



Gender-Responsive Cereal Breeding: The Case of Cereal Cooperatives in Morocco

Dina Najjar¹, Wuletaw Tadesse Degu², Filippo Bassi³,
Andrea Visioni⁴, and Miguel Sanchez-Garcia⁵

¹ Gender Scientist, Social, Economics and Policy Research Group, International Center for Agricultural Research in the Dry Areas (ICARDA), Rabat, Morocco

² Principal Scientist – Spring Bread Wheat Breeder, International Center for Agricultural Research in the Dry Areas (ICARDA), Rabat, Morocco

³ Senior Scientist – Durum Wheat Breeder, International Center for Agricultural Research in the Dry Areas (ICARDA), Rabat, Morocco

⁴ Associate Scientist – Barley Breeding, Phenotyping, International Center for Agricultural Research in the Dry Areas (ICARDA), Rabat, Morocco

⁵ Scientist – Barley Breeder, International Center for Agricultural Research in the Dry Areas (ICARDA), Rabat, Morocco



This research was carried out by ICARDA and conducted as part of the CGIAR Research Program on Wheat and the CGIAR Generating Evidence and New Directions for Equitable Results (GENDER) Platform.

Working Papers

Working Papers are one of ICARDA's global public goods; they capture and share knowledge and learning from projects and research partnerships. Each paper is internally reviewed as part of the Center's publishing process.

Suggested citation

Najjar, D., W.T. Degu, F. Bassi, A. Visioni, and M. Sanchez-Garcia. 2021. *Gender-Responsive Cereal Breeding: The Case of Cereal Cooperatives in Morocco*. Working Paper 2021-1. Beirut, Lebanon: International Center for Agricultural Research in the Dry Areas (ICARDA).

Corresponding author: Dina Najjar (d.najjar@cgiar.org)

About ICARDA

Established in 1977, the International Center for Agricultural Research in the Dry Areas (ICARDA) is a non-profit, CGIAR Research Center that focusses on delivering innovative solutions for sustainable agricultural development in the non-tropical dry areas of the developing world.

We provide innovative, science-based solutions to improve the livelihoods and resilience of resource-poor smallholder farmers. We do this through strategic partnerships, linking research to development, and capacity development, and by taking into account gender equality and the role of youth in transforming the non-tropical dry areas.

Address

Dalia Building, Second Floor, Bashir El Kasser St, Verdun, Beirut, Lebanon 1108-2010.
www.icarda.org

Disclaimer



The views expressed are those of the authors, and not necessarily those of ICARDA. Where trade names are used, it does not necessarily imply endorsement of, or discrimination against, any product by the Center. Maps are used to illustrate research results, not to show political or administrative boundaries. ICARDA encourages fair use, sharing and distribution of this information for non-commercial purposes with proper attribution and citation.

This document is licensed for use under the Creative Commons Attribution 3.0 Unported Licence.

To view this licence, visit <http://creativecommons.org/licenses/by-nc-sa/3.0/>

Unless otherwise noted, you are free to copy, duplicate, or reproduce and distribute, display, or transmit any part of this publication or portions thereof without permission, and to make translations, adaptations, or other derivative works under the following conditions:



ATTRIBUTION. The work must be attributed, but not in any way that suggests endorsement by the publisher or the author(s).



CGIAR

A CGIAR Research Center

cgiar.org

Contents

Executive Summary	1
1. Problem Statement and Significance	1
2. Objectives and Methods	2
3. Possible Beneficiaries of the Research	3
4. The Evolution of Gender Mainstreaming in ICARDA's Cereal Breeding Program	3
Bread Wheat	3
Durum Wheat	4
Barley	5
5. Traits of Seed and Flour of Wheat Bread, Durum Wheat, and Barley	7
Seed Traits	8
Flour Traits	12
Traits for Dishes	15
6. Concluding Remarks	15
References	16

EXECUTIVE SUMMARY

Cereals remain largely marginalized from the debate on gender-responsive breeding. This project aims to provide a timely contribution to the understanding of consumer and processing traits in wheat, with a focus on cereal-based cooperatives in Morocco. We employ qualitative action research that builds on existing wheat research for development projects, and attends to the questions of which traits men and women prefer in processing and consuming wheat; the underlying reasons; what engagement processes are effective; and the policy implications. We anticipate that the results of this research will be useful for a number of audiences, including men and especially women in local communities; CGIAR Research Program on Wheat breeders; and the CGIAR Generating Evidence and New Directions for Equitable Results (GENDER) Platform.

1. PROBLEM STATEMENT AND SIGNIFICANCE

The need to understand gender-specific trait preferences in crop varieties has been frequently reiterated as a gap in applied and theoretical assessment literature (CGIAR Gender and Breeding Initiative, n.d.; Khan, Kishore, and Joshi 2016; McGuire and Sperling 2016; Galie 2013). Available crop varieties are generally those that reflect men's needs and preferences (Galie 2013). In the past few years, efforts have been made in CGIAR to understand gender-specific trait preferences. Their main contribution has been to prove that women and men in the same household have overlapping and different needs for the same crop. These efforts are commendable (Diaz and Najjar 2019; Polar et al. 2021; Puskur et al. 2021; McDougall et al., forthcoming); however, they have been largely focused on root, tuber and banana crops (CGIAR Gender and Breeding Initiative, n.d.). Wheat remains largely marginalized from the debate on gender-responsive breeding, which has gained increased importance, most notably with the recently funded CGIAR Generating Evidence and New Directions for Equitable Results (GENDER)

Platform that has in its mandate working closely with the Excellence in Breeding Platform to develop so-called "G+ Product Profiles" (Ashby and Polar 2021). This project aims to provide a timely contribution to the understanding of gender-specific traits in cereal crops by focusing on processing and consumer trait preferences with a focus on cereal-based cooperatives Morocco, particularly wheat. These considerations will enable breeding programs to become more gender-responsive and improve adoption and relevance of improved cereal varieties.

These considerations are important as agriculture plays a major role in the Moroccan economy, and especially wheat, which is the single most dominant crop in the country. A total of 3.2 million hectares is dedicated to growing it; 7 million tonnes of wheat were produced in 2013 (Al-Monitor 2014). Employment in agriculture in Morocco has grown dramatically in the past 30 years and so has the contribution made to the sector by female agricultural labor. According to FAO (2011), Morocco witnessed a sharp increase in female employment in agriculture from 29 percent in 1980 to 38.9 percent in 1995 and 47.7 percent in 2010, while men's contribution to agriculture has decreased from 66 to 55 percent between 1995 and 2011 (Abdelali-Martini 2011). Given the increased role of women in agriculture in Morocco and the centrality of wheat to both agriculture and the local diet, it is clear that women should be centrally implicated in wheat breeding programs, quality testing, and ultimately decision-making around varietal release.

The research available on gender and traits in cereals, particularly in West Asia and North Africa, is focused on the production phase (see for example Galie 2013; Bishaw et al. 2019). Attention to traits at the processing level is largely based on commercial qualities. However, wheat by-products are expensive in Morocco and much of those are prepared with preferred qualities that are not detected in a lab context. Findings from a project in Sudan supported by the CGIAR Research Program on Wheat (CRP Wheat) reveal that involving women in quality testing from their own perspective not only reveals which variety is better suited to common wheat by products, but also contributes to wider uptake of locally produced wheat varieties, reducing the importation bill of wheat flour (Najjar, Abdalla, and Alma 2016). Along the same lines, closing the gap in importation is equally important for Morocco as a net

importer of wheat (GAIN 2016; Bishaw et al. 2019). Furthermore, most of the research conducted on gender and traits is focused on female heads of households (see for example Bishaw et al. 2019; McGuire and Sperling 2016) despite growing concerns with the unitary household model that assumes that heads of households are the sole decision-makers in their households (Chiappori et al. 1993; Razavi 2009; Doss and Kieran 2014; Doss and Quisumbing 2019). This approach leads to misleading policy recommendations and to leaving out women in male-headed households, who constitute the largest proportion of women in rural areas (Doss and Kieran 2014; Puskur et al. 2021).

This study builds on gender research conducted under CRP Wheat Flagship 1.3, Enhancing Gender and Social Inclusiveness, in Morocco, Sudan, and Ethiopia. Findings from Morocco reveal that although men have more power in households, decisions on wheat production and varietal adoption, including seed selection, are made by women – either alone or jointly with their spouses. Similar findings are reported in wheat production in Sudan and Nigeria (Najjar, Abdalla, and Alma 2016; Najjar, Abubakar, and Alma 2016). In Sudan, breeders reported that baking quality of wheat, which is assessed by women, often determines the receptiveness of households to adopting new wheat varieties. As such, involving women in the trait selection improves relevance and thus success of adoption by women and men in rural households. Based on work conducted in wheat research for development in Nigeria, Sudan, and Ethiopia, this project employs successful approaches to involve women in trait selection that includes women themselves hosting demonstration plots; the involvement of women chaperons in the participatory selection process; and testing of improved varieties in cereal by-products by women using their own criteria. In this working paper we focus on processing and consumption traits from women-based cereal cooperatives. The project proposed here builds on an already existing effort funded by the Crop Trust under the title Dissemination of Interspecific ICARDA Varieties and Elites through Participatory Research (DIIVA-PR), which conducts on-farm participatory variety selection with 35 farming communities around Morocco. The integration of an extra effort to provide a more gender-balanced perspective will ensure an overall higher impact of the project and a larger chance for adoption of CRP Wheat varieties.

2. OBJECTIVES AND METHODS

We take a relational approach to gender and attend to the following research questions:

1. What gender-responsive approaches facilitate the engagement of men and especially women in trait identification of cereal breeding programs?
2. Which traits do cooperative members prefer in the cereal crops? And why?

To understand the gender-specific trait preferences post-production phase, we employed qualitative methodologies. Qualitative methodologies enable us to understand trait preferences where limited research is conducted with more nuance, depth, and rigor.

Finally, based on our findings and analysis we identify how policies in Morocco can better enable women and men to participate equitably in varietal development. These considerations are important to address policy blind spots around women's engagement in these processes.

The project builds on ongoing R4D activities related to cereals in order to build synergies and achieve economy of scale. The CRP Wheat partnership grant with Oxfam in Morocco, which aims at the economic empowerment of women in cooperatives focused on wheat by-products, aims at identifying trait preferences in cereal varieties from the perspective of women in the premises of these cooperatives as well as consumer receptiveness of these varieties.

3. POSSIBLE BENEFICIARIES OF THE RESEARCH

We anticipate that the results of this research will be useful for a number of audiences:

- *Local communities* will benefit through more and improved gender-equitable participation in the selection of varietal preferences of a major crop in Morocco.
- *Research and development agencies*, in particular ICARDA, Morocco's National Institute of Agronomic Research (INRA), and the International Maize and Wheat Improvement Center (CIMMYT), will be able to target their interventions in a way that reduces gender inequality in their breeding programs. The project meshes well with the CRP Wheat Gender Strategy for Flagship 3, Global Partnership to Accelerate Genetic Gain in Farmers' Field, which aims at addressing the needs, preferences, and constraints experienced by male and female wheat farmers with regards to wheat varietal traits at both production and post-harvest stages (Badstue 2015). The CGIAR GENDER Platform will benefit from expanding its gender and breeding work to wheat.
- *Policymakers* will have empirical evidence at their disposal to address one of the most important challenges of rural development – gender inequality in agriculture.

We will start by examining the evolution of gender integration into cereal breeding programs at ICARDA, then move to the specific case study of cereal-based cooperatives.

4. THE EVOLUTION OF GENDER MAINSTREAMING IN ICARDA'S CEREAL BREEDING PROGRAM

Setting breeding objectives in CGIAR programs is defined by a combination of elements, including the interest of national partners, higher global goals such as food security and eradicating poverty, and the willingness of donors to fund specific outputs. At ICARDA, breeders do not deliver varieties but rather semi-finished elite lines. These are provided to national partners for further evaluation and selection, and ultimately the partners make decisions on which ones, if any, are worth releasing as varieties for commercial production. While this process takes more time, since it is not the originator of the line that makes the decision on what to release, it helps in selecting varieties well adapted to location-specific conditions, starting from a single centralized breeding program.

Bread Wheat

“We breed for the market,” explained a bread wheat project leader pre-gender integration into a multi-country project that aimed at achieving self-sufficiency in wheat production and reducing importation, most exemplified in the project slogan “Africa feeding Africa”. “At the end of the day farmers want what gets them into the market,” an agronomist in the project leadership also remarked. Midway, the project aimed at mainstreaming gender – with at least 30 percent of beneficiaries being women, a requirement stipulated by the donor. By looking at women and men inside the household, the customer segment eventually moved from the “market” to members inside the household (Najjar, Abdalla, and Alma 2016; Najjar, Abubakar, and Alma 2016).

Who bakes the bread?

Gender integration attended to the overall objectives of the project and became important for achieving the breeding objective of widespread adoption of improved varieties. As a breeder in Sudan working with ICARDA

material explained during the gender mainstreaming initiation workshop back in 2015, “we have seen time and time again that if the variety is not appropriate or convincing for women, who are responsible for the consumption of wheat in households, the varieties do not get adopted. If the variety is not suitable for home consumption, it does not get adopted; even if we release it thinking it has good yield.” If the first customer does not accept the variety, then the variety does not reach the market. Women are the gatekeepers for adoption in context where household consumption and market shares concern the same varieties. As another breeder nicely puts it, “who bakes the bread?” – meaning that women need to be involved in trait identification of a bread wheat variety.

In the same project, the involvement of women was also important in improving the consumption of local wheat varieties inside their households and more generally in their communities. Earlier, women preferred buying imported wheat from the supermarket, which they explained was “bleached”, whiter in color, and of superior baking quality. More recently, through the EiB Product Profile submissions breeders depended on women’s preferences to identify quality traits which are reiterated in many locations as desirable, for example color and elasticity. It is common understanding that these considerations are important as they will affect the adoption potential of the customer segment, which comprises men and women in smallholder households that simultaneously grow, consume, and sell surplus of the same variety of wheat. This makes a case for introducing customer segment as a replacement for the devoid-of-people concept of market segment.

The project also created job opportunities on station through ‘roughing’ tasks, namely the removal of off types which is done for seeds production. Although the purpose was not to keep women stuck in menial and low paying tasks, the seed production program for the improved wheat varieties in the project did create a niche for their employment.

Durum Wheat

Durum wheat is both a cash crop used for the industry to produce certain food products, and also a major staple crop in many parts of West Asia and North Africa for producing a vast array of traditional Mediterranean dishes.

As such, the ICARDA durum program aligns its breeding objectives with several culinary qualities necessary for different food types and scale of production (i.e. household vs. industrial plants, most notably cooperatives producing burghul in West Asia and couscous in North Africa) are the most common way for women to generate income from cereal production. This approach to rural employment has gained more traction in recent years, as explained by an ICARDA durum breeder:

“The best support we can receive as breeders to integrate gender responsive considerations when setting up our objectives remains the identification of difference in preference for certain traits between genders and age groups. This way I can quickly identify any possible bias in my attempt to deliver impactful varieties. Even more important would be the identification of traits that we are not targeting at all, and that are instead of great interest by rural women. However, to achieve reduction in rural poverty we need to look past breeding, to find ways to integrate women and youth in the steps that go from a variety release, to its adoption (certification of seed multipliers), production (farmers rights), and ultimately conversion into food (female cooperatives) to generate rural income.”

This approach exemplifies the need to break the stakeholders along the value chain into the different groups: farmers, processors, and consumers (who are also farmers). Working with gender researchers (as noted by the same breeder) has contributed to “a more objective way” for integrating gender along the breeding cycle and for the different customer profiles. Recent discussions in Lebanon have shown for instance that red colored durum grains fetch a higher price on the market because they are deemed to be of superior quality for making burghul. This trait is instead seen as negative by the food industry, which prefers yellow colored grains for pasta making. Hence, re-evaluating breeding objectives using socio-economic considerations was critical to ensure that red grained varieties reached consumers (see Alary, Yigezu, and Bassi 2020). A similar example is ongoing in Morocco, where two women’s cooperatives were involved in the evaluation of the grains of different varieties for the production of several food types. Male farmers who had grown these varieties in their fields had already made their selection of their preferred ones. However, now that women’s cooperatives have declared their interest

in purchasing seeds of some varieties at higher prices (compared to the standard market price), the farmers are changing their opinions to align with the women's preferences. Improving the linkages of these very short value chains (from local farmers' harvest to food made by rural cooperatives) is fostering higher incomes and more fair distribution of profits in rural areas. Coupling this with development programs raising awareness on minimum pay and social protection is expected to deliver positive changes not just in income but also in social inclusion. Three upcoming projects will contribute to this goal: MountainHER, MEDWEALTH, and the CGIAR Market Intelligence and Product Profiling Initiative (MIPPI). As such, a "gender-responsive" variety is not only a potential opportunity to produce more food, ensuring its availability to more people, but also a strategic approach to reduce poverty and foster gender inclusion in rural areas.

Barley

ICARDA is the lead CGIAR center responsible for the Global Barley Breeding Program. Barley is grown on over 15 million hectares in the developing world, and generally by subsistence farmers living in the harshest conditions. Barley is an intrinsically multi-purpose crop that is used for food, feed, malting, and forage, and in countries like Ethiopia its straw is important for roof thatching. Having several end uses increases the number of traits to select for and their relative importance in the variety adoption decision process. For decades, the barley program has engaged in farmer participatory approaches in collaboration with national agricultural research systems (NARS) to better understand the relevance of each trait during variety selection.

The participatory breeding approach developed in past years by ICARDA, in particular Dr Salvatore Ceccarelli, under the barley program, has highlighted different needs across genders in the same areas, countries, and/or regions (Ceccarelli et al. 2001). It has also showed that combining these different traits of interest into a single Product Profile is not an easy task, but it is possible. This approach was also introduced in universities. As ICARDA's barley breeders are young they have been exposed to this approach in their doctoral training.

On the job, breeders were also given the opportunity, through CRPs' implementations of their gender strategies, to attend gender integration into breeding workshops, such as the Gender and Agriculture Workshop run by the Dryland

Cereals CRP in Nairobi in 2017. Most recently, the Product Profile submission exercise by the Excellence in Breeding Platform further solidified gender integration. Taken together, these developments over the years have resulted in "gradual awareness of the issues related to breeding and gender," as one barley breeder nicely put it. Gender and breeding research or integration at the center was deemed a social justice issue: "it is basic to make sure that we take into account the needs and expectations of all the people and NOT only men.... I would like to think that I always tried to have the needs of both men and women when weighing the traits of a genotype during selection. However, with time and interaction with the gender research colleagues I have realized that this is not just an addition to breeding but a must if we want to have impact and improve the livelihoods of everybody and not only some."

Gender and breeding research is also deemed important by breeders in the center for achieving increased relevance and thus adoption: "it helps adding the proper weight to traits that otherwise would be defocused or neglected and this would directly impact in the adoption rates of the technology we develop and the potential impact we can achieve to the people in need." Interestingly, breeders also noticed the limited capacity of gender research in national centers which comprise largely of biophysical scientists. "Additionally, [gender and breeding research] helps the NARS breeders to receive technology with gender-relevant traits that due to the general lack of gender research in the NARS would not be aimed or selected," explained the same barley breeder.

Some of the traits defining a specific Product Profile (like disease resistance, which affects grain yield and grain quality) are beneficial for all genders, albeit in different ways (for example, grain yield may be the main interest of a male farmer while quality may be the main interest of his wife and of a women's cooperative).

A barley breeder felt that nutritional quality is mostly relevant to women, most notably for the processing cooperatives in West Asia and North Africa, referred to earlier as they can get higher prices for the higher nutritional quality of their products. While disease resistance and yield are well established in most breeding programs along with farmers preferences, nutritional qualities need more work. Nutritional qualities like beta glucan content in barley (a medicinal fiber for alleviating chronic diseases, such as cardiovascular diseases and diabetes) or its generally higher content in zinc and iron as compared to other cereals, are

neither marketable traits nor well known to farmers or consumers. These nutritional traits are intrinsically gender relevant in countries like Morocco and Ethiopia, where barley is a staple crop, yet around 20–30 percent of the population, especially pregnant women and people between 5 and 19 years old, are underweight (Ministry of Finance and UNICEF Ethiopia 2019). Micronutrient deficiency in Ethiopia, particularly of zinc, is still a problem among children and pregnant women and their access to supplements is limited (Kothari et al. 2019), indicating a gender benefit of this trait irrespective of the market value itself. This trait has an added-value aspect that would increase marketability and farmers' revenues if serious work was to be done by development organizations and governments to realize its potential. ICARDA has just started working on promoting the trait among women's cooperative in Morocco and providing labels for improving marketing. Another goal is to increasing producers' and consumers' awareness of the beneficial effects of beta glucan, zinc, and iron.

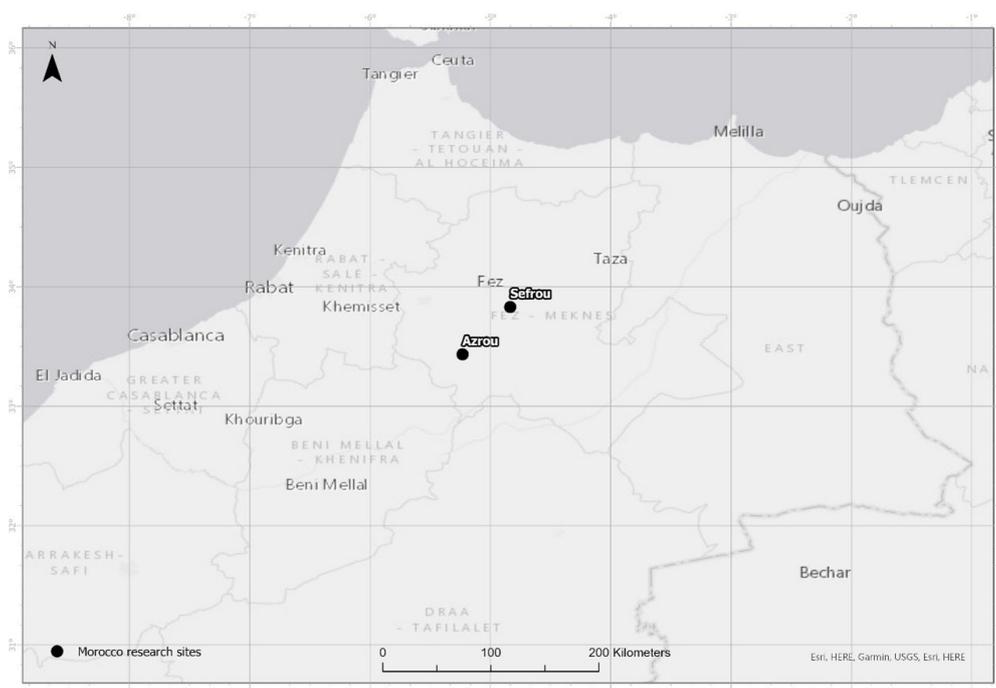
The breeding program at ICARDA has also promoted malting barley in Ethiopia, which had a big impact on income for farmers but unclear impacts on gender equity or benefiting and addressing gender inequalities. The naked barley trait, on the other hand, which also happens to have a higher content of beta glucan (2–3 times higher than other barley varieties) for a released variety in Morocco

called 'Chifaa' (meaning cure), has the potential to reduce women's drudgery, especially in non-mechanized contexts, as they are responsible for threshing. These considerations for lack of hull are especially important in barley as hulls are notoriously difficult to remove from barley grain, a process which can also lead to loss of parts of the grain (up to 20 percent of the grain content can be lost in threshing). Most notably, in Morocco, women cooperatives' cracked barley product *belboula* was not properly dehulled; this reduces the product's attractiveness to customers.

The barley breeder felt that although naked barley is potentially a success story for bigger social impacts, drudgery reduction, and improved nutrition and marketability of barley products, this depends on whether they would be able to succeed in improving its adoption. 'Chifaa' was released in 2016, although it is not yet widely available in markets. We also suspect that the gatekeepers as to whether or not the variety can be adopted are men in male-headed households, as drudgery reduction does not affect them directly. This can be overcome by improving the market for this variety using its higher content of beta glucan.

We now move to examining the trait preferences of cereal cooperative members in Azrou and Sefrou regions (Figure 1) processing respective by-products and consumer preferences.

Figure 1 Research sites of Azrou and Sefrou cereal cooperatives in Morocco



Source: ICARDA GIS Unit, 2021.

5. TRAITS OF SEED AND FLOUR OF WHEAT BREAD, DURUM WHEAT, AND BARLEY

We employed interviews with members and workers in 15 cereal cooperatives in the regions of Azrou (9) and Sefrou (6). The distribution of the participants is as shown in Table 1.

The roles of women and men in these cooperatives are addressed in another paper currently under review. For the most part, men participated in management roles while women did the actual processing of cereals into several by-products (see Figures 2 and 3).

Figure 2 Couscous made with barley



Table 1 Distribution of interviews by cooperative, type of respondent, and gender

Location/village	Members		Workers		Total	
	Male	Female	Male	Female		
Azrou (9 cooperatives)	Ossergen	3		3	1	7
	Al Ettihad		2	1	4	7
	Al Ansaf		2		2	4
	Ayurindu		2		2	4
	Izizel cooperative		2		1	3
	Al MustaqBel	1	1			2
	Teghzafin		2			2
	Al Amal		2		2	4
	Ahmar Nkhan		2		3	5
Sefrou (6 cooperatives)	Al Matbakh Al Aseel		2	1	1	4
	Ein Sebou cooperative		2		4	6
	Ein Al Siage	1	1		1	3
	Judeh		1		1	2
	Ecologia		2		1	3
	Amios Netmagaren cooperative		2		2	4
Total	5	25	5	25	60	

Figure 3 Couscous made with durum wheat



Cooperative members were asked about their preferences for seed and flour for each of wheat bread, durum wheat, and barley. The premise is that characteristics at the seed stage differ from flour characteristics. We found limited gender differences in these preferences. However, the answers of women were more likely to be elaborated and nuanced, as they were involved directly in the processing of these crops and men were largely involved in management of cooperative funds and marketing. Along the same lines, in some cooperatives female members had limited involvement in the processing of products and relied

on hired labor, which challenges the very definition of cooperatives. These governance issues are discussed in another paper.

Seed Traits

Traits of wheat bread seed

Traits mentioned were related to color, shape, and bran-to-flour ratio (see Table 2). Three colors were mentioned (white, golden/yellow, and red/brown), with golden/yellow being the most preferred by 36 percent of the total women. The underlying reason provided are due to a perception that golden/yellow reflects the maturity and good quality of the seed. The male participants, who were not too many, only talked about the red/brown color.

Among the different morphologies were round, bold, thin, elongated, short, and medium. A bold grain is the most preferred characteristic cited by men and women (40 percent and 44 percent respectively). The underlying reasons provided related to the perception that bulky seeds grow faster and adapt better to climate change. Higher productivity and more flour were given as additional reasons for this preference. Those who preferred fine grains explained that they wanted to avoid the high bran content found in bold grains. Even if thin grains indicated lower production than bold grains, this group believed that these grains have more flour. In addition to shape and color, the cleanliness of the seeds is one of the most cited traits for women (34 percent) and 20 percent of men. The origin of the seeds (preferably local), whether seeds were treated or not, and the year of production were of less interest.

Table 2 Preferences for wheat bread seed

	Male		Female		Total answers for each trait
	N	Percent	N	Percent	
Golden/yellow color			18	36%	18
White color			6	12%	6
Red/brown color	2	20%	3	6%	5
Thick/bold grain	4	40%	22	44%	26
Thin grain/fine flour			6	12%	6
Medium size grain			5	10%	5
Round grain			3	6%	3
Elongated grain	2	20%	2	4%	4
Short grain			2	4%	2
Clean of insects, dirt, small stones, and other weeds	2	20%	17	34%	19
Distinguished taste			2	4%	2
High quality/quality in seed type	1	10%	5	10%	6
Local grain			2	4%	2
The production of this year, not last year	1	10%			1
Treated			1	2%	1
Does not give semolina			3	6%	3
More bran			1	2%	1
Less bran			2	4%	2
More flour ratio	1	10%	2	4%	3
The cooperative does not buy any products but rather sells seed	2	20%			2
Do not use this type in the cooperative			4	8%	4
No clear answer, general information			2	4%	2
He/she does not work in this task	1	10%	3	6%	4
Total respondents		10		50	60

Traits of durum wheat seed

As for durum wheat, the reported preferences shown in Table 3 do not vary much from those of bread wheat. Men did not report any color-related characteristics, while 36 percent of women preferred golden/yellow grain, 9 percent white grain and 12 percent red/brown grain. In terms of shape characteristics, participants preferred bold grains (56 percent of women and 40 percent of men). Fewer spoke of elongated grains. Similar to bread wheat, for durum wheat the cleanliness of the

seed from insects, dirt, and small stones was important for 34 percent of women and 20 percent of men. The same preferences were given to the origin of the grain (preference to local), whether it was treated, and the year of production.

The underlying reasons for these choices were the same for bread: those who preferred bold-grained cereals did so because they believed these seeds give more production; those who preferred elongated or thin cereals did so because they wanted a low bran rate.

Table 3 Preferences for durum wheat seed

	Male		Female		Total answers for each trait
	N	Percent	N	Percent	
Golden/yellow color			18	36%	18
White color			9	18%	9
Red/brown color			6	12%	6
Thick/bold grain	4	40%	28	56%	32
Elongated grain	3	30%	7	14%	10
Thin grain/fine flour	1	10%	4	8%	5
Medium grain			1	2%	1
Clean of insects, dirt, small stones, and other weeds	2	20%	17	34%	19
Distinguished taste	1	10%	1	2%	2
High quality/quality in seed type	1	10%	3	6%	4
Local grain			1	2%	1
The production of this year, not last year	1	10%			1
Treated			1	2%	1
More farina ratio			2	4%	2
More semolina ratio	1	10%			1
More bran			1	2%	1
Less bran			2	4%	2
Greater productivity			1	2%	1
The cooperative does not buy any products but rather sells seed	2	20%			2
Do not use this type in the cooperative			3	6%	3
No clear answer, general information			2	4%	2
He/she does not work in this task	1	10%	3	6%	4
Total respondents	10		50		60

Traits of barley seed

For barley seed the same most cited traits were listed as for bread wheat as well as for durum wheat, but we notice differences in preferences. More women and men preferred elongated grain and white grain (almost as many as those who prefer golden/yellow grain) as illustrated in Table 4. Yellow color (preferred by 24 percent of women and 20 percent of men), bold grains (preferred by 52 percent of women and 40 percent of men) and the cleanliness of the seeds

(preferred by 28 percent of women) are mentioned for barley as for the other cereals mentioned above. However, we note for barley a slightly greater interest in the local variety (local grain) expressed by 12 percent of women.

More bran as a reason for preference of bold grains was reported more for barley. Large grains, similar to wheat, were also reported to give more production and a better quality and can be transformed into several products (for example, couscous and *belboula*).

Table 4 Preferences for barley seed

	Male		Female		Total answers for each trait
	N	Percent	N	Percent	
Golden/yellow color	2	20%	12	24%	14
White color	3	30%	10	20%	13
Black/gray color			5	10%	5
Thick/bold grain	4	40%	26	52%	30
Elongated grain	3	30%	15	30%	18
Thin grain/fine flour	1	10%	5	10%	6
Medium size grain			2	4%	2
Standing grain			1	2%	1
Sharp tip of grain			1	2%	1
Clean of insects, dirt, small stones, and other weeds			14	28%	14
Local grain			6	12%	6
The production of this year, not last year			1	2%	1
Less bran	1	10%	1	2%	2
More bran			1	2%	1
More flour ratio			2	4%	2
More semolina ratio	1	10%	1	2%	2
More <i>belboula</i>			3	6%	3
Greater productivity	1	10%	3	6%	4
High quality/quality in seed type			2	4%	2
Used in couscous as we use it in Al Dashisha			2	4%	2
The cooperative does not buy any products but rather sells seed	2	20%			2
Do not use this type in the cooperative			2	4%	2
No clear answer, general information			2	4%	2
He/she does not work in this task	1	10%	2	4%	3
Total respondents	10		50		60

Flour Traits

Traits of wheat bread flour

As shown in Table 5, women's preferences for wheat bread flour in terms of color are mainly oriented toward two colors, white (28 percent) and golden/yellow (26 percent). With regard to the texture of the flour, opinions were divided between 20 percent of women preferring it to be smooth and another 20 percent preferring it to be rough. As for its composition, women preferred it with less bran

(18 percent). Just 8 percent of women referred to the importance of grinding level for having desired texture. These choices are sometimes the result of their own experiences or knowledge transferred to them through their families.

The choice of the color is the same as the choice of the grain: white and golden/yellow. While the texture varies between rough and smooth, the same justification applies: good quality and results in good products. Perhaps these preferences are for different products.

Table 5 Preferences for wheat bread flour

	Male		Female		Total answers for each trait
	N	Percent	N	Percent	
White color			14	28%	14
Golden/yellow color	1	10%	13	26%	14
Red/brown color	1	10%	3	6%	4
Black/gray color			1	2%	1
Smooth	1	10%	10	20%	11
Rough			10	20%	10
Dry			2	4%	2
Less bran			9	18%	9
Medium ground			1	2%	1
Well ground			1	2%	1
The mill plays an important role in the characteristics of the flour			2	4%	2
Without a smell			1	2%	1
Good smell			2	4%	2
Distinguished taste	1	10%	2	4%	3
High quality/quality in seed type			2	4%	2
Whole flour contains bran and semolina			2	4%	2
Medium grain			1	2%	1
Soft grain			1	2%	1
The cooperative does not buy any products but rather sells seed/production of cereals only	6	60%			6
Do not use this type in the cooperative			3	6%	3
No clear answer, general information	1	10%	4	8%	5
He/she does not work in this task	1	10%	3	6%	4
Total respondents		10		50	60

Traits of durum wheat flour

Table 6 shows that for durum wheat flour, the same features were mentioned as for bread wheat. While 28 percent of women preferred golden/yellow durum wheat flour, 22 percent preferred it white. As for the texture,

there were those who preferred smooth flour (20 percent) and those who preferred rough flour (28 percent). Among the most cited preferences was flour with less bran (24 percent of women). Also, as in the case of bread wheat flour, 8 percent of women mentioned the importance of milling to obtain the desired texture of the flour.

Table 6 Preferences for durum wheat flour

	Male		Female		Total answers for each trait
	N	Percent	N	Percent	
White color			11	22%	11
Golden/yellow color			14	28%	14
Red/brown color	1	10%	3	6%	4
Black/gray color			5	10%	5
Smooth	1	10%	10	20%	11
Rough			14	28%	14
Less bran			12	24%	12
More bran			1	2%	1
Dry			1	2%	1
Very well ground			3	6%	3
The mill plays an important role in the characteristics			1	2%	1
Without a smell			1	2%	1
Distinguished taste	1	10%	2	4%	3
High quality/quality in seed type			2	4%	2
Greater productivity			1	2%	1
The bran and flour have complete ingredients			1	2%	1
Medium grain			1	2%	1
Does not stick to the hand when mixed with water			1	2%	1
The cooperative does not buy any products but rather sells seeds/production of cereals only	6	60%			6
Do not use this type in the cooperative			2	4%	2
No clear answer, general information			3	6%	3
He/she does not work in this task	2	20%	4	8%	6
Total respondents		10		50	60

Traits of barley flour

The preferences for barley flour were different, starting with the color: 46 percent of women preferred it to be black/gray and 24 percent white (Table 7). For texture,

12 percent of women opted for rough flour and three times as many (38 percent) for smooth flour.

The dark colors as well as the chosen texture (whether rough or smooth) were justified as leading to good quality and good taste for products.

Table 7 Preferences for barley flour

	Male		Female		Total answers for each trait
	N	Percent	N	Percent	
Black/gray color			23	46%	23
White color	1	10%	12	24%	13
Red/brown color			1	2%	1
Smooth			19	38%	19
Rough			6	12%	6
Distinguished taste	1	10%	5	10%	6
Less bran			3	6%	3
More <i>belboula</i>			3	6%	3
Soft grain			2	4%	2
Very light			2	4%	2
Without a smell			1	2%	1
Clean of insects, dirt, small stones, and other weeds			1	2%	1
Little ground			1	2%	1
The mill plays an important role in the characteristics			1	2%	1
High quality			2	4%	2
The cooperative does not buy any products but rather sells seeds/ production of cereals only	6	60%			6
No clear answer, general information	1	10%	6	12%	7
Do not use this type in the cooperative			2	4%	2
He/she does not work in this task	1	10%			1
Total respondents	10		50		60

Given the contradictory traits presented above, follow-up interviews with four key informants were conducted to understand these contradictions. Some products produced, for example couscous, do not have the same requirements as others, such as *belboula* (Figure 4).

Figure 4 *Belboula* or cracked barley



Personal experience was identified as the second main reason for these contradictions. Each of the women who work in these cooperatives have made the same products using a “grandmother’s recipe”. Women who process these products usually inherit their knowledge from their mothers or grandmothers, which can differ.

Traits for Dishes

We conducted interviews with key informants to understand how the choices of traits are different or similar for the dishes *couscous*, *belboula*, and *zomita* (a mixture of ground chickpeas, barley, and almonds). Our findings reveal additional trait preferences for dishes, such as taste, and different combinations of traits.

Traits for couscous

The interviewed cooperatives all make *couscous* except for the *Ossergen* cooperative.

For bread wheat and durum wheat, they prefer that it is clean without impurity to guarantee the taste, with more semolina, less bran, and well ground. They also spoke about the importance of local variety to guarantee good quality. For barley, it is true that barley *couscous* is not as commercialized and preferred as wheat *couscous*, but in cases where it is produced, they prefer fine grains with a dark color to have a good taste.

Traits for *belboula*

Not too many cooperatives among those interviewed produce *belboula* – only Ein Sebou, Ein Al Siage, and Al Ettihad.

Belboula is made with barley. There are those who prefer smooth flour of black/gray color, and those who prefer rough flour of white color.

Traits for *zomita*

The preferred choice of flour texture is rough flour, and the golden/yellow color is preferred for wheat. For barley, the black/gray color is preferred for *zomita*.

6. CONCLUDING REMARKS

The findings shed light on cereal traits which are not accounted for in respective breeding programs, such as color, bran-to-flour ratio, and seed size. Accounting for these traits creates income generation opportunities for cereal-based cooperatives whereby a trait is not just a trait but has economic significance. Looking at trait preferences at the processing and consumption stage for cereals is an essential first step for involving women in breeding programs, as well as improving their economic potential, while also increasing the extent of equitable benefits from improved cereal varieties.

REFERENCES

- Abdelali-Martini, M. 2011. *Empowering Women in the Rural Labour Force with a Focus on Agricultural Employment in the Middle East and North Africa (MENA)*. Aleppo, Syria: International Center for Agricultural Research in the Dry Areas.
- Al-Monitor. 2014. "Green Morocco Plan Focuses on Sustainable Agriculture". *Al-Monitor*, November.
- Alary, V., A. Y. Yigezu, and F. M. Bassi. 2020. "Participatory Farmers-Weighted Selection (PWS) Indices to Raise Adoption of Durum Cultivars." *Crop Breeding, Genetics and Genomics* 2020;2 (3): e200014.
- Ashby, J. A., and V. Polar. 2021. *User Guide to the G+ Product Profile Query Tool (G+ PP)*. CGIAR Research Program on Roots, Tubers and Bananas, User Guide 2021-2. Lima, Peru: International Potato Center.
- Badstue, L. 2015. *WHEAT CRP Gender Strategy*. El Batán, Mexico: CGIAR Research Program on Wheat. <https://wheat.org/wp-content/uploads/sites/4/2013/08/Updated-WHEAT-Gender-Strategy-2015.pdf>.
- Bishaw, Z., A. Y. Yigezu, A. A. Niane, R. Telleria, and D. Najjar, eds. 2019. *Political Economy of the Moroccan Wheat Sector: Seed Systems, Varietal Adoption, and Impacts*. Beirut, Lebanon: International Center for Agricultural Research in the Dry Areas.
- Ceccarelli, S., S. Grandi, E. Bailey, A. Amri, M. El-Felah, F. Nassif, et al. 2001. "Farmer Participation in Barley Breeding in Syria, Morocco and Tunisia." *Euphytica* 122 (3): 521–536.
- CGIAR Gender and Breeding Initiative. N.d. "Gender and Breeding." CGIAR. Accessed January 2021. <https://gender-portal.rtb.cgiar.org/breeding>.
- Chiappori, P., L. Haddad, J. Hoddinott, and R. Kanbur. 1993. *Unitary versus Collective Models of the Household: Time to Shift the Burden of Proof?* Policy Research Working Paper 1217. Washington, DC, US: The World Bank.
- Diaz, I., and D. Najjar. 2019. "Gender and Agricultural Extension: Why a Gender Focus Matters?" *Journal of Gender, Agriculture and Food Security* 4 (2): 1–10.
- Doss, C., and C. Kieran. 2014. *Standards for Collecting Sex-Disaggregated Data for Gender Analysis: A Guide for CGIAR Researchers*. CGIAR Gender and Agriculture Research Network.
- Doss, C. R., and A. R. Quisumbing. 2019. "Understanding Rural Household Behavior: Beyond Boserup and Becker." *Agricultural Economics* 51 (1): 47–58.
- FAO (Food and Agriculture Organization of the United Nations). 2011. *The State of Food and Agriculture. Women in Agriculture: Closing the Gender Gap for Development*. Rome, Italy.
- GAIN (Global Agricultural Information Network). 2016. *Morocco Grain and Feed Annual: 2016 Annual Report*. GAIN Report Number MO1602. Washington, DC, US.
- Galie, A. 2013. "The Empowerment of Women Farmers in the Context of Participatory Plant Breeding in Syria: Towards Equitable Development for Food Security." PhD dissertation, Wageningen University, Netherlands.
- Khan, T., A. Kishore, and P. K. Joshi. 2016. *Gender Dimensions on Farmers' Preferences for Direct-Seeded Rice with Drum Seeder in India*. Discussion Paper. Washington, DC, US: International Food Policy Research Institute.

- Kothari, M. T., A. Coile, A. Huestis, T. Pullum, D. Garrett, and C. Engmann. 2019. "Exploring Associations between Water, Sanitation, and Anemia through 47 Nationally Representative Demographic and Health Surveys." *Annals of the New York Academy of Sciences* 1450 (1): 249.
- McDougall, C., L. Badstue, A. Mulema, G. Fischer, D. Najjar, R. Pyburn, M. Elias, D. Joshi, and A. Vos. Forthcoming. *Beyond Gender and Development: How Gender Transformative Approaches in Agriculture and Natural Resource Management Can Advance Equality*. CGIAR GENDER Platform.
- McGuire, S., and L. Sperling. 2016. "Seed Systems Smallholder Farmers Use." *Food Security* 8 (1): 179–195.
- Ministry of Finance and UNICEF (United Nations Children's Fund) Ethiopia. 2019. *National Situation Analysis of Children and Women in Ethiopia 2019*. Addis Abeba, Ethiopia. Accessed November 10, 2019. <https://unicef.org/ethiopia/reports/national-situation-analysis-children-and-women-ethiopia>.
- Najjar, D., I. Abdalla, and E. Alma. 2016. *Gender Roles in the Wheat Production of Sudan: Strengthening the Participation of Women*. ICARDA Report. Amman, Jordan: International Center for Agricultural Research in the Dry Areas.
- Najjar, D., F. Abubakar, and E. Alma. 2016. *Gender Roles and Relations in the Wheat Production of Nigeria: Strengthening the Participation of Women*. ICARDA Report. Amman, Jordan: International Center for Agricultural Research in the Dry Areas.
- Polar, V., R. R. Mohan, C. McDougall, B. Teeken, A. A. Mulema, P. Marimo, and J. O. Yila. 2021. "Examining Choice to Advance Gender Equality in Breeding Research." In *Advancing Gender Equality Through Agricultural and Environmental Research: Past, Present and Future*, edited by R. Pyburn and A. van Eerdewijk, Chapter 2. Washington, DC, US: International Food Policy Research Institute.
- Puskur, R., N. Netsayi, E. Nchanji, D. Najjar, E. Njuguna-Mungai, A. Galie, and R. Vernoooy. 2021. "Gender Equality and Seed Systems Development: Nurturing a Mutually Beneficial Relationship." In *Advancing Gender Equality Through Agricultural and Environmental Research: Past, Present and Future*, edited by R. Pyburn and A. van Eerdewijk, Chapter 2. Washington, DC, US: International Food Policy Research Institute.
- Razavi, S. 2009. "Engendering the Political Economy of Agrarian Change." *The Journal of Peasant Studies* 36 (1): 197–226.



Established in 1977, the International Center for Agricultural Research in the Dry Areas (ICARDA) is a non-profit, CGIAR Research Center that focusses on delivering innovative solutions for sustainable agricultural development in the non-tropical dry areas of the developing world. We provide innovative, science-based solutions to improve the livelihoods and resilience of resource-poor smallholder farmers. We do this through strategic partnerships, linking research to development, and capacity development, and by taking into account gender equality and the role of youth in transforming the non-tropical dry areas.
www.icarda.org



CGIAR is a global research partnership for a food-secure future. CGIAR science is dedicated to reducing poverty, enhancing food and nutrition security, and improving natural resources and ecosystem services. Its research is carried out by 15 CGIAR centers in close collaboration with hundreds of partners, including national and regional research institutes, civil society organizations, academia, development organizations and the private sector.
www.cgiar.org