Identifying Sorghum Yield Limiting Factors and Farmer's Criteria Traits in East and Northern West Niger

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Abstract

Sorghum is one of the most important cereal crops well adapted to harsh and dry environmental condition. In Niger, a dry country with limited rainfall distribution (three to four months per year), there are biotic and abiotic factors impacting sorghum cultivation. The objectives of this study were to determine production limiting factors and preferred traits of sorghum farmers in Niger. Twenty sorghum growing villages in Tahoua and Maradi region were surveyed. The villages were selected based on sorghum production volumes recorded in the various regions as documented by the National Institute of Statistics of Niger database. Limiting factors affecting sorghum cultivation which include, rainfall scarcity, water logging, midge, migratory bird, Striga, animal straying, soil fertility, non-adaptative and non-productive varieties utilization were identified. Among the factors, water scarcity and Striga impact were identified as the main sorghum limiting constraints in the two regions. Sorghum productivity is also affected by the utilization of local land race with low grain yield and is susceptible to Striga. In addition, early maturing planting and taller and high yielding Striga resistant varieties with white pericarp and good taste are preferred by farmer. Insertion of farmers' views in the breeding process is the best improvement strategy for developing the easiest and most acceptable variety by smallholder's farmers.

Subject Areas

Soil Science

1. Introduction

The failure of conventional breeding approach applied in variety development and their acceptability by farmers, has pushed researchers to develop new strategies for better results. Thus, when farmers are involved in the breeding process, the variety will be easily accepted by them [1]. In fact, one of the most utilized strategies to determine farmer's choices and production constraints is utilization of participatory rural appraisal (PRA) [2].

Participatory rural appraisal is designed in the broad sense to let farmers express their own views. By this way, it allows a bidirectional learning activity between breeders and farmers [3]. It gives more emphasis and guiding map in the development of varieties that will be accepted by the farmers.

In Niger, sorghum is produced for feeding humans and animals. The crop is largely produced in Maradi, Zinder and Tahoua regions, where the yields are estimated at 0.2 to 0.4 t/ha in farmer's field and 2.5 to 3.5 t/ha at the research fields [4]. Niger agriculture system is mainly based on traditional techniques utilization and faces many challenges and constraints which highly affect the yield. Among those limiting factors that affect sorghum cultivation, Striga hermonthica is the most damaging one with around 20% to 80% of yield loss [5]. It is a serious problem in sub-Saharan African region, especially in Niger where the damage can go beyond 80% reduction yield. The yield loss varies from one location to another location depending on the type of variety used due to host plant specificity [6].

In Niger, Striga has been reported in Tahoua, Maradi and Dosso regions, where it negatively impacts sorghum productivity [7]. In controlling the weed, around the world several control methods have been successfully tested but some are hazardous to the environment and not accessible by poor smallholder farmer. In order to solve the low productivity challenge due to Striga, there is a need to develop genotypes which combine Striga resistance, high grain yield and should be accepted by poor farmers in Niger. For this reason, a participatory rural appraisal should be conducted to obtain farmers' varietal preferences for a successful breeding programme [8]. Therefore, farmers' local materials should also be included in the breeding process in order to incorporate farmers preferred traits. In this way the newly developed varieties will be acceptable to farmers and the varieties adoption rates will increase significantly.

2. Material and Methods

2.1. Study Location

The study was conducted in two agro-ecological areas of Niger, namely Tahoua

and Maradi, with different rainfall distribution patterns (Figure 1). These areas are characterized by high Striga seed infestation on sorghum fields. Under those circumstances, with a geographical position of 13˚30'0"N, 7˚6'0"E, Maradi is a Sahel area located in the south-center of Niger and the area can receive rainfall of between 650 and 700 mm depending on the year. It is the highest sorghum growing area of Niger. The second site for the study was at Tahoua, located in the north of Niamey. It is an area with high sorghum diversity and large scale sorghum producers especially in Konni. The region is located in the northeast of Maradi with a geographical position of 14˚48'45"N, 5˚22'58"E.

2.2. Site Selection

The sites selection was based on sorghum production volumes recorded in the various regions as documented by the National Institute of Statistics of Niger database (INS, 2016). In each selected region (Maradi and Tahoua) one village was selected for focus group discussion according to their experience on sorghum cultivation and the level of constraints affecting the crop. Thus, before the focus group discussion and the interviews, visits were made for discussion between farmers and National Institute of Agricultural Research of Niger (INRAN) agents. The focus group discussions were conducted in Adraoua (Maradi) and Tserassa Mangou (Tahoua).
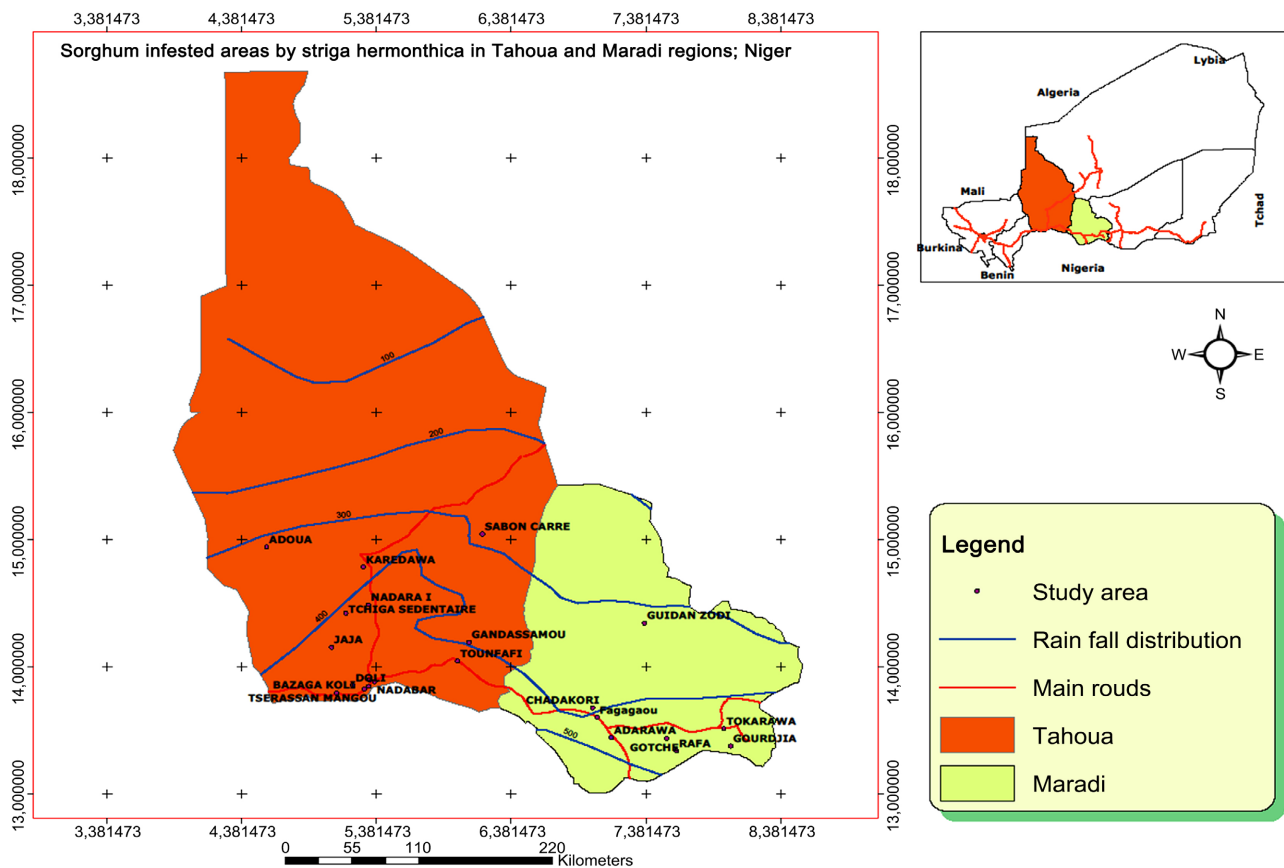

Figure 1. Survey village's geographical position in Tahoua and Maradi (Niger).

2.3. Study Design

A Purposive sampling method was used.

2.4. Sample Size Estimation

Ten (10) villages were selected in each region where questionnaires were administered. In each selected village, based on the sorghum growers' experiences (more than 10 year experiences on sorghum cultivation), 10 sorghum growers per village were randomly selected through a purposive sampling method, giving a total of 200 persons interviewed in the two regions with the geographical position recorded.

2.5. Data Collection and Analysis

Farmers were interviewed on their traits preferences and the constraints affecting their productivity using a semi-structured questionnaire (Appendice 1). Thus in the two regions, two focus group discussion were made in Tserassa Mangou in Tahoua region and Tarna in Maradi region. The collected data were analyzed using STATA 14.

3. Result

3.1. Demographic Characteristics of Sorghum Farmers

The ages of sorghum farmers ranged from 13 years to above 50 years (Table 1), with a mean and standard deviation of 4.37 to 48.7 and 14.14 to 51.49 (Table 2) respectively Maradi and Tahoua region. Only 6% of the farmers interviewed were below 20 years. Fifty-one percent of them were 50 years and above. In Maradi and Tahoua regions, the growers' ages varied respectively from 1. In fact, in the visited areas no women were among the 200 farmers interviewed due to religion issue (Table 1). Concerning the educational level, about 16.5% of the growers were illiterate in the two regions, with 18% of the growers in Maradi and 15% of the growers in Tahoua (Table 3). In term of literate level Tahoua had 59% of farmers compared to 29% at Maradi.

Sorghum crop is generally cultivated on valley soil and on sandy soil. Thus, in the visited areas, about 92% of the farmers in Tahoua, were producing sorghum on valley soil, against 22% of farmers in Maradi. In addition, in Maradi, 78% of the farmers have cited to grow sorghum on sandy soil, against 8% of farmers in Tahoua region (Table 4).

In order to obtain better yields some of the farmers mix their seeds with fungicide to protect their plants from fungal diseases. In this regard, around 81.5% of the sorghum growers interviewed treated their seed against insect and pest damage whilst the remaining farmers did not carry out seed treatment.

For soil amendment, farmers applied fertilizers in their fields depending on their financial capability. At the regional level, especially in Maradi, 60% of the interviewed growers used NPK-15:15:15; others (8%) used DAP, SSP (3%), urea

(17%) and still some farmers (12%) did not know the identity of the fertilizer they used (Figure 2). In Tahoua, the pattern of fertilizer type used was similar to Maradi, with NPK-15:15:15 and urea applied by more growers than the other fertilizers.

Table 1. Sorghum famer's age distribution across surveyed areas in Maradi and Tahoua region in Niger.

Characteristics		Farmers numbers and percentage	
		n = 200	%
Ages	13 - 15	12	6
	20 - 30	35	17.5
	31 - 40	56	28
	41 - 50	46	23
	51 - 60	51	25.5
Gender	Male	200	100
	Female	0	0

Table 2. Sorghum famer's age distribution Means and Standard deviation in Maradi and Tahoua region in Niger.

Region	Means	Sd
	AGE	AGE
MARADI (n = 100)	48.75	14.37
TAHOUA (n = 100)	54.18	13.45
Total (n = 200)	51.49	14.14

Pearson chi2 = 10.4841 Pr = 0.005.

Table 3. Sorghum farmer's educational level percentage across surveyed areas in Maradi and Tahoua region in Niger.

Education level	Regions		
	MARADI (%)	TAHOUA (%)	Total (%)
Illiterate	18	15	16.5
Literate	29	52	40.5
Koranic	53	33	43
	100	100	100

Pearson chi2 = 10.4841 Pr = 0.005.

Table 4. Distribution of the different soil type devoted to sorghum cultivation in Maradi and Tahoua region in Niger.

Characteristics	Regions		
Soil type	MARADI (%)	TAHOUA (%)	Total %
Clay soil	22	92	57
Sandy soil	78	8	43
n= 200	100	100	100

Pearson chi2 = 99.9592 Pr = 0.000.
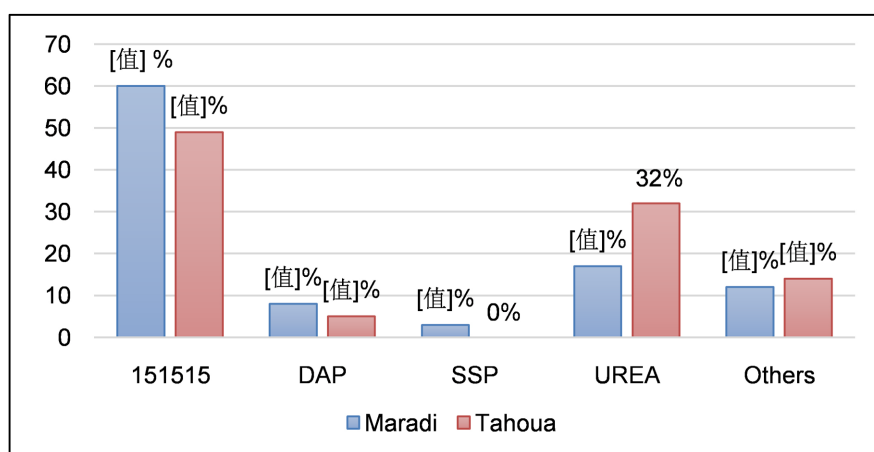
Figure 2. Shows the different type of fertilizers application in Maradi and Tahoua region in Niger (X: Different fertilizers; Y: Percentage of growers).

## 3.2. Farmers Preferred Varieties and Traits

In the 20 villages interviewed, an important numbers of information were carryout on farmers preferred varieties, their preferred traits and the selection criterions. Along those areas there are specific trait desired by farmers in each area. For that, 24.50% of the interviewers are willing varieties with good yield; 20.50% of them along the two regions have requested Striga resistant variety with good yield. In addition, early mature varieties (22.50), Long stem (6), MDK early mature (5.50), medium stem (5.50), good culinary quality (4.5%), variety resistant to water flood (4.50), big panicle (3.5), red grain (3%) were requested by farmers (Table 5).

In addition, in term of colours, among the 200 persons interviewed, 58% 0f them have a high preference on the white sorghum grain. The yellow colour is represented by only 5% percent, 32% for the red grain and the others colours by 6.50% (Figure 3). Thus at the region level, the white colour is highly appreciated in Maradi (65%) than Tahoua region (50%). Concerning the yellow colours, their appreciation is smaller in the two regions (4% in Maradi and 6% in Tahoua). In Tahoua region, the red sorghum is well appreciated by 35% of the interviewers than Maradi region (27%). The others colours were less represented in the two regions (4% in Maradi and 9% in Tahoua).

Table 5. Distribution of sorghum preferred traits from surveyed farmers across Maradi and Tahoua regions.

	Regions		
Characteristics	Maradi (%)	Tahoua (%)	%
Good Yield	21.00	28.00	24.50
High yielding Striga resistant sorghum	15.00	26.00	20.50
Good taste	7.00	2.00	4.50
Red grain	4.00	2.00	3.00
Big panicle	2.00	10.00	6.00
Long stem	6.00	1.00	3.50
Early mature variety	23.00	22.00	22.50
Early mature (MDK)	9.00	2.00	5.50
Flood resistant variety	5.00	4.00	4.50
Medium stem	8.00	3.00	5.50
	100	100	100

MDK: Matche Da Koumgna; Pearson chi2 = 148.8570 Pr = 0.000.
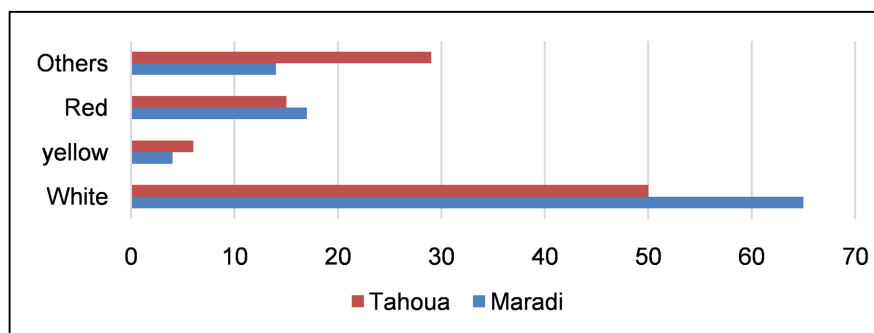
Figure 3. Participatory rural appraisals on farmers preferred sorghum seed colour accross Maradi and Tahoua region in Niger (X: Percentage; Y: Seeds colour distribution).

3.3. Sorghum Production Constraint's

Of the total numbers of growers interviewed, 54% of them identified rainfall scarcity as their first liming factors across the visited villages. Wind followed by migratory bird and water flood was also important as constraints, represented respectively by 6% of farmers, 5.50% of farmers and 4.5% of farmers in the two regions. In addition, animal straying, soil fertility and non-adaptive and productive sorghum varieties were identified as important in term of percentage factors influencing sorghum production in Maradi and Tahoua region. At the region level, the rainfall scarcity was represented by 55% of the farmers at Maradi and

53% of the farmers in Tahoua region. Therefore, water flooding impact is less important in Maradi were only 4% of the interviewers were affected, Tahoua region is more affected with 5% of the farmers. In Tahoua region, an estimation of 11% of the growers among the 100 persons selected for the survey, have declared to be affected by midge against only 1% in Maradi region ([Table 6](#)). In addition, migratory bird also causes damage and seriously affects the production with 4% of growers in Mardi and 7% of growers affected in Tahoua. So in Maradi region, were sorghum is highly produced, 19% of farmers were affected by Striga impact, while 31% of the growers in Tahoua were impacted.

According to the focus discussion made, in Tserassa Mangou, Striga hermonthica was ranked as the first constraint that affected sorghum cultivation followed by soil infertility, midge, insects, the lack of manure and the wind. For the first constraint, NPK 15-15-15, DAP and manure were used for fighting the weed. Farmers have indicated utilization of pesticide from Nigeria (Red and Blue package) as a fertilizer in the way that they allow a good development of the sorghum crop and against insects. Concerning Striga impact the farmers also used Nere (parkia biglobosa), sesame seed and hand pulling against the weed. In the area the Striga plants are used for feeding animal, in sorcery and for women during painful periods. For midge impact, an early sowing and pesticide application were recommended. In Tarna, rainfall scarcity, soil fertility, insect's problem, Striga and midge were recorded as sorghum main constraints. For soil fertility farmers are using DAP, NPK 15-15-15 urea and manure. A red pesticide from Nigeria is used against the insects.

Table 6. Participatory rural appraisal on sorghum production constraints in Tahoua and Maradi region in Niger.

Production constraints	Region	
	Maradi (%)	Tahoua (%)
Rainfall Scarcity	55	43
Water logging	4	5
Midge	1	11
Migratory bird	4	7
Striga	19	31
Animal straying	0	1
Soil fertility	16	2
Non-adaptative and non-productive varieties	1	0
	100	100

Pearson chi2 = 31.6989 Pr = 0.004.

4. Discussion

The sorghum growers interviewed in the two regions had average ages between twenty and more than sixty (60) year old. The old sorghum growers with more than sixty (60) years represented more than 50% of the farmers. Thus, it is reported that young educated farmers can easily master news technologies and try new varieties than the old [9]. In addition, it is also important to notice that old farmers have more experience and devoted in their work than the new generation [10].

The study also showed that most of the sorghum growers interviewed in Maradi and Tahoua region were men, and some of them were illiterate. The absence of women in the interviews is highly linked to religion, where women are not allowed to express themselves in public [11]. In Niger, women are daily involved in processing, preparing different meals but they have not been consulted for traits preferences. However, there is a necessity to include women views in the breeding process for a speedy and higher acceptance of new varieties in Niger. In addition, to the absence of women views, the high illiteracy is also a challenge for new varieties and technologies adoption in agriculture [12]. Therefore, the visited areas are also characterized by a chronic poverty and utilization of rudimentary instruments for weeding and soils preparations.

In addition, concerning farmers' trait preferences, several traits were mentioned. Thus, for the colour appreciation, it was different in Tahoua and Maradi region. Although, in Tahoua and Maradi region more than 50% of the interviewees preferred the white sorghum. The yellow colour was more preferred in Maradi than Tahoua region where an estimation of 10% of the growers preferred this colour. The red colour was also less preferred in the two regions, especially in Tahoua region. The lower preference of red compare to white grain colour is due to religion and social purposes [13]. Rainfall scarcity, wind, migratory birds, water flooding, soil infertility, Striga impact were the main constraints affecting sorghum cultivation in the two visited regions. The result is in conformity to what has been previously found in Niger [14]. The rainfall scarcity is one of the most cited constraints due to the climate change affecting rain regularity in Niger. In the past 10 years the rain fall distribution across the country has considerably decreased due to climate change [15].

At the base, Niger is a Sahelian region where it does not rain a lot, it only rains three to four months in a year. So, where global warming is combined to dry and hot conditions it may seriously affect that rainfall distribution. In Tahoua region around 11% are concerned by midge damage. In fact, midge can seriously impact sorghum grain yield at flowering stage especially during late planted-crops. That is why farmers in Niger preferred early planting. Meanwhile, it is urgent to develop new sorghum genotypes adapted to those identified constraints in Niger for fighting hunger and food insecurity.

5. Conclusion

In this study, rainfall scarcity, water logging, wind, migratory bird impact, Striga

problem, animal straying, soil fertility, and the use of non-adaptive and non-productive varieties by smallholder's farmers were the common sorghum production constraints. In addition, the farmers preferred traits are: High yielding striga resistant sorghum, good taste, white grain, big panicle, and long stem, early mature.

In Niger, a dry land country characterized by a short rainy season, sorghum is one of the most valuable staple crop well adapted to this harsh environmental condition. Today with the accession of the global warming and the impact of both biotic and abiotic constraints, the crop is subjected to an important yield loss. This survey made in Niger, especially in Tahoua and Maradi region put in light sorghum production constraints', farmers preferred traits for striga resistant variety development, traditional fighting methods used against the weed and their utilizations. So rainfall scarcity, water logging, wind, migratory bird impact, striga problem, animal divagation, soil fertility, non-adaptive and non-productive varieties utilizations' cited by stallholder's farmers are the most sorghum production constraints. The impact of each constraint can vary from one location to another. Water scarcity and striga infestation were the main constraints to sorghum cultivation. It is a poor country where more than 80 percent of the stallholder's farmers have limited resources and are doing subsistence agriculture. The low income has limited sorghum growers them to properly fight the weed through fertilizer application in their field. In addition to those factors, the high prices and the unavailability of herbicides couple to the absence of striga resistant genotype in farmers' field, the high demographic rate which reduce the lands availability crop for rotation, are the reason that make the striga management difficult and not accessible. So, the best and cheaper way to fight the weed is developing striga resistant genotype by including farmers preferred trait. In this way the developed variety will be easily accepted by farmers, in response to what make failed the previous varieties acceptation by them. It is also interesting to train farmers on technology transfer on how to better manage striga spread and effect.

Conflicts of Interest

The authors declare no conflicts of interest.

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Appendice 1: Pra Questionnaire and Focus Group Discussions Topics

- Group discussions topics (Tserassa Mangou and Tarna)

Topics	Assessment
Main crop cultivated	Ranking methods
Sorghum productions constraints	Ranking methods
Sorghum utilisations	Listing
Striga utilization and fighting methods	Listing

- Semi structure face to face interviews questionnaire
   1) Starting time:
   2) Ending time:

I. Farmers General Information

1) Questionnaire number
2) Interviewer code   1 Ardaly Ousseini   2 Issaka Hamani
3) Region   1 Dosso   2 Maradi   3 Tillaberi   4 Tahoua
4) Department
5) District
6) Village
7) Village geographical position
8) Date
9) Rain fall annual mean: _____
10) Total population number_____: Men_____ Women_____ Children_____
11) Number of households in the village

II. Socio Economic Characteristics of the Interviewees

Questions	Responses		
Name of the household's head			
Gender	Male = 1 Female = 2		
Age			
Marital status	Maried = 1 Divorced = 2 Single = 3 Widow = 4		
Household size			
Working member's in the household ≥ 14 years ≤ 55 years ≥ 60 years	Men	Women	Children
Education level	1 Primary 2 Secondary 3 Literate 4 Koranic 5 No formal education		

Are you member of any producer organization?	1 = No 2 = Yes
Activity by order of importance	☐ Agriculture ☐ Business ☐ Agricultural transformation ☐ Live stock ☐ Fishing ☐ Others

III. Fields Number and Major Crops in Order of Importance

Number of Field	Area cultivated (ha)
1 ☐	
2 ☐	
3 ☐	
4 ☐	
5 ☐ several	

IV. Sorghum Production

1) Total farm devoted to sorghum cultivation in ha

Are you producing sorghum every year?　　1 Yes　　2 No

Periods	Number of field utilized	Total area (ha)	In association 1	Alone 2
2014				
2015				
2016				

Periods	Production in boots	Type de Culture	
		If in association (with which crop)	Alone
2014			
2015			
2016			

Local unit for weight estimation = …………….…………………………………..

Other information's ………………………………………………………………

Boot unit price ……………………………………………………………………

2) Sorghum Product utilization

Periods	Quantity produce	Quantity consume	Quantity sold	Others
2014				
2015				
2016				

V. General Information on Sorghum Crop

5.1. Type of Sorghum varieties you are cultivated

Varieties	Supplies origins	Acquisition mode
Land races	1 Village market 2 Neighbors village market 3 Intrans Shops 4 previous year production 5 NGO project 6 Research institute 7 Others	1 Gift 2 Buy 3 Own production
Improved varieties	1 Village market 2 Neighbors village market 3 Intrans Shops 4 Previous year production 5 NGO projects 6 Research institute 7 Others	1 Gift 2 Buy 3 Own production

5.2. Sorghum Cultivation Methods

1) On whatever sort of soil are you producing sorghum

1 valley soil   2 sandy soil

2) Which techniques are you using for field preparation

1 Plough   2 Tractor   3 Hoe   4 nothing

3) When is the showing periods ……………………………………………………

5.3. Are you treating the seeds before the showing   1 Yes   2 No

1) Which product…………………………………………………………………………

2) Reasons…………………………………………………………………………………

5.4. Are you fertilized your fields   1 Yes   2 No

1) Organic   Period………   And how it is done

1 spreading   2 micro dose

2) Mineral   which one   1 1515   2 DAP   3 SSP   4 Urea   5 Others

Period   1 During field preparation   2 During emergency

3 during the tillering   4 Bolting   5 seed set   6 heading time

Mode of application   1 spread   2 micro-dose

3) Where did you buy it   1 Market   2 Intrant shop   3 Others

4) Which quantity   1 Bag number…………   2 Number of Tia…………

3 Number of kilos…………

5) How is about the accessibility   1 Easy   2 Difficult

5.5. Do have notion on organic an mineral fertilizer impact on sorghum growth

1 Yes   2 No

Give examples

1………………………………………………………………………………

2………………………………………………………………………………

3………………………………………………………………………………

5.6. How Sorghum field weeding is done in our area?

1 hilaire   2 hoe   3 plough   4 Herbicides   5 hand   6 others

At which level……………………………………………………………………..

At which stage of crop development

1 During emergency   2 during the tillering   3 Bolting

4 seed set   5 heading time

5.7. How is the distance between hills   1 Low   2 Medium   3 Wide

5.8. How is the distance between rows   1 Low   2 Medium   3 Wide

5.9. Do you have information on the varieties that you are using cycles

1 Yes   2 No

Landraces:…………………………………, Cycle: ………….. Month………….

Are you satisfied on them   1 yes   2 No

Why…………………………………………………………………………..

Cycle: ……………….. Month, Are you satisfied   1 yes   2 No

Why…………………………………………………………………………..

Cycle: ……………….. Month………… Are you satisfied   1 yes   2 No

Why…………………………………………………………………………..

Ameliorate varieties………………… Cycle………………. Month……………….

Are you satisfied   1 yes   2 No

Why…………………………………………………………………………..

Cycle: ………………………………….. Are you satisfied   1 yes   2 No

Why…………………………………………………………………………..

Cycle: …………………… Are you satisfied   1 yes   2 No Why……………..

5.10. Are you using ameliorate varieties   1 Yes   2 No

5.11. For how many year are you using those varieties   …………...year

1) Why are you using those varieties   1 yield   2 Earliness

3 Grain quality   4 Livestock quality   5 cooking quality   Others …….

2) How are those ameliorate varieties compare to your landraces

1 Good yield   2 Earliness   3 Good grain quality   4 livestock quality

5 cooking quality   Others ………………..

3) Do you have any problems with those varieties   1 Yes   2 No

Cite the problems if yes

1………………………………………………………………………………

2.…………………………………………………………………………………

3.…………………………………………………………………………………

5.12. Do you have any problem of the sorghum grain colours   1 Yes   2 No

Why

1.…………………………………………………………………………………

2.…………………………………………………………………………………

3.…………………………………………………………………………………

5.13. Which grain colour do you like?

1 White   2 yellow   3 Red   4 Others

Why

1.…………………………………………………………………………………

2.…………………………………………………………………………………

3.…………………………………………………………………………………

5.14. Do you think it is possible to improve?

The Local land races   1 yes   2 No

Why

1.…………………………………………………………………………………

2.…………………………………………………………………………………

Improved varieties   1 yes   2 No

Why and how

1.…………………………………………………………………………………

2.…………………………………………………………………………………

5.15. Can you cite sorghum production constraints?

1 Insufficient rains   2 Poor distribution of rains   3 Flooding

4 Torrential rains   5 High winds   6 Migratory birds

7 Insect damage   8 Rodent damage   9 Pet damage

10 Delay in sowing   11 Delay in weeding   12 Movaise field management

13 Soil type not suitable for sorghum cultivation   14 Degraded soil

15 Laundry soil   16 Low soil fertility   17 Non-productive varieties

18 Old seeds   19 Poor land fertilization   20 Poor land fertilization

21 Away from fields   22 Hard to access

23 Lack of phytosanitary treatment   99 Missing data

1) How do you think we can combat these constraints?

1.…………………………………………………………………………………

2.…………………………………………………………………………………

3.…………………………………………………………………………………

5.16. Do you know the Sorghum Striga (Show photo)   1 yes   2 No

1) When it appears on sorghum plants …………………………….

2) Do you know Striga impact on sorghum growth   1 yes   2 No

Cite them

1.…………………………………………………………………………………

2.…………………………………………………………………………………

3.…………………………………………………………………………………

4.…………………………………………………………………………………………

3) Cite the fighting methods

1.…………………………………………………………………………………………

2.…………………………………………………………………………………………

3.…………………………………………………………………………………………

4) Do you have Striga resistant/tolerant varieties   1 Yes   2 No

List them

………………………………………………………………………………………..

………………………………………………………………………………………..

………………………………………………………………………………………..

5) Do you use Striga plants for other purposes   1 Yes   2 No

1 Medicinal

2 Feeding animals

3 Others

5.17. Do you need resistant varieties Striga   1 Yes   2 No

List your agronomic Characteristics

………………………………………………………………………………………..

………………………………………………………………………………………..

………………………………………………………………………………………..

5.17. Do you know Acacia Senegal   1 Yes   2 No

1) What do you know about this plant?

1.…………………………………………………………………………………………

2.…………………………………………………………………………………………

3.…………………………………………………………………………………………

2) Do you use this plant in agricultural production   1 yEs   2 No