

GENDERED KNOWLEDGE OF DURUM WHEAT PROCESSING AND GENETIC TREATS IN RAINFED AGRICULTURE OF MOROCCO**Abdelali Laamari¹ and Hajar El-Fatouaki²**¹Agricultural Economics, Dryland Research Center, INRA Morocco²PhD Candidate on Economics, Faculty of Economics and Management, University Ibn Tofail Kenitra¹ Abdelali.laamari@inra.ma and ² hajarelfatouaki74@gmail.com**ABSTRACT**

In Morocco, durum wheat is an important ingredient in the structure of the consumption of cereals. It contributes enormously to the protein and calorie intake of people across the country. However, consumption of durum wheat is more substantial in rural than urban areas. If the production of durum wheat was conventionally associated with couscous, semolina and pasta in a rural Moroccan use of durum wheat in bread is a common practice. For rural populations, bread made from durum wheat is a fundamental component of daily diet. Given the relation production/consumption in rural areas, the quality treat is becoming important in research, especially breeding programs. Women have certainly developed knowledge and perspectives on quality and differentiated use of different varieties. Therefore, research on the quality of durum wheat varieties have everything to gain and learn to pay attention to views of women producers and traders on the varieties, their criteria of preferences, and desired traits in varieties. In this perspective, research conducted on; (i) women and durum wheat grain processing as an alternative for improving the value added of this crop, and (ii) understand the perceptions of farmers (men and women) of new varieties of durum wheat. Determine quality traits sought by farmers (men and women) in durum wheat varieties. Results showed that 100% of end processed products of durum wheat grain are made by women. The value added of processed grain is very high and contribute to improve farm income and women development in wheat areas of rainfed zones. Variety selection and preferred treats are gender specific. To optimize the use of improved durum wheat varieties, it's important to consider both man and women preferences in developing varieties.

Keywords: Drum, Genetic, Treats, Processing, Varieties.

INTRODUCTION

Nearly 68% of Morocco's arable land is considered arid and semi-arid areas. Livestock and cereal crops are the main components of the farming systems in these areas. More than 22% of total area cropped to cereals is allocated to durum wheat. However, its contribution to national grain production is only about 27%. Most of the farming systems studies in these areas have attributed the poor performances of cereal crops (low yield and poor grain quality) to the low adoption rate of new improved technologies by farmers (eg. Fertilizer use, improved variety, machinery, etc..). Since 1982, more than 35 new varieties characterized by high productivity and large adaptations were released. On the average, each year INRA ⁽¹⁾ release more than three varieties of durum wheat. Farmers are still using old, improved varieties such as Karim and Marzak. The national grain yield of durum wheat is irregular and reflects environmental effects and the low impact of research efforts.

The introduction of new varieties at the farm level is still low and it does not follow research progress. Farmers are still using old varieties, or varieties released since 1982. One reason for this problem is seed availability for specific varieties. The *Société Nationale de Commercialisation des Semences* (SONACOS), parastatal, is in charge of certified seed production, distribution and marketing. SONACOS does not produce seed itself seeds. Certified Seed production it concludes under agreements with agricultural state companies and private farmers. The office on health security ONSSA is responsible of the control of certified seed quality. Only tested varieties that satisfy quality criteria are accepted and registered in the Official Catalog. Moroccan government has established different

¹INRA : Institut National de la Recherche Agronomique/National Institute for Agricultural research

regulations for seed sector in the perspective to allow private and state seed companies to operate and contribute to the production and commercialization of seeds.

Modern varieties are the easy technology that can farmer afford and use. INRA has the responsibility since its creation to create varieties and provide seed companies with new genetic materials when it's accepted by ONSSA. So, INRA has developed different breeding programs that target cereals, food legumes, forage crops, oils seeds, sugar beet and vegetables. Certified seed use is still low and efforts of the Ministry of Agriculture to increase its rate of use are clear through BOUDOUR Program. Access to seeds of improved varieties in general and certified seeds of those varieties are often cited among the major determinants of successful adoption among farmers (Zewdie and al, 2018). However, the adoption of modern varieties is still low and not reflecting the efforts of the Breeding National Program of Morocco. So the objective of the study is to explore gendered farmer's opinion about improved varieties and preferred durum wheat treats.

METHODOLOGY

The target rural communes selected for the study are located in three agro-ecological zones. The three agro-ecological zones are distinguished by the amount of rainfall and soil characteristics.

Settat: rainfall in the region is highly erratic with an annual rainfall around 370 mm. The region was classified by the Ministry of Agriculture as part of the intermediary rainfed regions of Morocco. As a semi-arid region, Settat is considered as a low rainfall area. Bread wheat, durum wheat and barley represent more than 26, 37 and 34% of total cereal area in 2019-2020 growing season. Based on soil characteristics and rainfall conditions two major sub-regions could be distinguished; *low Chaouia* and *high Chaouia*. The first one is more favorable to mixed farming systems. However, in *high Chaouia* livestock is predominating. *Oulad Saïd*; the study area; is in the low *Chaouia* and considered as a less favorable rainfed area (LFRA) with high soil quality.

The sampling framework was developed in collaboration with DPAs⁽²⁾ in the selected province. The criterion that was used to select farmers is cereal and food legume production. List of farmers were prepared in the different regions in collaboration with the *Service de Production Agricole* of DPA. The sample was developed as follows: Farm area producer's identification by name and douar and a two-digit number was assigned to each farmer in the list.

A random sample of 150 farmers was established using two-digit random numbers drawn from a standard statistics book appendix table. Sampling results are reported in table 1.

Table 1: Sample distribution

Provinces	Durum Wheat Producers	Agro-Ecological Zones
Settat	60 [0] (61)	Less Favorable (LFRA)

[...] cases with out-of range variables or inconsistencies between responses

(..) valid cases

RESULTS AND DISCUSSION

3.1 General characteristics

Most of the surveyed farmers are young with an average age around 44 years. The education level is high in comparison with the average situation in Morocco. The illiterate population is about 26% meaning that. More than 74% of the farmers were at school (elementary or koranic). It's important to consider these indicators in developing rural development programs or technology transfer programs.

² Direction Provinciale de Agriculture

International Journal of Applied Engineering & Technology

Table 2 represents the major sources of income in the three regions. In farm agricultural activities are representing more than 69% of the generated income followed by commercial activities with 11%. According to this frequency, farm income is more vulnerable to climate condition in the region.

Table 2: Income sources and activities

Sources	Frequency
In farm activities	69%
Agricultural labor	3%
Trade and marketing	11%
Administration	7%
Income transfer	
Industrial activities	7%
Others	3%

Farmers in Settata are allocating more labor to non-agricultural activities. In general, more labor is allocated to trade and marketing activities. More than 19% of total family labor is allocated to extra-farm agricultural labor. According to table 3, limited number of associations and agricultural professional organizations exists according to the survey. A large number and diversified professional organizations exist and are involved in agricultural activities.

Total used area is about 19 hectares, small and medium farms represent most surveyed farmers (75% of total farms households). Private status is the most frequent status. It's important to notice that rented and shared area is representing more than 50% of total used area. Thus, the sample is little bit representative of the land distribution among farmers in Morocco.

Table 3: Farm size and land status

	Total used area in ha	Rainfed in ha	Irrigated in ha	Private in ha	Rented in ha	Shared in ha
Settat	19	18	1	10	3	6

No collective land, for crops or range lands, is observed in the study areas. Sharecropping is an important practice to increase crop production by farmers, especially small farmers. Sharecropping arrangement tends to be more specific to food legume crops. The landowner provides the land and inputs are provided by the sharecropper. In general, each one receives 50% of total product.

The cropping system is well diversified. More than 90% of farms cultivate autumn cereal crops in Settata. This distribution will give as an idea about rotations and the importance of fruit trees and olives.

Table 4: Crop distribution in % of area

Site	Cereals	Food legumes	Forages	Vegetables	Trees	Others
Settat	91	5	1	2	0	0

The data in table 5 show that 100% of farms cultivate autumn cereal crops, occupying more than 85% in Settata region. The relative importance of durum wheat, bread wheat and barley is similar in cereal-based production systems in the region. The importance of food legumes is very limited in Settata region.

Table 5: Major cropped cereals and food legumes

Crops	Settat
Bread wheat	95%
Durum wheat	85%
Barley	85%
Lentils	7%

Faba bean	7%
Chickpeas	26%

Cropping decision and land allocation are largely determined by soil quality, household needs, flock size and the expected pattern of rainfall. Generally, in arid regions, marginal lands are devoted to barley. Farmers in the arid areas have specifically adapted their farming practices to rainfall uncertainty (Ellis; 1988). Barley is a drought resistant crop and has a large utilization spectrum. It remains the principal livestock feed, especially in the arid and semi-arid zones. It's a dual-purpose crop. The major rotations are fallow/cereal and mono crops. Crop rotations practices depend on the climatic conditions and farm size. It seems that crop rotations have changed since the extended drought at the beginning of 1992. The trend now is monocropping or cereal/cereal rotation practices by more than 57% of farmers.

3.2 Sales and grain uses.

As reported by farmers, cereals, and food legumes productions (grain and straw) have multiple uses. A large part of bread wheat, durum, faba bean and peas grains are destined to market immediately after harvesting time. For its multiple uses barley grain sales are occasional and the most part of the production is stored or used as animal feed. In general the uses of grains are different from region to another one. As is recorded, the amount of bread wheat sold is high. The same situation is observed for the uses of faba bean, lentils and peas.

According to farmer's opinions, there is a change in farmer's consumption habits due to the introduction of bread wheat. However, for its different forms of consumption durum wheat is more consumed as well as in rural and urban areas (laamari ; 2009). The other uses of cereal grains are, essentially, 'Al Ouchour' ⁽³⁾ and gifts to the farmers' close relations. More than 60% of the production is sold in local market. That means that prices are below the reference price set by the Ministry of Agriculture. But it's important to notice that market is considering price premium for good grain quality. Also, middlemen are contributing with more than 20% of the total grain distributed in Settât.

VARIETIES USED

4.1 Bread wheat

In Settât region, figure 1 presents the most used varieties of bread wheat in the study area. Radia is used by 23% of farmers in Settât. Tissa, Arrehane and Achar are largely used in Settât region. Radia and Achar were registered in 2005 and 1988 and representing, respectively two breeding origins Florimond Desprez France and INRA Morocco. It's important to notice that used varieties are obsolete.

The main source of seed is private and public enterprises such as SONACOS. Most farmers are using seeds produced by neighbors as a source of seeds. According to the survey, the trend is use SONACOS seeds because it's certified and subsidized, but it's not possible to find preferred varieties and most farmers use available varieties.

For Settât province, the 2015-2019 period is considered as the phase for introducing more than one bread wheat variety. Some of these varieties such as Bandera, Rajae, Sereine and Virgile were introduced the first time in the region. This situation reflects that farmers are becoming using at least two to three varieties. The use of other varieties is also important, and we can notice the introduction of Mouna, Faiza and others. So the number of varieties used by farmers has increased but limited to available varieties.

³In the Islamic *chariâa* it's considered as a tax. This tax is equivalent to 10% of total harvested grain and should be distributed at the harvested area.

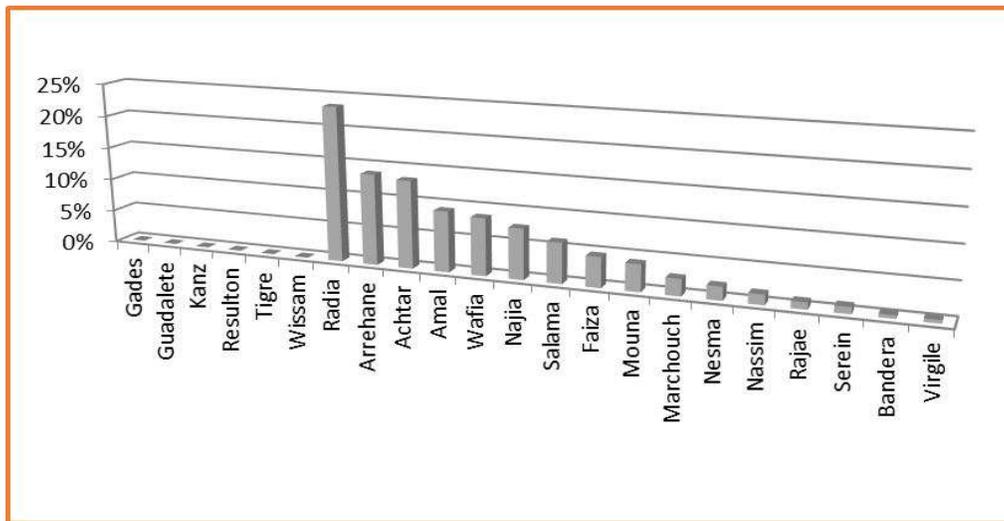


Figure 1: Bread varieties used farmers

In table 6, there is a net evolution of the use of improved varieties by farmers. We have recorded that only 58% of farmers have introduced new varieties before 2000. Among 42 surveyed farmers 41 have used improved varieties during the 2015-2019 period indicating the large adoption of improved varieties without considering the registration date. We have a mixture of old and modern varieties, national and foreign breeding material. The users don't distinguish between the origins of the variety, but they have some references such as Achtar for example. An important output of the survey is the use of common bread wheat varieties. Radia, Arrehane, Achtar, Amal and Radia by farmers in Settât provinces. So farmers have consensus on the preferences of these varieties, particularly Achtar.

Table 6: Introduction of bread wheat varieties in Settât

Varieties	2015-2019	2010-2014	2000-2009	Before 2000
Achtar	15	10	42	38
Amal	17	0	56	28
Arrehane	19	0	63	19
Bandera	100	0	0	0
Faiza	78	0	22	0
Marchouch	40	0	0	60
Mouna	75	0	25	0
Najia	80	0	20	0
Nassim	33	0	67	0
Nesma	50	0	0	50
Radia	43	0	57	0
Rajae	100	0	0	0
Salama	83	0	17	0
Sereine	100	0	0	0
Virgile	100	0	0	0
Wafia	82	0	18	0

To understand the dynamic of the variety portfolio of the farmer in the studied area, it was important to ask about breeding traits preferences. The survey results show that farmers relate variety choice to agronomic traits (tillering capacity, number of spikes per plant and water use efficiency, etc.), grain quality and grain yield. Grain and straw are commercialized for a large part of farmers. For some farmers, bread wheat straw production is important for

animal. So, characteristics of purchased variety should satisfy farmers' needs first. We notice a change in farmer's preferences in comparison to last studies conducted in Chaouia and Abda regions about farmer's opinion on adoption of improved bread wheat varieties where grain and straw yields were the most important (Belaid and al, 2005). In the previous studies, grain yield treat was the most important criteria for used seeds. Now, more than 28% of farmers are looking water and nitrogen efficient use varieties with 48%.

4.2 Durum wheat

Still Karim, Marzak, Carioca and Kanakis are the most used varieties with different proportions. In Settat region, Karim and Carioca are used with equal rate by farmers (less than 25%) followed by Kanakis and Prospero. In general Karim is still appreciated by farmers in the three sites for its quality and grain color and size. For some farmers, the large demand for Karim is justified by the absence of similar variety and the use of formal seed exchange channels. Most of Karim variety comes from neighbors and own production.

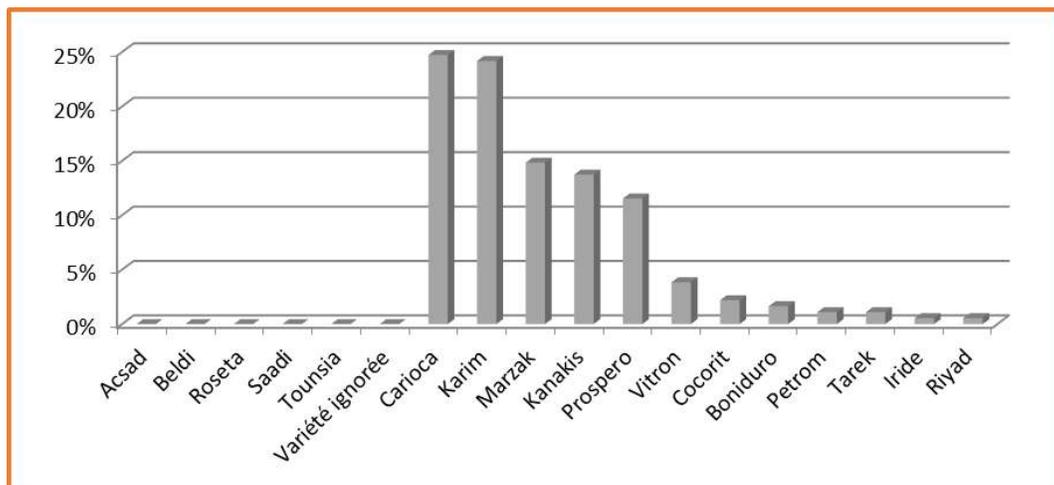


Figure 2: Durum wheat varieties distribution

Major part of farmers is using certified seed provided by seed companies. The use of own production is still an important source, but local providers such neighbors are important. The trend is the use of certified seed but the price and the availability of varieties that satisfy farmer's preferences are the major constraints. Up to the survey, different sources of information about durum wheat varieties are used. The contribution of ONCA⁴ to variety diffusion is about 11%. However, in Settat region farmers and enterprises are the main source of information on varieties. Farmers are the common source of information for all farmers on varieties. These results can be explained by the use of smart phone and WhatsApp for exchanging information and communication between farmers or researchers and ONCA agent.

According to the survey outputs, in average each farmer is using 2 varieties in the Settat region. If we consider farmer's opinions, Carioca and Kanakis are representing 48% of total varieties used in Settat and if we include Karim and Prospero, this amount is high (76%). During 2010 and 2014 Vitron and Boniduro represented 78% of total varieties used. The introduction of foreign genetics varieties is becoming important in Settat region since 2009. However, it's important to notice that farmers are still looking for old improved varieties and looking for diversifying varieties between late and early maturing varieties but also between high quality and high yielding varieties.

⁴ Office National du Conseil Agricole (Extension)

Table 7: Certified durum varieties used.

Varieties	2015-2019	2010-2014	2000-2009	Before 2000
Carioca	26	0	0	0
Kanakis	22	11	40	0
Karim	14	0	0	15
Prospero	14	0	0	0
Marzak	12	0	5	0
Vitron	5	22	28	58
Boniduro	3	56	9	23
<i>Petrom</i>	2	0	0	0
Iride	1	0	14	0
Riyad	1	0	0	0
Cocorit	0	11	2	0
Tarek	0	0	2	4

Survey results show that grain yield breeding treat is an important criterion in choosing durum wheat varieties to be used by farmers in Settat (about 36% farmers). farmers prefer varieties with high quality and Karim is one of them. In general, there are some similarities between farmers when it comes to durum. More than 34% of farmers are looking for high quality durum varieties.

In general researchers are more interested by grain yield which criteria represent a low proportion of farmer's opinion. Farmers are looking for more than one criterion. Grain and straw yields potential, grain yield stability and quality are also important criteria

GENDER AND DURUM WHEAT TREATS PREFERENCES

Durum is an important crop for the rural economies in rainfed regions. For many small-scale farmers, durum is not only the major grown crop, it also constitutes the main staple food commodity. On-farm indigenous processing of durum wheat is a significant activity, especially in arid and semi-arid regions. Further, durum utilization at the farm level relies to a great extent on women's input, especially with respect to on-farm processing of durum products such as couscous, bread, and pasta. However, despite the importance of indigenous durum processing in the region, it has received very little attention from research and policy. At present, little information is available on the extent of indigenous on-farm processing, the systems used, usually relying on women's indigenous technical knowledge, and the marketing of the processed products. Combined to the lack of reliable data, the negligence of these indigenous activities has led to partial and incomplete analysis of the basic functioning of rural households of dryland farming communities. This study is conducted in different phases to provide data on durum processing at the farm level and inform on preferred treats by women.

The first phase concerns the test of four varieties Daoui, Snina, Hammadi and Faraj as new varieties tested in the two platforms Settat and Oued Zem. Probably two other varieties (imported from Europe) will be associated to the local varieties. Women will try to classify these varieties according to baking quality, flour, semolina, and the quality of spikes. A first experimentation was conducted in Chaouia⁵ by Nassif and all (2012) and demonstrated that man and women have different preferences for durum wheat varieties according to their end-uses. These criteria are completely different, men are preferring colour and size of the grain, but women are preferring varieties with high quality for making couscous, bread, and pasta.

⁵Nassif F., Laamari A. et Boujnah M. Importance de la culture du blé dur et évaluation différenciée de dix variétés de blé dur dans la région Chaouia au Maroc. Al Awamia, Nouvelle série. Numéro Double 125-126, pp 57-81. 2012

Reasons for Limited use of Certified seed of Improved Varieties

Farmers variety treats preferences can't be satisfied by current system of seed production and distribution. SONACOS satisfy a limited quantity of certified seed needed by wheat and barley producers. More than 54% of farmers are producing their own barley seed. This percentage is low for durum wheat and bread wheat but very important in comparison with the other sources. Developing high potential varieties of wheat and barley is necessary but not enough to increase cereal production in Morocco if the seed sector doesn't work well.

Seed as a limiting factor to increase improved wheat area was reported by more than 30% of farmers in average. For durum wheat more than 66% of farmers in Settat justify the limited use of certified seed because of the non-availability of varieties needed. But if we consider bread wheat stress and agronomic treats are limiting the use of certified seed of available varieties. It seems that available certified seed of bread wheat are vulnerable to biotic and non biotic stress, and agronomic considerations. It's important to notice that the price of certified seed is high for durum and bread wheat, particularly since 2018.

According to farmers the major constraint to increase improved area is land availability. The farm size was revealed by all surveyed farmers as the main constraint. Also, the use of purchased inputs is increasing quantitatively in cereal production when new variety is adopted. From farmers' point of view, it's another constraint associated to the use of new varieties or the certified seed. Generally, farmers have difficulty to control all these variables but most of them have made important changes in their cereal production. They have reported that new varieties are more responsive to the use of nitrogen than old varieties.

CONCLUSION

For many small-scale farmers of Morocco, wheat is not only the major grown crop, it also constitutes the main staple food commodity. On average, over 60% of durum production are used for home consumption, the rest is used for seed and sold on local markets, especially in years of production surplus. Improve and stabilize dryland wheat production through adoption of more adapted, good quality, and productive modern varieties. Provide a better understanding of prevailing on-farm processing systems and develop new skills and techniques to improve their efficiency to increase the benefits to rural women and lessen their workload. Establish better linkages/integration between biophysical and socioeconomic scientists, on the one hand, and the farming community (including women), on the other hand.

Considering genetic treats, according to women opinion is important for the development of high-quality varieties that can be used in diversifying end uses of durum wheat and offer opportunities for developing income generating activities and help breeders to develop new varieties. Up to now, the data collected on rural communities was an opportunity to understand wheat varieties used and the main characteristics of the production systems in rainfed areas. The National Breeding Program has always tried to develop, in collaboration with ICARDA, varieties adapted to the agroecological conditions of wheat but also which can satisfy the requirements of stakeholders (Aden and al., 2011), in particular flour millers and consumers. However, the level of use of these varieties remains low and the use of certified seeds is below the expectations of the Ministry. The adoption of Moroccan varieties is regressing in favor of the use of varieties imported from Europe. Different questions can be addressed:

1. How to integrate gendered genetic preferences of wheat varieties in the breeding program?
2. How to improve the adoption of improved varieties developed by the national breeding program?
3. How can policy support breeding program and develop policy measures to improve the use of certified seeds of improved varieties?

All these questions can be addressed through target research programs conducted in collaboration with CGIARs and the National Agricultural Research System involving young researchers from universities and key stakeholders.

REFERENCES

- [1] Abderrezak Belaid, Naserlhak Nsarellah, Abdelali Laamari, Miloudi Nachit, Amri Ahmed (2005) : Assessing the economic impact of durum research in Morocco. ICARDA, Aleppo, Syria, v +50 pp.
- [2] Aden Aw-Hassan and Abdelali Laamari (2011). Good research, poor adoption: Promoting new technologies more effectively. Review of agriculture in the dry areas. Caravan Issue 27.
- [3] Elis Frank (1993). Peasant economics: Farm households in agrarian development. Second Edition, Cambridge University Press
- [4] Nassif F., Laamari A. et Boujnah M (2012). Importance de la culture du blé dur et évaluation différenciée de dix variétés de blé dur dans la région Chaouia au Maroc. Al Awamia, Nouvelle sérié. Numéro Double 125-126, pp 57-81. 2012
- [5] Laamari Abdelali (2009). Durum Wheat status in rainfed agriculture : A socioeconomic studies. TRITIMED Project report.
- [6] Zewdie Bishaw, Yigezu Yigezu, Abdoul Aziz Niane, Roberto Telleria, Dina Najjar. (2018). Political Economy of the Wheat Sector in Morocco: Seed Systems, Varietal Adoption, and Impacts. Beirut, Lebanon: International Center for Agricultural Research in the Dry Areas (ICARDA).