

Determinants of the Adoption of Forage Crops in the Rural Municipality of Koumbia in Burkina Faso

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Abstract: To improve animal productivity and increase producers' income, forage production is encouraged by many development actors. However, these crops are low adopted by producers and struggle to be sustainably integrated into farms despite their technical potential. This study was conducted in the rural municipality of Koumbia with 73 agro-pastoralists. The objective of the study was to evaluate an optional approach to the development of fodder production implemented by the project "Production and development of fodder resources by small-scale producers in the High Basins region in intensive, market-oriented animal production. The quantitative research method was used to conduct the study. Thus, the questionnaire and the document review were used to collect information in the villages of Makognadougou, Gombélédougou, Sébédougou and Koumbia center, which represent the 4 villages in the commune that hosted the project. The information obtained was processed with SPSS version 26 software and then subjected to descriptive statistics analysis. The results obtained from the study reveal an adoption rate of 88% for forage crops. The factors that determine the adoption of these crops by producers are the level of education, access to land, improved income, availability of forage seeds and mastery of forage production techniques. These are the factors mentioned above that guide the decision and the logic of the choice of whether or not to adopt fodder crops among agro-pastoralists. The influence of these factors on the decision of these farmers depends on their perception of fodder crops as an alternative for feeding their animals. It should be noted that a negative perception of forage production has a negative influence on the decision to produce "grasses to feed animals" and inversely.

Keywords: Optional Approach, Valorisation, Fodder Production, Koumbia, Animal Production

1. Introduction

Burkina Faso is an agro-sylvo-pastoral nation. The livestock subsector accounts for 18% of gross domestic product (GDP) [1] and is a critical component of the national economy. Over 80% of families engage in livestock farming and receive all or a portion of their income from it [2]. After cotton, livestock is the second greatest contribution to agricultural value added. It provides people with animal products, energy, and fertilizers for crops. Additionally, it is a significant source of savings for rural people. Despite its

significance, the livestock sub-sector faces several constraints that hinder its development. These constraints are of a health, genetic, and dietary nature. Livestock feed remains the main limiting factor contributing to poor livestock performance [3]. Natural pastures are the main source of livestock feed, contributing nearly 85% of animal feed [4]. However, there is an increasing tendency for there to be a considerable reduction in natural grazing due to the significant pressure exerted on land resources. Under these conditions, livestock struggle to feed in sufficient quantities and quality. Faced with this observation, agricultural research has found alternatives to usual animal feeding practices in

order to reduce food deficits. Fodder crops have thus emerged as an alternative to improving animal feed. Beyond their technical performance, the adoption of fodder crops poses a problem because there are few villages where one can observe fodder crops in place and in good condition [5]. Among the reasons for this low adoption, the insufficient involvement of producers in the design of innovations seems central. Indeed, for a long time, agricultural research has produced technologies intended to improve the productivity of crops and herds. But these technologies have not sufficiently considered peasant logic. To remove these limits, the actors have proposed approaches favoring the involvement of producers in the design of technological innovations. Among them, the optional approach developed by the project "Production and valorization of fodder resources by small producers in the High Basins region in intensive animal production oriented towards the market". This three-year project (2018–2020) aimed to promote the use of fodder crops by small agricultural producers in connection with targeted animal production workshops linked to the market. A variant of the participatory method of co-design of innovations, the optional approach makes it possible to identify with producers the options for possible changes to allow them to freely choose those that best meet their production needs. Since the adoption of an innovation is not only linked to its technical performance, but it also seemed necessary to understand the other factors that affect the decision of agropastoralists in the adoption of fodder crops. This study is part of this logic and aims to identify the determinants of the adoption of fodder crops by agropastoralists. It basically revolves around three parts. The first part deals with the working methodology used in the study, the second analyzes the results obtained, and the third presents the discussion of the results.

2. Methodology

2.1. The Study's Universe

The study was conducted in Burkina Faso in the rural municipality of Koumbia and involved four villages: Makognadougou, Koumbia, GombéléDougou, and Sébédougou. The rural municipality of Koumbia (12° 42' 20 north latitude and 4° 24' 01 east longitude) is located in the province of Tuy, 35 km from Houndé, the capital of the said province, and 67 km north of Bobo-Dioulasso, the capital of the High Basins region. It has fourteen administrative villages. The total area of the municipality is 1,358 km² with an estimated population of 46,005 inhabitants, including 22,346 men and 23,659 women in the general population and housing census (RGPH) of 2019 [6]. The population density is 50.6 inhabitants per km².

2.2. Methodology Approach

This study falls within the field of socio-economic research. The quantitative research method was the one that was used in this study. It makes it possible to collect

quantitative information on specific subjects. It thus leads to numerical data, which makes it possible to carry out descriptive analysis and analysis of correlations or associations between variables from statistical tables and graphs. Open-ended questions were introduced in order to capture what would escape quantitative analysis. This openness made it possible to obtain verbatim statements to support the statistical data and also refine the analysis.

2.3. Sampling and Selection

The survey sample is made up of all voluntary producers who took part in the experiments, even if only for one year out of the three covered by the project. This is an exhaustive sampling, and the target population is therefore the population observed in the present study. Thus, this population is composed of seventy-three (73) producers distributed in four villages of the rural municipality of Koumbia, which are Makognadougou, Koumbia, GombéléDougou, and Sébédougou.

2.4. Information Collection Tools and Analysis Strategies

The data collection tools were mainly documentary research and the survey questionnaire, administered to producers according to the production options. The survey questionnaire contains closed and open questions, which made it possible to collect the maximum amount of information on the opinions of the producers in order to make relevant proposals for the implementation of the project in the rural municipality of Koumbia. The data collected was processed using SPSS version 26 software and then analyzed using the descriptive statistics method. The chi² test made it possible, thanks to cross-tabulations, to identify the determinants of the adoption of forage crops by producers at a significance level of 5%. The independent or explanatory factors that impact the producer's choice to adopt the fodder crop include land accessibility, seed availability, income improvement, conflict management between farmer and stockbreeder, technical challenges in production, and degree of education.

3. Results

3.1. Status of Adoption of Forage Crops

Table 1 shows the situation of the adoption of fodder crops by the producers surveyed.

This table shows that sixty-four 64 producers produced fodder in the year following the end of the project, i.e., an adoption rate of 88%. On the other hand, 12% of respondents gave up fodder production at some point.

Table 1. Status of adoption of forage crops.

adoption of fodder crops	Number	Frequency (%)
Yes	64	88
No	9	12
Total	73	100

Source: field survey data, 2021.

3.2. Having Access to Land Resources Promotes the Adoption of Fodder Crops

A determining variable in agricultural studies, access to land has an influence on the adoption of agricultural innovations. The analysis shows that the relationship between the availability of agricultural land and the adoption of forage crops is very significant, as shown in Table 2 below. Thus, for Mr. S. T. from the village of Gombélédougou, "The fodder crops are very beneficial for my animals. Unfortunately, I did not continue production because I have a small plot on which I also have to produce enough to feed my family". Producers who have difficulty accessing land have a higher probability of not adopting forage production. In fact, 78% of non-adopters have difficulties accessing land, compared to only 1.6% of adopters.

Table 2. Adoption of fodder crops in relation to access to land.

acces	Adopters		Non-ado		Total	
	nu	Fréq	nu	Fréq	nu	Fréq
Yes	63	98,4	02	22	65	89
No	01	1,6	07	78	8	11
Total	64	100	09	100	73	100

P = 0,000; chi 2 = 38,576; ddl = 1; r = 0,727**

Source: field survey data, 2021.

3.3. Seeing an Increase in Income Encourages Producers to Grow Forage Crops

The possibility of improving income through the development of fodder production positively influences the adoption of the latter by the producers surveyed. Indeed, among the number of non-adopters, 67% gave up fodder cultivation because this activity did not allow them to increase their income. In this group, Mr. B. B. from the

village of Koumbia confides, "I stopped the production of fodder because the money I earned was insufficient compared to the expenses I incurred." On the other hand, among the adopters, all saw an improvement in their income. In this last group, Mr. D. A. from the village of Koumbia says, "Cultivating fodder brought me a lot of money. In addition to the sale of milk and animals, I also sold the surplus fodder produced." The results of the analysis on the adoption of fodder production in relation to the improvement of incomes are recorded in Table 3.

Table 3. Adoption of forage crops is linked to improved incomes.

incomes	Adopters		Non-adop		Total	
	N	Fréq	N	Fréq	N	Fréq
Yes	64	100	03	33	67	92
No	00	0	06	67	6	8
Total	64	100	09	100	73	100

P = 0,001%; chi 2 = 19,707; ddl = 5; r = 0,798**

Source: field survey data, 2021.

3.4. Forage Crop Adoption and Management of Farmer-Herder Conflicts

The aim here is to examine the influence that the practice of fodder crops can have in reducing conflicts between farmers and herders. The analysis showed that the prevention of conflicts between farmers and breeders is not a determining factor in the adoption of fodder production by the producers surveyed. In fact, only 44% of non-adopters believe that fodder production can help reduce conflicts between farmers and herders. In the group of adopters, 33% share this opinion. Table 4 below summarizes the results on the link between the adoption of fodder crops and the management of conflicts between farmers and herders.

Table 4. Adoption of fodder crops and management of farmer-herder conflicts.

Reduction of conflict	Adopters		Non-adopters		Total	
	Number	Frequency (%)	Number	Frequency (%)	Number	Frequency (%)
Yes	21	33	04	44	25	34
No	43	67	05	56	48	66
Total	64	100	09	100	73	100

P = 0,74%; chi 2 = 0,110; ddl = 1; r = 0,39

Source: field survey data, 2021.

Table 5. The impact of seed availability and fodder production adoption.

Availability	Adopters		Non-adopters		Total	
	Number	Frequency (%)	Number	Frequency (%)	Number	Frequency (%)
Yes	61	95	01	11	64	88
No	03	5	08	89	8	12
Total	64	89	09	100	73	100

P = 0,000; chi 2 = 35,655; ddl = 1; r = 0,699**

Source: field survey data, 2021.

3.5. Analyses of the Impact of Seed Availability and Forage Production Adoption

Analyses of the availability of forage seeds reveal that this variable strongly influences the decision to adopt forage

crops by producers (Table 5). Thus, 89% of non-adopters gave the unavailability of seed for these crops as the reason for abandoning fodder production. In this sense, Mr. S. T. from the village of Gombélédougou affirms: "I wanted to produce the *Brachiaria* which I really liked, but I couldn't because I looked for the seed in vain. I even went downtown

to Bobo-Dioulasso, where I was asked to wait. I waited, and finally the sowing dates passed without me getting the seed. Not only are the seeds expensive, but they are hard to find on the market here and even in town. "

3.6. Fodder Production Is Hampered by Technical Difficulties

The difficulties encountered in the production of fodder are essentially of a technical nature and relate to the low emergence of seeds of sorghum grinkan and the drying of the biomass of mucuna and cowpea. At this level, Mr. S. B from

the village of Makognadougou affirms: "producing fodder is a good thing for my animals. But the only problem is the drying of the harvested biomass, which tires me". For Mr. D. K from Gombélédougou: "the mucuna biomass is easily attacked by mold, which causes its quality to decrease. Drying is really difficult for me. Other than that, the production is not difficult." The analysis results show that almost all of the non-adopters think that the technical difficulties encountered in fodder production constitute a bottleneck to the adoption of these crops. In the group of adopters, only 20% of producers think so. The results for this variable are presented in Table 6.

Table 6. Difficulties of fodder production in relation to their adoption.

difficulties of fodde	Adopters		Non-adopters		Total	
	Number	Frequency (%)	Number	Frequency (%)	Number	Frequency (%)
Yes	13	20	09	100	22	30
No	51	80	00	0	59	70
Total	64	100	08	100	73	100

$P = 0,003$; $\chi^2 = 9,055^a$; $ddl = 1$; $r = -0,352^{**}$

Source: field survey data, 2021.

3.7. Influence of the Level of Education on the Adoption of Forage Crops

The level of education has an influence on the adoption of forage crops. Table 7 shows that 89% of non-adopters have not received any education, compared to 19% of adopters. Among the adopters, 37% have primary education, 7% have secondary education, and 26% are literate. 11% of non-adopters are literate.

Table 7. Influence of educational level on the adoption of forage crops.

degre	Adopters		Non-adop		Total	
	N	Freq	N	Freq	N	Freq
None	19	29	08	89%	27	37%
Prima	24	37%	00	0%	24	32
Secon	05	7,5%	00	0%	05	07%
Litera	17	26%	01	11%	18	24%
Total	64	100%	09	100	73	100%

$P = 0,005$; $\chi^2 = 13$; $ddl = 3$; $r = -0,280^*$

Source: field survey data, 2021.

4. Discussion

The analysis of the determinants of the adoption of forage crops has identified five factors that significantly influence the decision to adopt these crops. These are access to land, level of education, availability of seed, complexity of production, and the possibility of improving income. The variable relating to the management of conflicts between farmers and herders, mentioned by some producers, did not give a significant result in the analysis. The availability of land and hence land tenure is undoubtedly the main factor determining the adoption of fodder crops. Indeed, how do you find a vacant plot when you don't have enough land for your food and cash crops, even if you own your plot? Can we make crop projects on a plot that we are not sure of being

able to exploit? In view of these questions, the production activities of food crops and those of fodder crops seem antagonistic. In this case, part of the farm will only be allocated to fodder production when the producers' self-supply of cereals is guaranteed. This situation could also explain the small areas devoted to forage species. The difficulty of accessing land is a recurring constraint that discourages the producers surveyed from adopting fodder crops, as also underlined by Young [7]; Temple [8]; Ouattara [9], Dabiré and Fayama [10] in their studies.

The level of education was found to be a factor positively affecting the adoption of forage crops. This reality could be explained by the fact that the more the producer is educated, the easier it is for him to receive and understand the technical information provided to him. He is thus able to analyze the technology offered to him and reduce his level of uncertainty. The authors Roussy [11]; Bayard [12], and Mercer [13] also obtained similar results, which show that the level of education of the producer is a factor influencing the adoption of a new technology. The availability of seeds also appears to be a determining factor in the adoption of fodder production for 87% of non-adopters. For some producers, the difficulty lies in the cost of forage seeds, which is considered high. For others, it is the poor quality of the seed, particularly that of granny sorghum, for which producers have mentioned low germination power. The availability of seed has also been identified as a determining factor in the adoption of fodder crops by Ouattara [9] in his study on the characterization of livestock feed resources in the Bobo-Dioulasso area and the production of fodder crops.

With regard to the difficulties of fodder production, all the non-adopters and 20% of the adopters declared having encountered difficulties in the production of fodder. These difficulties are of a technical nature and are largely related to the drying of the harvested mucuna and fodder cowpea biomass. Harvesting of mucuna and cowpea takes place

before the end of the rainy season. This causes rotting of the harvested biomass, which becomes unfit for animal consumption. The difficulties encountered could be explained by the poor mastery of the technical itinerary of these crops. Thus, the technical difficulties of fodder production constitute a factor limiting its appropriation by producers. These results corroborate those of Roussy [11], Ouattara [9], Coulombe [14], and Rogers [15], who showed that production constraints generally have a key role in the decision to adopt innovation by operators. Like any crop, that of forage species requires appropriate techniques. Producers are familiar with the cultivation of food crops (maize, sorghum, millet, etc.) and some industrial crops (cotton, sesame, peanuts, etc.). On the other hand, they are not yet familiar with the cultivation techniques of fodder species, hence the difficulties they encounter in the production of these crops. This will make Dabiré and Fayama [10] note, in the conclusions of their research, that the technical factors of production of *mucuna pruriens* constitute, in many respects, obstacles to its adoption by producers, although it is palatable to animals.

The fifth determinant of the adoption of forage crops is the possibility for the producer to improve his income through forage production. Profit is an important argument in the adoption of any technology by producers, and it is in view of this importance that this aspect is taken into account in the very definition of adoption by various authors. The financial incentive is still one of the most important determinants of new technology adoption. This determinant is also noted by Mercer [13] and Weijnert [16], who support the importance of the economic benefits expected when a population engages in the application of a new technology. Crop residues and natural grasses consumed on pasture are not always sufficient to meet the food needs of animals. Fodder production in such a context can represent an essential asset for the intensification of animal production in Burkina Faso.

5. Conclusion

This study was carried out as part of the project "Production and development of fodder resources by small producers in the High Basins region in intensive animal production oriented towards the market," which aims to contribute to the development of crops fodder. Indeed, fodder crops have been confronted since their introduction with a lack of adoption despite their technical performance and the efforts made by research projects and NGOs. The study made it possible to identify the factors determining the adoption of fodder crops in the municipality of Koumbia. It has thus been shown that the adoption of fodder crops by producers is influenced by certain determinants, namely the availability of land, the availability of seeds, knowledge of fodder production techniques, the level of education, and the improvement of income. These determinants of adoption influence the perception that producers have of forage crops and guide them in their decision to adopt these crops or not. Forage crops could increase the feed supply of animals while

reducing expenditure for the purchase of feed concentrates. But the practical difficulties related to the techniques of drying and preserving the tops of legumes, etc., are likely to demotivate producers. It is therefore important to develop, with the participation of producers, suitable infrastructures for the optimal conservation of the fodder produced. Finally, it is necessary to deepen the economic aspects and measure the impact of fodder valorization options on farms. This would contribute to further inducing the adoption of forage crops because the improvement of income was mentioned by a large number of the producers surveyed as a factor influencing the adoption of these crops.

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