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Developing the Millet and Sorghum Value Chain from Gendered Trait Preference study in Burkina Faso

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Abstract

Prioritizing the different traits and cultivar demand of farmers and other actors in the cereal value chain has been the challenge faced by the breeding program in sub-Saharan Africa. The present study aims to assign concrete weights to different profile of actors-related constraints and trait preferences by focusing on the value chain studies; paying more attention on gender related aspects that the value chain of Millet and Sorghum encounter. Drowing from mix method, using the value chain approach combined with the Self Identity approach, this paper uses trait prioritization to assess producers/consumers, traders and processors' preferred traits in three agro-ecological regions of Burkina Faso targeting 712 respondents, with 389 female respondents, or 46.75% of total sample size, 12 focus groups and one participatory workshop. The findings show that despite existing efforts for inclusive agriculture, the social construction and allocated roles have shaped the varietal traits preferences. It appears that the desired traits are more related to one specific position which relate to one identity on the value chain. Value chain actors' options and choices then depend on either they are farmers, processors, and traders with specific challenges in relation to their professions. Such professions impact these actors' preferences.

Key words: Gender; value chain; traits; preferences .

1. Introduction

It is believed that agriculture is the driving force of economy in Sub-Saharan Africa. As such its value chain development remains a key element in agricultural programming and innovation.

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It helps look beyond individual actors by looking at the inter-relationship between actors with different functions. It is argued that by focusing on the value chain and by looking at the links between them, we can better understand and also identify existing problems and suggest solutions that would generate win-win outcomes [1] (p.47).

Burkina Faso is of sorghum and millet most producing country in West and Central Africa. These two crops Millet and sorghum are the main staple crops in Burkina Faso and serve as food and nutritional security as well as source of income for smallholder farmers [2]. Although the two crops are critical for livelihood improvement for actors engaged in these value chains, millet and sorghum are frequently produce under unpredictable biotic and abiotic stress which influence negatively on the speed and the rate of adoption of new improved varieties. Thi adoption is estimated at 8.4% according to [1] sorghum and millet represent 73.6% of the national cultivated areas and have the lowest coverage rates of improved seeds (evaluated at 1.3 and 0.6% respectively according to recent studies this low rate of adoption could be explained by the fact that the improved varieties do not sufficiently meet the producers' criteria. It is therefore necessary to find improved varieties not only adapted to local soil and climatic conditions with good yield but also meeting specific criteria of users in the value chain and their desired varietal traits in the process of participatory selection.

To address this, many efforts and interventions have been taken by ICRISAT and its partners (NARS) in WCA to improve yield and adaptation of the crops' varieties to the local ecologies. One of the major decisions was to move from a conventional breeding program to Participatory Plant Breeding (PPB) which assumes the involvement of all stakeholders in the breeding process and decision. The main purpose of PPB is the assessment of farmers' variety needs to improve varieties so that they contain the characteristics relevant and important to the livelihoods and context of farmers' conditions; with the final goal of improving adoption and targeting clients and environments (social and agro-ecological). Over the years, there has been increased emphasis on gender-responsiveness in PPB in order to effectively and efficiently meet the needs/demands of all value chain segments actors. The low speed and rate of adoption of improved varieties can be partially explained by the non-prioritization of needs of all clients or users of the breeding materials and by the non-consideration of gender specific issues and needs in breeding activities and decisions.

Sorghum participative plant breeding activities started in Burkina Faso in 1995 with varietal tests in rural areas funded by the Regional Research Network on Sorghum (ROCARS). This experience has enabled researchers to gradually build up the participatory selection method, although it should be noted that the various activities carried out within the framework of these projects remain marked by a "linear downward" approach [3] (p.31) from research towards peasant structures without real feedback mechanisms. It was more a partnership between research and producers than real participation of farmers in setting breeding activities and priorities. It took the advent of bilateral and regional projects like Harnessing Opportunities for Productivity Enhancement (HOPE), "Collaborative Crop Research Program" (CCRP), and Millet and Sorghum Project (PROMISO) to see the Participatory Plant Breeding (PPB) set up. Despite this progress in collaborative and or participatory research on prioritization of farmers' preferences in the development of varieties, studies have reported both differences and complementarity between men and women's trait preferences due to their contrasting role and responsibility in household management [4,5,6,7] Most of these studies on gender differentiated information about trait

preferences were not specifically designed for understanding gender related issues. One of the consequences of these studies is not only the non-consideration of gendered trait preferences and demands, but also the non-trait prioritization in breeding decisions. This related to the way those studies were not designed to take into account the social significance crops for men and women based on the potential of every agro-ecology, dietary habits and economic patterns. To bridge this gap and limitations, deep understanding of a wider social group of actors' varietal preferences and the must have trait for prioritization through gender and social inclusion is necessary for achieving demand driven breeding and food security in context of changing the climatic and socioecological conditions.

Through our review of the literature, it emerges that certain themes related to the subject have already been dealt with. Thus, [8] sought to know the varieties of sorghum to meet production requirements. The results of this study showed that hard-grained red sorghum is the preferred type of sorghum for local beer. A study carried out by [9,10] cited by [8], also reveals that the sorghum grain characteristics most desired by beers industries are good germination, red color of the grain and its hardness. According to them, the hardness of the grain is measured by sorghum beer. The literature review shows that in reality the publications that appear in the millet and sorghum value chain, it is above all sorghum that was processed and only mentioned the transformation link. It is therefore important to discuss this theme by taking millet into account and by extending this study to all the links in the millet sorghum value chain in this case, production, marketing and processing. Because, as we can see, millet and sorghum are two (2) speculations which occupy an important place in agricultural production. While these two crops have long remained traditional cereals for consumption by many small producers, these cereals have evolved over time. Thus, nowadays, millet and sorghum occupy a prominent place both in the marketing link and in that of processing. The objective of this study is to examine and determine traits preferred by men and women in the different segments of the cowpea value chain including farmers, grain traders/sellers, seed out growers, processors and seed consumers. More specifically, it aims to:

- Understand agronomic and socio-economic constraints in production and utilization of millet and sorghum varieties.
- Understand and determine all value chain actors' preferences regarding sorghum and millet
- Understand the similarity or difference of traits preferences among the value chain actors in order to determine the most or least preferred traits to inform breeding pipeline

- What is the rate of the adoption of the Millet/Sorghum varieties?
- What justify this level of adoption?
- What are the desired traits from the whole Millet/Sorghum and groundnut varieties? value chain?
- What are the gender differences in terms of choices and options to inform breeding processes in Burkina Faso?

1.1. Theoretical framework and method

An approach to the study of the relationship between identity and behavior and choices regarding specific variety appears very key in this paper. Studying farmers, processors and traders' choices and behavior regarding

varietal traits. Consumers as well as the other actors in the value chain behavior toward a specific product have a symbolic meaning beyond their practical and objective features and consequences. Farmers, traders and processors can be seen as professions that define oneself in the way he or she adopt a specific behavior or specific preferences. For instance, as [11] shows it, buying a typical car is behaviors associated with an image or also associated with a kind of person (young, sexy, attractive, man or woman etc. We can then explain young people's women/men either they are farmers, traders or processors preferred varietal choices based on their professional occupation. As a farmer one has some constraints, needs and desired that may differ from a processor who is at a different angle another professional with a specific role in society. As such women who play a key role for example in preparing food has then her identity and role which is assigned to her identity that influence her varietal traits related to preferences and choices. Identity here is related to one profession and position in the community. In fact, before engaging in a given behavior, people take into account their identity, but also the circumstances and opportunities that would define their choices. As rightly put by [12] (p49) « In the domain of consumer behavior, suggested that the individual, before purchasing a given product, assesses the match between the image associated with this purchase and his or her self-image ». When farmers are producing to consume, they have a specific image of what they need, and what the idealized buyer of their product that they grow. People decide and choose based on a thorough weighing of costs and benefits which are the consequences that a given behavior may bring about for the actor's identity. Furthermore, the Value chain approach help operationalized identity in terms of personal identity. The present study provides evidence supporting the measure of personal identity that was derived from the theoretical framework shared by Self-Identity Theory [11] Personal identity was measured in the present studies using a value chain approach which is similar to the multi-step procedure used by [12; 13] we assessed the value chain actors by making explicit the gender-related consideration between the image or the prototype of the typical person choosing a typical variety.

Looking at the value chain, women occupy an essential position in the different segments: as farmers, processors, traders and or consumers. Thus, understanding what are the choices and their characteristics in relation to the value chain in addition to gender related issues have helped us evaluate different actors' participation and appreciation to both sorghum as well as millet improved variety.

1.2. Context and study sites

A study was conducted between December 2019 to April 2020 in Burkina Faso and aims to understanding men and women's varietal choice and preferences of sorghum and millet and how this choice and preferences can influence the crop's breeding pipeline and products adoption. To align with the overall objective assigned to the research project, the study was conducted across three regions in Burkina Faso. These include the regions of Centre-Sud, Plateau Central and Centre-Ouest. All the three regions are located in the central part of Burkina Faso. The study sites were purposively selected not only because Environmental Institute for Agricultural Research (INERA) millet and sorghum national research programs are conducting trials, demonstrations plots and have implemented participatory plant breeding activities with farmer organizations for the last thirty years, but also because they are safe compared to Northern and Eastern regions. The three selected regions are also the main millet and sorghum producing areas in Burkina Faso. Districts and villages were likewise selected based on former breeding activities or the presence of breeding activities, the importance of millet and sorghum in the

livelihoods, presence of seed growers' association, the presence and the dynamism of the different segment of actors and receptivity to agricultural innovations in the villages. Before the survey, the sample size of each segment was pre-determined. At the village level, the respondents were randomly sel ected based their engagement in the crops' value chain segments.

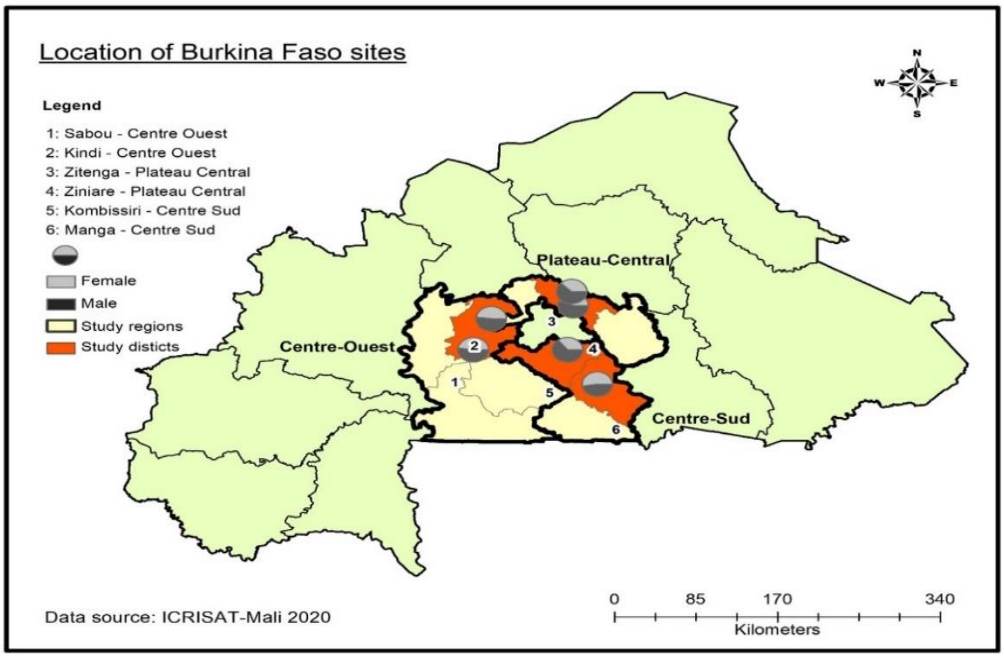

Figure 1

One of the peculiarities of the three regions is the patriarchal social organization and the importance of dry crops (sorghum and millet) in the diet of the populations. In each of the three regions, women and young people have limited access to agricultural land, agricultural equipment and participate less in agricultural training because of the patriarchal structure of agricultural production units, as in many other rural communities in West and Central Africa.

This present study addresses characteristics among diverse user groups along the millet and sorghum value chain which aims to link farmers, traders, processors and consumers' preferences with breeders' selection criteria to ensure adoption along the value-chains of millet and sorghum. The methodology includes an evidence review, consultations with key informants and rural communities, processing diagnoses with experienced processors and consumers in urban and rural areas. Importantly, the methodology incorporates a sampling and conceptual foundation to enable analysis by gender and other factors of social difference, to help identify and prioritize specific user-preference–based traits. It is expected that the results from profiling the value chain actors' preferences according to their gender-differentiated trait- and product-preferences will support breeding programs to improve adoption of new varieties and impact on food and income security in Burkina Faso and beyond. Mix method (qualitative and quantitative) was used to unpack all users' categories in the millet and sorghum value chain preference. This helps us triangulate our research findings from FGDs (qualitative) and

survey (quantitative) data. As such it enhances the accuracy of the results of our findings as supported by (Andrew and Halcomb, 2005).

The study involves millet and sorghum value chain actors consisting of farmers, traders (wholesalers and retailers), processors (small scale and large-scale), and consumers. Millet and sorghum grain traders are considered as individuals or organizations traders (wholesalers/retailers) who buy large quantities of millet and sorghum from different sources to resell either to local or regional markets or engage in smaller volumes of cowpea trade and sell directly to 'pure' consumers. Processors are individual or private firms that process grain into another useable product (mostly we can find women involved in this, they may either produce or purchase millet and sorghum from wholesalers or directly from farmers. Consumers are individuals who buy cowpea from farmers, traders, and processors for direct consumption.

We have two sources of data using questionnaires and interview guides. This was done through face-to-face interview and focus group discussions (FGDs) with all the value chain actors (farmers, processors and traders) during December 2019 to Jun 2020 to complete all data collection and begins the analysis. Multi-stage sampling technique was used to sample the respondents across the study sites with a few differences between value chain actors (farmers, processors, traders).

1.3. Study results

In this analysis, specific traits are identified for farmers, processors and traders. Their options and choices will depend on either they are farmers with the challenges in growing millet and sorghum. Being at the beginning of the value chain, farmers have a kind of responsibility to satisfy the processors and the traders. As a valu chain there appear to be a kind of strong relationship in terms of traits preference between them. In addition, processing apears to be an exclusive women segment.

The situation of the profile of the sorghum and millet desired for production in the different regions surveyed show that there is a slight difference between millet and sorghum in terms of expectations from farmers perspectives. At least in five districts among the six regions, yield, large grain and striga resistance are the 3 must-have straits whereas for millet large grain, sweet taste like local and medium cycle criteria are the prioritized as must have traits from farmers emerging from the focus group discussions. It is therefore important that breeders can take these criteria into account in their selection process in order to produce millet and sorghum varieties that meet the needs and aspirations of farmers and also consumers. Our focus group discussions show also that high profitability, large seed size, hield, resistance to striga, and also the good taste of tô are the criteria that stand out for both millet and sorghum in the six regions. The striga resistance is crucial for many crops such as millet and sorghum. The high yield is explained by the fact that although sorghum is used a lot in households for consumption, it is also sold for cash specifically red sorghum which is used for beer. The analyzes allow us to specify that the size or high yield are common desired. It is therefore important for breeders to take these common criteria into account in the process of releasing new varieties in these dryland regions of Burkina Faso.

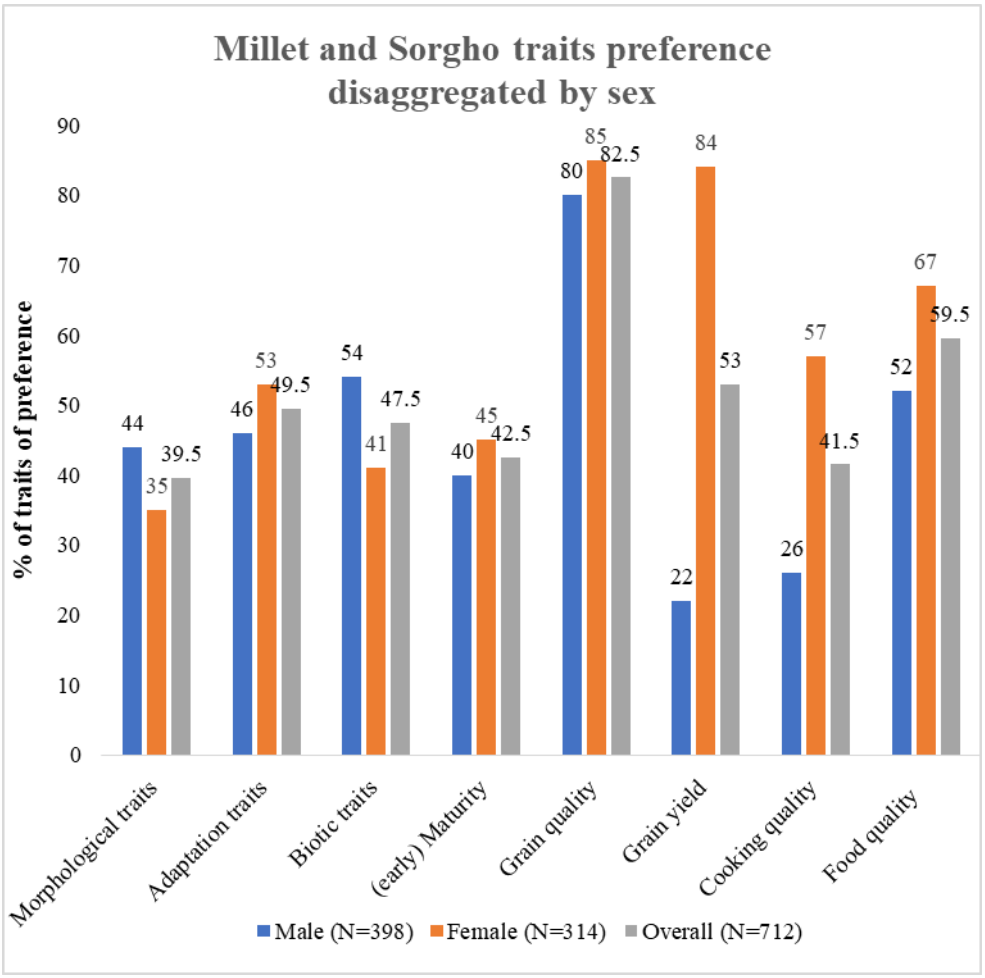

Figure 2

There are some similarities in terms of proportion of people both males and females with regard to the morphology, the capacity to adapt to the environment, the biotic and early maturity and the grain quality seems to have almost the same weight between men and women. the situation of the profile of the sorghum and millet desired for production in the different regions surveyed There is a slight difference between millet and sorghum in terms of expectations from farmers perspectives. At least in five localities among the six regions, yield, large grain and striga resistance are the 3 must-have straits whereas for millet large grain, sweet taste like local and medium cycle criteria are the prioritized as must have traits from farmers emerging from the focus group discussions. It is therefore important that breeders can take these criteria into account in their selection process in order to produce millet and sorghum varieties that meet the needs and aspirations of farmers and also consumers. Our focus group discussions show also that high profitability, large seed size, hield, resistance to striga, and also the good taste of tô are the criteria that stand out for both millet and sorghum in the six regions. The striga resistance is crucial for many crops such as millet and sorghum. The high yield is explained by the fact that although sorghum is used a lot in households for consumption, it is also sold for cash specifically red sorghum which is used for beer. The analyzes allow us to specify that the size or high yield are common desired. It is therefore important for breeders to take these common criteria into account in the process of releasing new varieties in these dryland regions of Burkina Faso.

Out of all two hundred and fifty-eight (258) traders surveyed in the 33 markets of Ouagadougou, two hundred and forty-one (241) sell millet, a proportion of 93.4%. Only 6.6% don't sell it. As for the sale of sorghum, there are two hundred and twenty (220) traders who sell it, a percentage of 85.3% while 14.7% do not. We can easily see that the number of traders who sell millet is greater than that of sorghum sellers. This can be explained by the fact that millet is much more demanded on the market by customers for various processing needs such as porridge, couscous etc., whereas Sorghum is a bit more produced for consumption and therefore less sold on the market compared to millet in Ouagadougou. It is important to add that families in town use maze for to instead of sorghum which is the commonly use in rural areas for the same dish. They argue that they usually sell what is desired by customers until they cannot afford to get then they sell what is available knowing that customers would buy if they themselves do not have any choice. The following statement confirms this view "the millet from *djibasso* is the best, until this millet is gone customers will buy the remaining, but so far, it is this millet the best…if you guys can have this typical variety, we will be happy …and our client"

According to their desired traits of millet and sorghum for processing it is important to note that the color, as well as the size of the grain are the most commonly mentioned traits. The color goes with the process product. For instance, very, dark millet flour and related products are not desired by customers in general, light -dark. For sorghum, dark red is desired by those making the beer whereas light red is more preferred by those making porridge. For the to with processors, it is mostly the white and or red color. As can be seen, color plays a key role in the traits' preferences for traders who consider customers/consumers' choices. Most of the traits are from the two aspects the color and the hardness of the grain. During the traders-processors workshop in May 2020, one trader considers that "my customers most of the time will taste before buying, those who are experienced can just identify the best one by the look and the touched. We have seen all, but mainly the color is the first attractive criteria laugh …"

Processors are very much concerned with color, hardness and floury traits. Better understanding of the real aspirations of consumers allows processors to make a choice and to realize that the characteristics of a product go beyond the processing ability to include the consumers' experiences, including packaging and presentation in-store etc. must be considered. We are focusing here on the intrinsic quality of the grain that is desired.

It is very important to note that the grain and food quality that processors choose as their must have trait refer to the color and the hardness. Out of all of these 189, those that process millet number 150 and only 39 are not in the process of processing this. And of the 150 millet processors, the majority, including 93 processors, wish to have black millet for processing. Regarding the other colors of millet, we have 32 processors for the color white, 21 processors for the color red and only 4 processors for the color yellow. The high number of processors for black millet can be explained by the appearance of the finished product after processing the raw product. In other words, the processing of black millet results in a finished product of black color which attracts a lot of customers and is greatly appreciated by consumers.

It appears that out of all 189 processors surveyed, only 43 processors process sorghum and most of which 146 do not process sorghum. Of the 43 sorghum processors, the majority of them or 40 processors wish to have red sorghum for processing. The red color of the sorghum desired for processing can be explained by the fact that

this variety of millet gives a red and attractive color "dolo" (sorghum beer ", also that the red sorghum flour would have therapeutic virtues on health. The comparative study of the transformation of the two speculations that are millet and sorghum show that out of all the processors the majority transforms millet and only a minority is interested in processing sorghum. The high workforce which processes millet can be explained by the fact that through millet we can obtain several finished products such as lumps, flour, cakes, couscous, biscuits and many other products, while most of sorghum production is intended for domestic consumption through its transformation into “to” (a local dish made from sorghum flour.

Finally, in order to compare the extent to which self-identity behavioral intentions are predicted on the basis of the profession. As a processor, one choice reflects those from the clients. this may contrast or not with the processor own choice. As a value chain segment, the challenges are enormous. As can be seen, either it is a farmer, a trader or a processor their choices have something to do with their profession. Traders want their product to be sold on the market. Choices are therefore directly affected only by this external professional influence despite their gender-related status. In fact, either it is a mal or a female processor, what drives their choices is their customers preferences not their status as a woman or a man. In this analysis, specific traits are identified for farmers, processors and traders. Their options and choices will depend on either they are farmers with the challenges in growing millet and sorghum. Being at the beginning of the value chain, farmers have a kind of responsibility to satisfy the processors and the traders. As a value chain there appear to be a kind of strong relationship in terms of traits preference between them. In addition, processing appears to be an exclusive women segment. The gender-related issues on the preferred traits regarding millet and sorghum can be understood throughout the value chain. At the farm level, the key societal leading role of women leaves room to understand their choices. Millet and sorghum are staple crops grown on the family farm more often. Most of the appreciation of women regarding these crops is more related to their position within the household. In addition, the traders link is more dominated by men. This present study does not show a high significant gender-related differences. Finally, the processing segment is mainly dominated by women. This is because processing remains largely semi-manual and therefore women find their traditional role as food makers. Based on the different traits’ preferences among the value set of actors, a summary of what one can consider as a must have trait that met all segments need for millet and sorghum is shown in the following graphs.

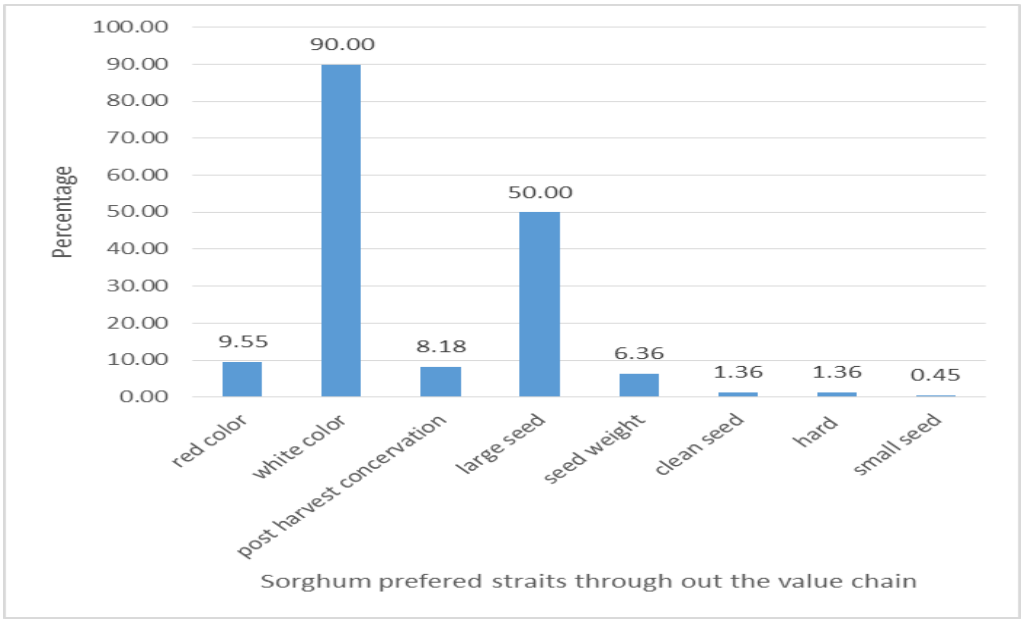

Figure 3: traits preference for sorghum and millet value chain actors.

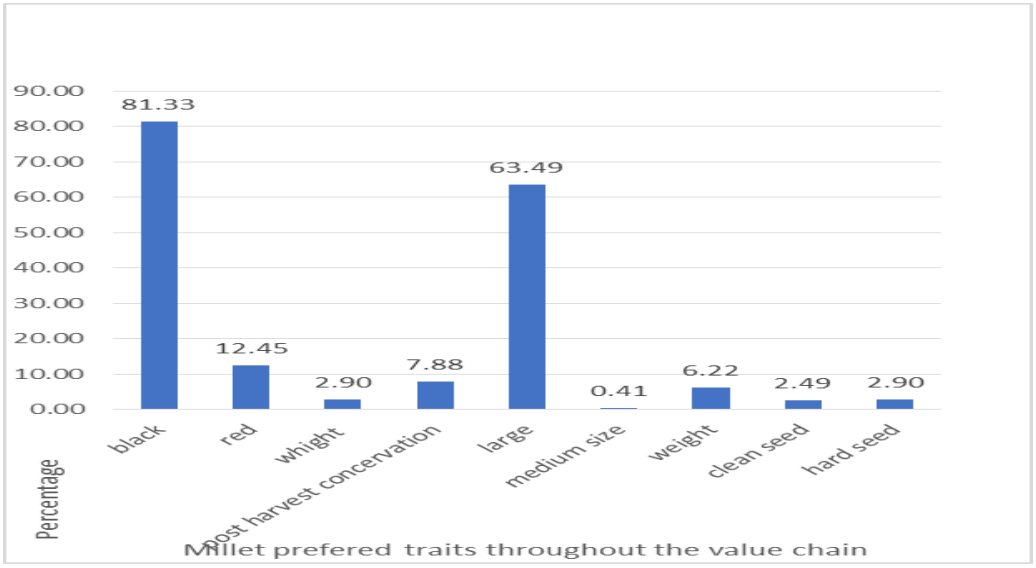

Figure 4: traits preference for sorghum and millet value chain actors.

2. Discussion and conclusion

In the millet-sorghum value chain, several criteria are involved in the choice of varieties for the different value chain links that do not involve gender-related differences. Thus, our study focused on the value chain and varietal criteria desired in the process of participatory selection. Our results show that a set of physical and taste characteristics are desired by the various actors. Based on production statistics, it appears that sorghum occupies the first place in terms of cereal production far ahead of millet, yet through our study it appears that in terms of marketing, millet is better sold than sorghum. As for the color of the seeds, it is obvious that this is a very important criteria for all actors in the value chain, but it would be wise to be careful about this. Because when it

comes to the color because what one considers as black can be dark or light black etc. Further analysis is needed to specify such characteristic. In addition, for the desired sorghum, if producers and traders are unanimous on the white color, this is not the case for processors who favor red sorghum for processing beer. They claim that red-colored sorghum is more suitable for making the sorghum beer which is much appreciated by consumers. The choice of preferred traits is linked to the customers need for final product. We can then say that the choice of varieties according to the color and size of the seeds are relevant with what is desired from the customers/consumers. Because the trader, by purchasing the product with the producer, has preference requirements, which are indirectly dictated to him by the processors and the consumers who will buy the product. These processors have an obligation, if they want to sell their finished product, to consider the preferences of their customers and or consumers. Certainly, consumers have not been mentioned in this study, but we can estimate that they constitute the main actor who influences all the other players in their varietal preferences. Also, in rural areas where sorghum and millet are staple crops, white sorghum is preferred for family consumption more often, red sorghum is grown for selling purpose more generally.

It is believed that a value chain is no more and no less that a close partnership between different links in the supply chain, in order to respond to requests from consumers and create value and profits. The beginning of the chain consists of identifying the needs and desires of consumers. The end, she in the setting appropriate product market. This is a key aspect that the value chain approach brings about in terms of the need that takes into account what is desired and what are the specific characteristics of these needs at every stage of the value chain. It is important to unpack the farm level, processing level and trade level. The key to success, however, remains a close link between these value chain level components. There is an importance given to identifying the various actors 'needs and meet them in order to achieve this, every link of a chain clearly express their needs in terms of millet and sorghum varietal choice.

How the social construction defines the gender role that shape the traits preferences. How this preference be articulated in the case of the stapple crops such as millet and sorghum. While this process is often intentional, different value chain actors in the learning and sharing process may be marginalized or left out of trait targeting dialogues due to the social construction, cultural context or the breeding methodologies used. Conducted in Burkina Faso between December 2019 to June 2020, we were able to understand men and women's varietal preferences of sorghum and millet and have examined how considering the trait preferences of the diverse actors may influence the adoption of the breeding products, welfare, and nutritional outcomes of the users. Given the kind of crops (millet and sorghum) the desired traits are more related to the position on the value chain than to sex-related issues as it stands. The results show that the needs and preferences of the value chain actors should therefore be addressed through engaging with and listening to their perceptive in terms of breeding priorities for varietal trait developments.

As for the color of the seeds, it is obvious that this is a very important criterion for all actors in the value chain, but it would be wise to be careful about this criterion. Because when it comes to the color of the desired sorghum, if producers and traders are unanimous on the white color, this is not the case for processors who favor red sorghum for processing. They claim that red-colored sorghum is more suitable for making dolo sorghum beer which is much appreciated by consumers in addition to a more rising sorghum porridge. When one is

producing in a logic of family consumption, he/she is very much attached to local so call variety, the change of logic (from consumption to selling) can help bring together breeders and the V/C actors so that breeding tackle specific issues while giving sense to production not only for consumption but also for market-oriented trends. Another implication is related to the fact that women in the rural areas usually mix family challenges with their personal challenges. Usually, both are linked. Either it is cooking time or post-harvest storage etc.

3. Author Contributions

"Conceptualization, Eveline M.F.W Sawadogo/Compaoré. Jummai Yila and Nofou Ouédraogo; methodology, Eveline M.F.W Sawadogo/Compaoré.; software, X.X.; validation, Eveline M.F.W Sawadogo/Compaoré. Jummai Yila and Nofou Ouédraogo; formal analysis, Eveline M.F.W Sawadogo/Compaoré; resources, Smill and ICRISAT; data curation, Eveline M.F.W Sawadogo/Compaoré and Jummai Yila; writing—original draft preparation, Eveline M.F.W Sawadogo/Compaoré.; writing—review and editing, Jummai Yila. All authors have read and agreed to the published version of the manuscript."

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