

Fertilizer Use Patterns in the Semi-arid, Cereal Producing Region of Chaouia

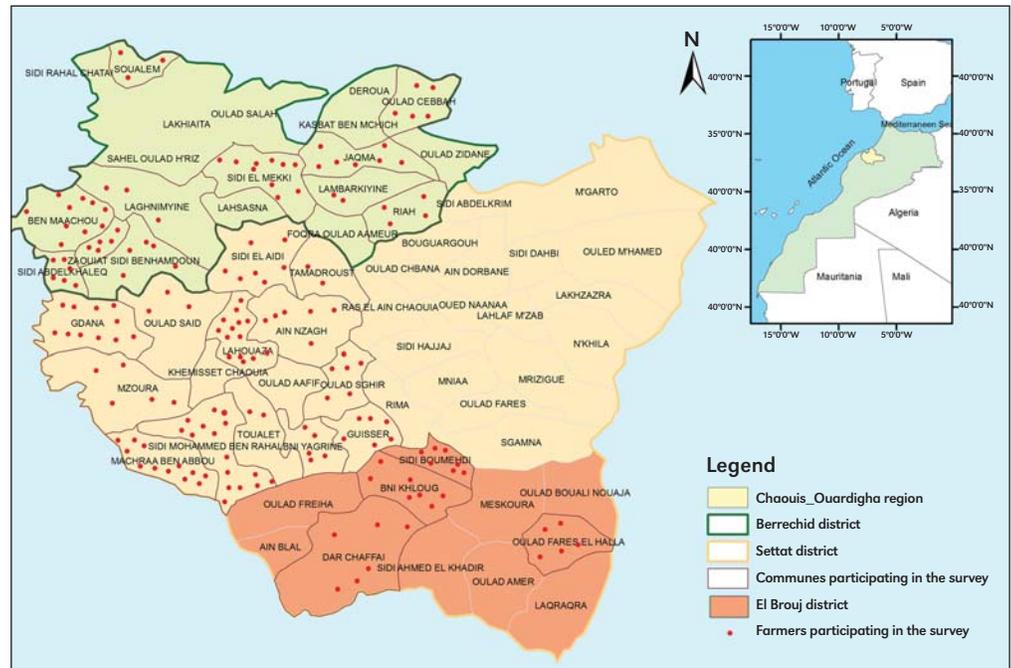
By Zhor Abail, Oumaima Iben Halima, Hakim Boulal, and Mohamed El Gharous

Fertilizer use in Morocco must increase to ensure that soil nutrients are being replenished and to help reverse the current trends of low crop productivity and land degradation. The role of the agricultural extension centers in making fertilization-related advice needs to be improved drastically to help in promoting best management practices.

Morocco is among the Mediterranean countries where agriculture plays an important role. Agriculture contributes about 15% to the gross national product and employs almost half of the active population. The arable land represents 21% of the total area of Morocco. Over 85% of the arable land is located in rainfed areas, where wheat and barley are the primary crops grown. The best management practices adapted to low rainfall area including variety selection, fertilization, and weed and pest management have contributed to mitigate the negative effects of drought.

While soil fertility research conducted in Morocco has played a major role in the improvement of knowledge about the fertility status of Moroccan soils, and has provided a rational basis for fertilizer use in the field, the impact at the farm level is still far from satisfactory in terms of fertilizer application and yield increases. Several on-farm trials conducted in the semi-arid areas of North Africa showed that the use of fertilizers is highly profitable for wheat production (Soltanpour et al., 1987) and significantly improved grain yields (Shroyer et al., 1990; Cossani et al., 2011). This diagnostic study was conducted with the objective of providing an overview of fertilizer use in one of the most important cereal production areas of Morocco.

The study was conducted in the summer of 2013 in Chaouia region, which is located in the central part of Morocco. In general, the soils of Chaouia are characterized by high contents of Ca and calcium carbonates and are rich in clay. The soils have poor physical and structural properties and are low in organic matter. The main cultivated crops are barley and wheat with a cropping system of one crop per year, or two crops in three years. Crop rotations are either continuous cereals or cereals (wheat or barley) in rotation with fallow, food legumes, forage, or spring crops such as chickpea. Wheat–fallow is, however, the dominant cropping system. Most farmers integrate livestock into their cropping system, which becomes quite important as the quality of soils and annual rainfall decrease. Beyond the social and economic considerations, the cropping system is dictated by average annual rainfall, soil quality and water



Locations of the surveyed farmers in Chaouia region at the districts of Berrechid, Settât and El Brouj, Morocco.

storage capacity.

For the survey, a sample of 179 farmers was randomly selected from the districts of Berrechid, Settât and El Brouj. These districts provide a range of crop production potential (Berrechid - high, Settât - intermediate, and El Brouj - low). Berrechid district is characterized by the dominance of wheat, productive soils (vertisols, vertic calcixerolls) and a good annual rainfall between 350 to 400 mm. Settât district is characterized by the dominance of wheat and an average rainfall of about 350 mm. El Brouj district is characterized by the dominance of barley, marginal soils, and an average rainfall of less than 300 mm.

The selection of farmers was done in collaboration with regional extension centers within each district. This sample size was designed in order to achieve a representative sample for the Chaouia region and to represent major farming systems and sizes. Thus, 46 farmers were interviewed in Berrechid, 81 farmers in Settât and 27 farmers in El Brouj.

On average 90% of the agricultural lands that belong to surveyed farmers were rainfed, which generally represents the characteristics of the Chaouia region. The most common farmers are smallholders (land area <10 ha) representing 66% of the total surveyed and with an average land area of 5.6 ha (Table 1). The main cropping pattern is cereals (wheat and/or barley) grown as a monocrop or in rotation. According to the survey, cereals/cereals/food legumes and cereals/fallow rotations are the dominant cropping systems. The historically

Abbreviations and notes: Ca = calcium; DAP = diammonium phosphate.

Table 1. Distribution of surveyed farmers under different farm size at three districts.

Farm size, ha	Berrechid	Settat	El Brouj	Total %
< 10	63	67	67	66
10-20	22	19	20	20
20-50	11	11	10	10
> 50	4	4	4	4

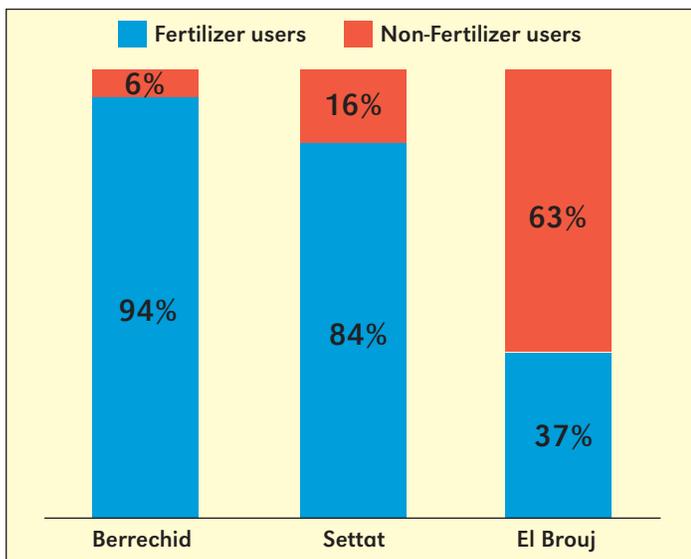


Figure 1. Proportion of fertilizer users and non-users in Berrechid, Settat and El Brouj districts.

important cereals/food legume rotation, which is now only practiced by 6% of surveyed farmers, was reported by farmers to be less popular due to high costs of manual labor required for weeding and harvest operations. Wheat is the predominant crop within Settat and Berrechid, while barley was more dominant in El Brouj.

Fertilizer Use by Farmer Types

Results of the survey showed that 79% of respondents had used fertilizers on at least one crop. There were, however, some variations between districts. A high percentage of fertilizer users (94%) are located in the favorable region (Berrechid), while in the less favorable region (El Brouj), the percentage of fertilizer users was less than 40% (Figure 1). Decreased fertilizer use is often associated with the economic risks of high probability of drought.

The choice of fertilizers and their rate of application by farmers were based on four main factors (i.e., previous experience, advice from dealers, advice of neighbors, and advice from the extension services). About 65% of farmers in Berrechid and El Brouj reported that their management of fertilizers was based on their past experience, while 65% farmers in Settat reported that their neighbors had the most significant influence. The role of agricultural extension centers in fertilizer advice was mentioned by less than 25% of farmers. Despite the fact that soil tests are subsidized by about 50%, only 25% of the respondents reported using soil testing once, and just over 50% of farms used soil testing for the first time during the 2012-13 cropping season. Only 5% of farms reported frequent use of soil testing (i.e., at least once every two years) all of which

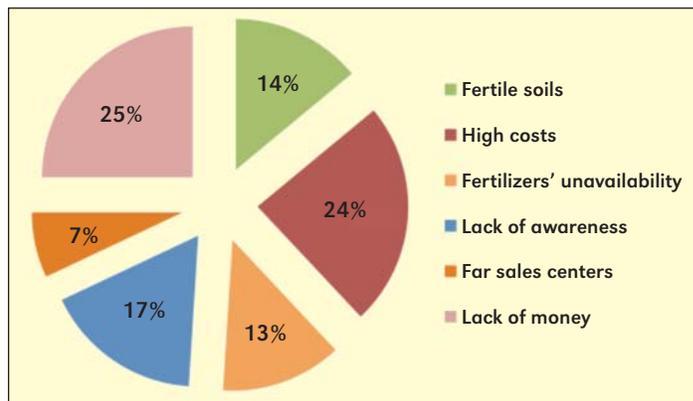


Figure 2. Main constraints expressed by non-fertilizer users (% of farmers) in Chaouia region.

were mainly large farms (> 20 ha).

In the survey, three groups of non-fertilizer users were identified (Figure 2). The first group, which represents 49% of non-users, reported that the high cost of fertilizers and lack of money were their main constraints. The second group, who represented 20% of non-users, revealed limited to no availability of fertilizers and a remoteness from fertilizer sale centers as their main constraints. The third group reported a complete lack of awareness on the use and benefits of fertilizers. Farmers in this second and the third group expressed willingness to use fertilizers based on easy access to a dealer and improved awareness on fertilizer use. High prices of fertilizers, as cited by many farmers, are also a challenge to increasing crop production on smallholder farms.

Fertilizer Use By Crops

The survey found that farmers using fertilizers were confident in receiving a return on their investment. However, about 75% of wheat growers, and only 36% of barley growers, use fertilizers. Only 35% of wheat growers used fertilizers in El Brouj region compared to 86% in Settat, and 100% in El Berrechid (Figure 3). Fertilizer use in barley was comparably low with 23 to 69% of growers across the Chaouia choosing the apply any fertilizer.

In wheat and barley, a high percentage of farmers use N and P fertilizers at planting time, and topdress N at later stages. The most favorable rainfall district of Berrechid receives 50 to 200 kg/ha of fertilizer applied at planting to wheat and barley, with 89% of wheat growers using 100 to 200 kg/ha applied mainly as DAP (Table 2). This decreases to 72% in the Settat region. In El Brouj, only 10% of wheat growers use fertilizer at planting between 50 to 100 kg/ha. DAP is also widely used in wheat at planting time in all three districts. The availability of DAP and its low price in Moroccan market increases its use by wheat growers. In barley, where the proportion of non-fertilizer users is higher, farmers use less than 100 kg/ha of fertilizers.

At topdressing, more than 50% of wheat growers use less than 100 kg/ha of fertilizers (Table 3). A large proportion of farmers (45%) were using higher amounts of fertilizer at topdressing in Berrechid, while in El Brouj only 30% use rates between 50 to 150 kg/ha. Barley growers use lower rates of fertilizer at topdressing, with more than 90% of them using less than 100 kg/ha of fertilizers. For both wheat and barley, ammonium nitrate is the predominant topdress fertilizer followed by urea. In a few situations, ammonium sulfate can also be used.

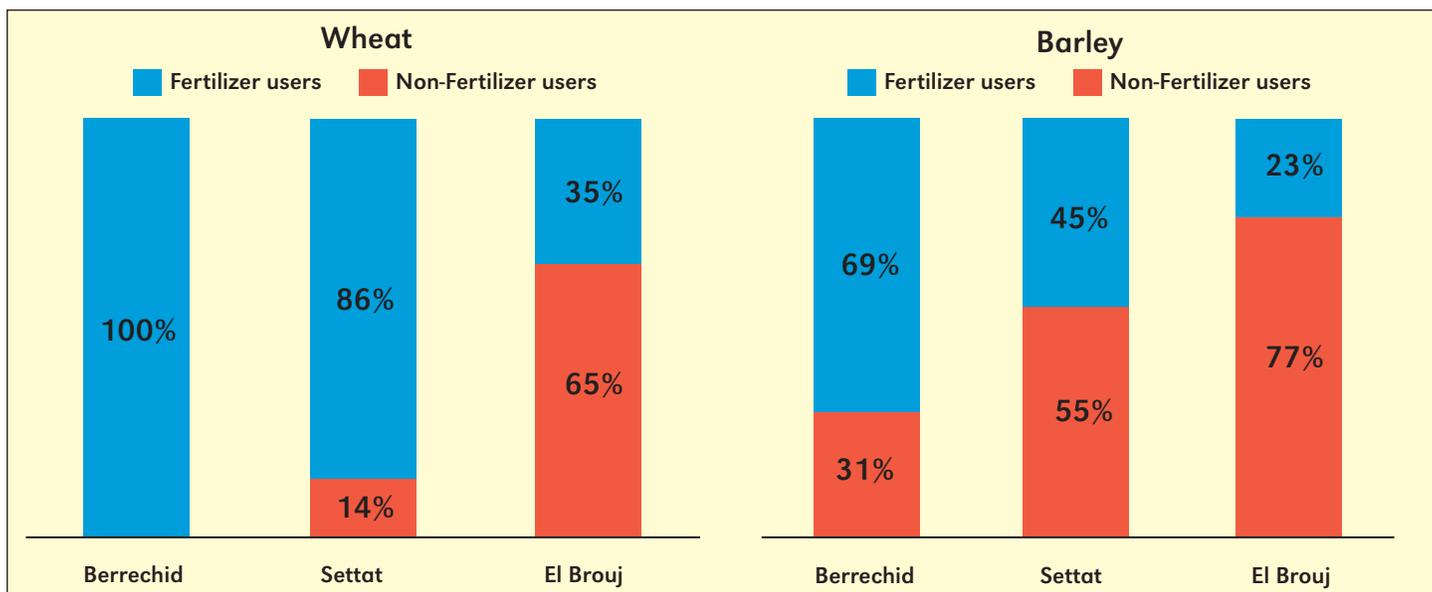


Figure 3. Proportion of fertilizer users and non users among the wheat and barley' growers in Berrechid, Settata and El Brouj districts.

Summary

About 79% of farmers presently use fertilizers in the Chaouia region of Morocco. However, fertilizer use decreases when rainfall decreases or when barley is the main cultivated crop. Even if farmers are willing to use fertilizers to increase crop production, their experience in fertilizer management is largely based on their self-experiences. The role of the agricultural extension centers in making fertilization-related advice needs to be improved drastically to help in promoting fertilizer best management practices in the semi-arid region of Morocco. Also, the overall fertilizer use in Morocco must increase in order to ensure that soil nutrients are being replenished and to help reverse the current trends of low crop productivity and land degradation.

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Table 2. Percentage of fertilizer users based on fertilizer rates and sources used in wheat and barley at planting time in Berrechid, Settata and El Brouj districts.

Rate, kg/ha	Wheat			Barley		
	Berrechid	Settata	El Brouj	Berrechid	Settata	El Brouj
0	9%	20%	89%	40%	60%	95%
50	2%	8%	6%	4%	10%	5%
100	35%	23%	4%	28%	17%	-
150	28%	35%	-	12%	10%	-
200	26%	14%	-	16%	3%	-

Source	Wheat			Barley		
	Berrechid	Settata	El Brouj	Berrechid	Settata	El Brouj
DAP	51%	80%	50%	55%	82%	-
Am. Sulfate	11%	12%	25%	19%	5%	100%
14-28-14	29%	7%	-	26%	5%	-
17-16-12	8%	-	-	-	-	-
Others	1%	1%	25%	-	8	-

Table 3. Percentage of fertilizer users based on fertilizer rates and sources used to topdress wheat and barley in Berrechid, Settata and El Brouj districts.

Rate, kg/ha	Wheat			Barley		
	Berrechid	Settata	El Brouj	Berrechid	Settata	El Brouj
0	20%	31%	70%	43%	78%	83%
50 to 100	35%	43%	17%	50%	18%	17%
100 to 150	37%	24%	13%	7%	4%	-
150 to 200	8%	2%	-	-	-	-

Source	Wheat			Barley		
	Berrechid	Settata	El Brouj	Berrechid	Settata	El Brouj
Am. Nitrate	64%	72%	57%	63%	62%	75%
Am. Sulfate	10%	8%	-	25%	-	-
Urea	26%	20%	43%	12%	38%	25%