep breed from the short-haired Moorish sheep group, resulting from a cross between Touabir Moorish sheep in the 1970s.

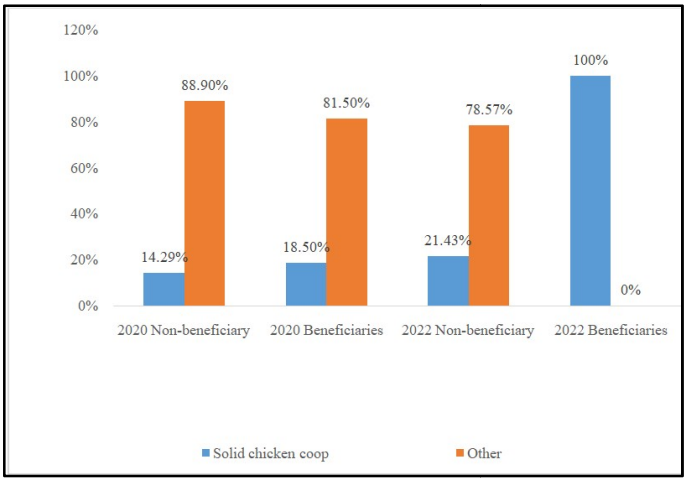
respondents (Fig. 2), 66.7% of beneficiaries and 81.5% of non-beneficiaries use local cereals (millet, corn, sorghum, etc.) to feed their poultry. The rest of the respondents use industrial feed, i.e. 33.3% and 18.5% of beneficiaries and non-beneficiaries respectively. Thanks to the training received from the project on poultry feed composition techniques (received from the project), the beneficiaries (59.30%) noted a change in the feeding behavior of their subjects. These techniques consist of a mixture of cereals (millet bran, broken corn) and smoked fish. The remaining 29.60% still continue to use industrial feed. According to the work of de Fall *et al*., (2021) poultry farmers use cereals and industrial foods.



Source: Authors, 2024

Fig. 2. Evolution of poultry feeding

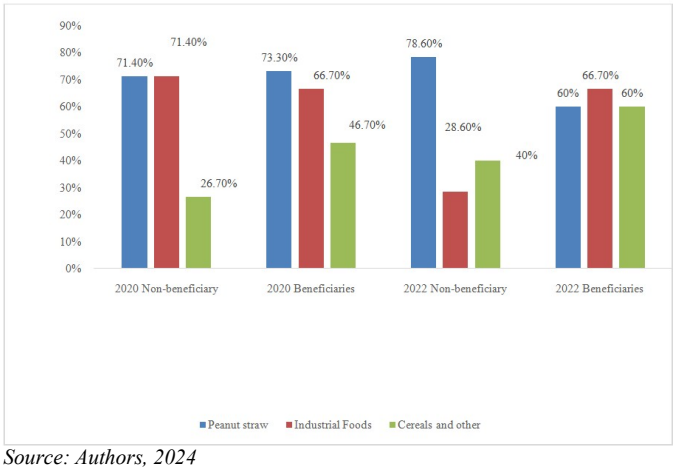
With the arrival of the project, the beneficiaries built solid chicken coops. However, before the arrival, the types of habitats were woven and zinc cages or uninhabited buildings. Few did not have solid chicken coops (18.5% of beneficiaries and 14.29% of non-beneficiaries) (Fig.3). However, the types of chicken coops identified in the department of Thies (Senegal) by Fall and *al.*, (2016) consist only of improved traditional chicken coops (11%) and 36% in the department of Bambey (Senegal) (Fall and *al.,* 2021).



Source: Authors, 2024

Fig. 3. Evolution of poultry habitat

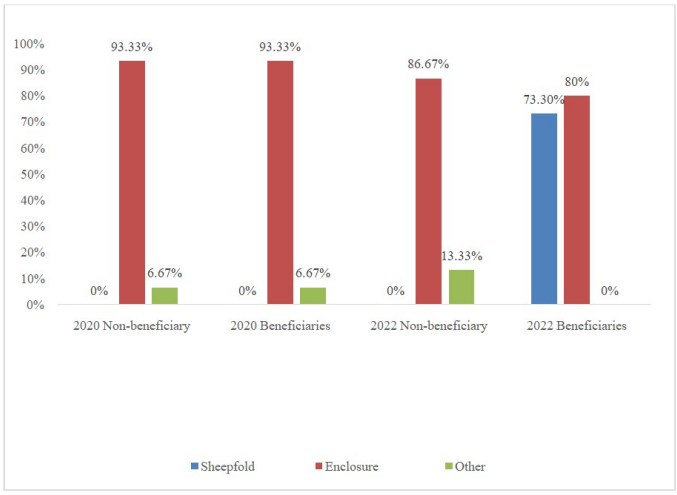
Evolution of the sheep breed ("ladoum"): The project allowed beneficiaries (66,67%) to have more purebred sheep than non-beneficiaries (53,33%) who had twice as many. Crossbreeding between purebred sheep and local breed ewes did not produce good results over the period 2020-2022. This is due, according to 26% of beneficiaries, to the loss of breeding sheep. This loss is caused, on the one hand, by the lack of veterinary care and unfavorable conditions for their development, and on the other hand, by the non-adaptation of the breeders' feed. Most of the feed consists of peanut straw and industrial products. This feed is supplemented by portions of cereals (millet, corn or sorghum) and kitchen leftovers (Fig. 4).



Source: Authors, 2024

Fig. 4. Sheep breed, feeding methods

With the passage of the project, the behavior of breeders has changed slightly from one respondent to another. The beneficiaries of the construction of sheepfolds from the project represent 73.3%. Others (80%) use traditional sheepfolds (enclosures) and uninhabited buildings to raise their sheep (Fig.5).



Source: Authors, 2024

Fig. 4. Sheep breed, Habitat

Evolution of income from poultry and sheep breeds

Income from poultry farming: The average income of poultry farmers benefiting from the project has generally changed. Indeed, their average income per individual is 62,500 CFA franc in 2022, while in 2020, it was estimated at 8,000 CFA franc. Non-beneficiaries see their means decrease; it went from 2,500 CFA franc to 1,500 CFA franc. However, the interpretation of the result of this indicator must be done with particular caution. Indeed, the data collected show a low percentage of individuals whose poultry farming activity is very profitable (0.14%); they also have great mastery in breeding management due to their seniority in the field. The latter (11.11% of non-beneficiaries) also had improved breed roosters well before the implementation of the project in addition to a large number of local breed poultry.

Income of sheep farmers: The beneficiaries achieved, following the sale of their sheep, an overall average result estimated at 10,000 CFA franc during the pre-project period. For the post-project period, this indicator was positioned at 25,000 CFA franc, while for non-beneficiaries, it is 62,500 CFA franc. This low result, achieved by the beneficiaries, is due, on the one hand, to the increase in the price of industrial feed which went from 10,000 to 15,000 CFA franc. In

addition, at the time of the survey, the breeders were reserving their sheep for the "Tabaski[4]" festival in order to make their activity profitable. On the other hand, this low result is explained by the fact that the mixed-race sheep that were given birth had not yet reached sufficient maturity to be sold by the beneficiaries. Indeed, only 20% of the beneficiaries said they had sold their subjects resulting from the crossbreeding between the "ladoum" breed and the local breed. The comparative study of sheep farming after the project shows that the activity is generally profitable. However, non-beneficiaries record a higher average overall income than beneficiaries. This phenomenon is explained by the fact that non-beneficiaries have acquired (by purchase) breeding stock; in addition, they can sell their subjects as they wish and increase their income while beneficiaries do not have the possibility of selling the breeding stock granted to them. Despite these results (for poultry and sheep farmers), the respondents encountered many difficulties. These include: the high cost of livestock and poultry feed, diseases, constraints related to access to veterinary care and the non-adaptation of the introduced subjects (Ladoum, Brahman and Holland Blue) to the climatic conditions of the areas where the project is implemented. These difficulties persist even after the project has passed. Furthermore, it should be noted that the results of the project intervention are much more significant at the level of plant production than at the level of animal production.

CONCLUSION

The results obtained made it possible to identify production supports and analyze the resulting effects. In terms of the agricultural component, significant progress was noted, in particular the increase in the production and yield of millet and corn. As for the livestock component, the expected performances were not achieved, which is explained by the high mortality of the subjects introduced, in particular the Brahman and Holland Blue poultry breeds. The project has boosted the income of beneficiaries in animal and plant production. Indeed, the project supports producers in the certification, storage and sale of millet and corn seeds with remunerative prices. Self-consumption of millet and corn has also recovered, thus contributing to the consolidation of efforts made to achieve food security, unlike animal production where self-consumption of products resulting from project support is almost non-existent. However, several constraints were raised by the beneficiaries of both components.

In plant production, the most important are difficult access to inputs (availability and/or high cost of seeds and fertilizers, etc.), reduced rainfall and pest attacks. In animal production, the constraints identified are access to veterinary care, the non-adaptation of the subjects introduced to the climatic conditions of the project intervention areas as well as the shelters built, in particular sheepfolds and chicken coops. The beneficiaries declared that they were satisfied with the support they received and reiterated their commitment to the project and wished to be supported in order to achieve more valuable results.

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[4]Name given to the most important Muslim festival in West African countries, the Feast of Sacrifice or Eid al-Adha. Muslims are recommended to sacrifice a sheep