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Survey of Some Agronomic Practices of Cereal Production in Arid Region (Biskra-Algeria)

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CEREALS remain the main crop practiced in farms of some rural provinces of Biskra, south-eastern Algeria. The present study aims to analyze agricultural practices in cereal growing and to provide solutions to the constraints encountered. For this purpose, a transversal survey was carried out within 259 farms where irrigated cereals are grown, generally using borehole water, associated to other crops and livestock. Results showed that despite the availability of irrigation water, the production means in this region remain insufficient to promote the improvement of cereal yields. The extension of land in a non-regulatory way in cereal cultivation is an obstacle for farmers to obtain subsidies and bank loans allocated by the State. Also, mechanization is very underdeveloped and farming operations are largely performed manually. In addition, flood irrigation remains is very widely used and seeds used are farm-saved ones, especially in small holdings. The low doses of fertilizers and applied phytosanitary products negatively affect yields. The availability of unskilled salaried and family labor reduces the overall efficiency of technical itineraries. To fight against these constraints, farmers must first be encouraged to regularize the land situation of plots exploited in a non-regulatory manner in order to be able to benefit from State subsidies and bank loans. However, the success of this sector imperatively depends on the respect of the technical itinerary, the introduction of agricultural mechanization and its intensification. This can contribute to strengthening the country's food security in terms of cereals.

Keywords: Agricultural practices, Arid region, Biskra, Cereals, Yields.

Introduction

Cereals hold the first place in the occupation agricultural land, because they serve as staple foods for a large proportion of the world's population, especially in Africa (Harold & Tabo, 2015). They constitute with their derivatives the backbone of the Algerian food system (Kellou, 2008), of which durum wheat is the most consumed cereal (Jouve et al., 1995) with 200 to 219kg/capita/year (Hervieu et al., 2006; Boulal et al., 2007; Chehat, 2007). Wheat is of great importance for food security (Harold & Tabo, 2015). However, cereal production growth remains low relative to population growth (Djermoun, 2018), which resulted in Algeria becaming cereal importer (Moulai, 2008).

In order to meet growing grain needs, it is essential to improve national production by intensifying cereal crops (Mebdoua, 2017). It should be noted that more than half of Algeria's usable agricultural area (UAA) is devoted to field crops, mainly grain farming. Cereal growing is essentially rain-fed in the semi-arid areas of the high Tellian plains, sub-arid areas of the High-Trays, and the humid and sub-humid areas of the coastal and sub-littoral regions (Feliachi, 2000; Chehat, 2006;

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Djermoun, 2009; Rastoin & Benabderrazik, 2014; Bessaoud et al., 2019). Conversely, in the Saharan zones it is irrigated according to a traditional or intensive production system (Feliachi, 2000; Djermoun, 2009). In these regions, the state has invested considerably in equipping large grain farms with pivots under the agricultural land development law of 1983 (Otmane & Kouzmine, 2013).

Despite the efforts made, cereal yields in Algeria remain very low, insufficient and above all very uncertain (Chadouli, 1991; Kellil, 2010), reaching only 7 to 15 quintals per hectare depending on the year (1 quintal is 100kg) (Selmi, 2000; Bessaoud et al., 2019). This is explained by the influence of bad pedoclimatic conditions and by the insufficient mastery of cultivation techniques (Chabi et al., 1992), where much of this production system is subject to the practices of traditional agricultural, unable to overcome the irregularities of the climate (Ait–Slimane-Ait-Kaki, 2008). While the current agricultural policy aims to modernize the strategic sectors in order to increase production, particularly of durum wheat, substitute national production to imports and increase the amounts of exports (Bouzid et al., 2020).

Cereal growing occupies an important place in the region of Biskra (Algeria), it comes in second place after date palm cultivation (Phoenix dactylifera), with a total sown area estimated at 29,464ha (2017/2018 agricultural campaign). Moreover, despite the importance allocated to it, namely the extension of irrigated areas, yields are still lower than expected.

In this context, a survey is needed to assess the means deployed by cereal-producing farms to propose a strategy to fight against the various development constraints of this sector to reach an acceptable yield threshold.

Materials and Methods

As part of this work, a survey was conducted among farms located in potentially cereal-growing areas of the agropastoral region of Biskra located in southeastern Algeria (Fig. 1).

This region is characterized by heterogeneous, poor and shallow soils. Indeed, saline, gypsum and limestone accumulations are present in the south. Alluvial soils and fertile clay soils are found in the east. However, in the north the soils are poorly developed and not very fertile. The northwest plain is characterized by clay-sodium soils. (Khechai, 2001; Sedrati, 2011, Masmoudi, 2012).

These investigations were conducted during the 2017/2018 agricultural season, extending over 12 months: from June 2017 to June 2018.

A stratified random sampling of cereal farmers was used, covering seven sites, namely El Fiedh, Ain Naga, Mlili, Ourlal, Oumeche, El outaya and Doucen. Survey receipe was process on the nominal lists of cereal farmers obtained from the agricultural services directorate of the wilaya of Biskra (DSA, 2018).

The sample size (n= 254 farmers, increased to 259 farmers) was determined by Steven's formula (2012). Considering a prevalence P of 50%, a margin of sampling error d of 5%, the reduced variance Z is 1.96 when the accepted confidence level is 95%.

The total number (N= 750) of cereal farmers registered was obtained from the agricultural services directorate of the wilaya of Biskra in 2017/2018.

$$(n = \frac{N \times P(1-P)}{[N-1 \times (d^2 \div Z^2)] + P(1-P)})$$(Steven, 2012).

The number of producers to be surveyed according to the formula of Steven (2012) per site and that actually surveyed are recorded on the Table 1.

The questionnaire is intended for the head of the farm, who deals with management and above all with decision-making in terms of investment in order to assess the means of cereal production in this region. In particular, production systems, kind of cereals prevailed, irrigation sources, size and legal status of farms, availability of agricultural equipment, Kinds of seed used and use of agricultural inputs and labor employed.

The data collected was processed, coded and entered for descriptive statistical processing using Excel 2007 and IBM SPSS (Social Package for Social Sciences) version 20.

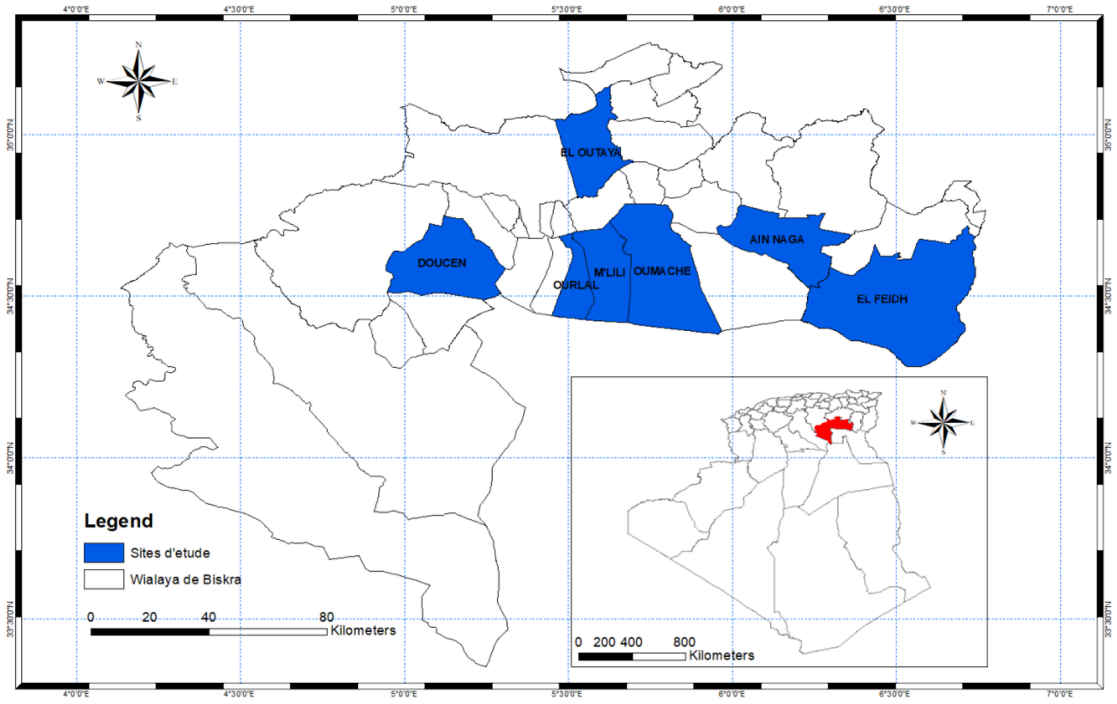

Fig. 1. Location of the study sites

TABLE 1. Distribution of cereal farmers surveyed in the study site

Sites	Total number of grain farmers per site (N)	Number of grain farmers to investigate (n)	Number of grain farmers investigated (n)	Percentage of grain farmers investigated (%)
Ain Naga	72	24	29	11,2
El feidh	366	124	124	47,9
El Outaya	138	47	47	18,1
Ourlal	26	13	13	5,0
Mlili	20	10	10	3,9
Oumeche	48	9	9	3,5
Doucen	80	27	27	10,4
Total	750	254	259	100,0

Results and Discussion

Production system

Although the farms studied are cereal (100%), given the specificity of the areas considered, other crops such as open field market gardening (32.8%) and greenhouse market gardening (24.7%), date palms (33.6%), fruit trees (20.8%) and fodder (7.7%) are practiced in association. The pastoral character has allowed some farms to combine their production system with ovine and caprine livestock (46.3%) (Fig. 2). The results recorded are in agreement with those found by Lazarev (1989), Bencharif et al. (1994), Jouve et al. (1995), Abdelguerfi & Laouar (2000), Djermoun (2009), Benniou et al. (2014), Hattab & Gaouar (2016), the latter attesting that the majority of farmers in the Maghreb regions, especially Algerian cereal farmers, combine agriculture and livestock. According to Otmane & Kouzmine (2013), farmers in the Saharan regions seek agricultural activities complementary to cereal production, such as cash crops, fodder crops and livestock, to overcome the various constraints on Saharan agriculture. The search for profitability is the main motivation for farmers to reorient their production.

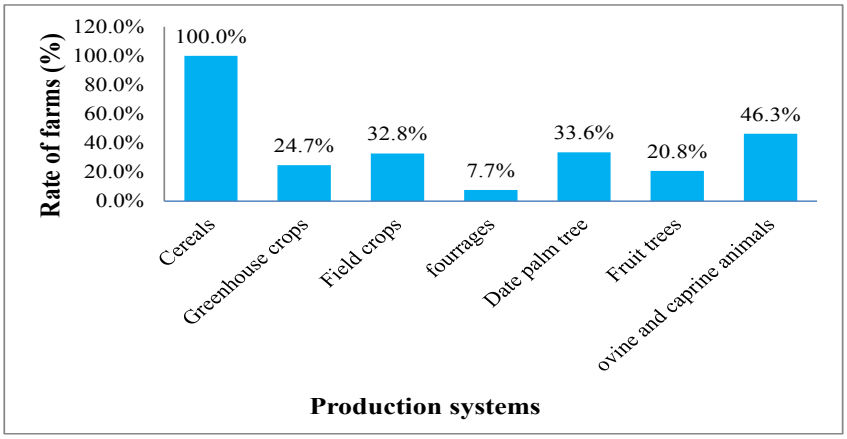

Fig. 2. Production systems practiced by the surveyed farms

kind of cereals prevailed

Figure 3 shows that the surveyed cereal farmers integrate one or more cereals in their crop rotation, durum wheat is the predominant cereal crop with 79.9%, followed by barley with 64.5%, while soft wheat occupies the third place with 41.7 % in relation to the total cereal area cultivated. The results recorded are similar to those found by Boulechfar (2010) and Karkour (2012), these authors attest that the strict cereal system dominated by durum wheat is more present in the high Setifian plainnes (Algeria). Generally durum wheat is the crop most adapted to the agro- climatic conditions of Algeria (Rastoin & Benabderrazik, 2014). It remains the predominant product because of its large consumption by the Algerian population (Jouve et al., 1995).

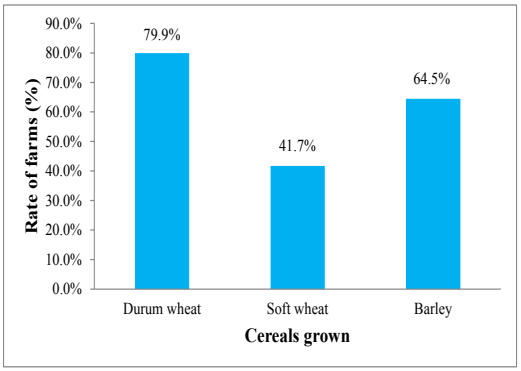

Fig. 3. Prevailed Cereals in surveyed farms

depth of the drillings realized in the region of Biskra varies between 150 and 200m (DSA, 2018). Moreover, the study of Bouammar (2010) revealed that (83%) of the cereals cultivated in the region of Biskra were irrigated by wadi floods and (17%) by drillings and old wells, which represents a clear improvement in terms of irrigation. Filali-Boubrahmi (1991) and Boulal et al. (2007) attest that this is a solution to ensure the improvement and stability of cereal yields. According to Bessaoud et al. (2019), investments in water resource infrastructure have contributed to transforming Algeria's agricultural mapping and land reclamation has turned the Saharan and Steppe regions into important agricultural production basins.

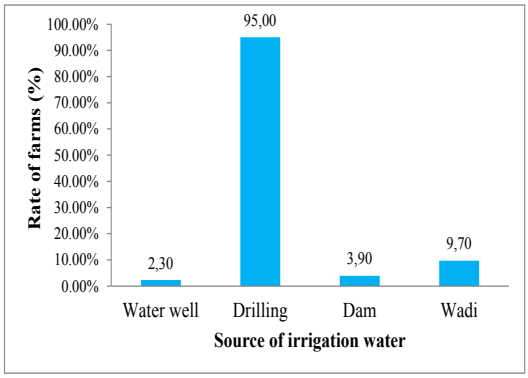

Fig. 4. Rate of farms with irrigation sources

Sources of irrigation water

The diversity that characterizes cereal farms can be explained by the availability of irrigation water, which is a real limiting factor in agricultural production, where most of the surfaces are irrigated by drillings water (95%) (Fig. 4). The

Size and legal status of farms

The area under cereals varies from 01 to 137 ha, with an average of (14.83± 14.86ha). In fact, (58.7%) and (31.3%) of farmers cultivate (10-50ha) and (5-10ha) respectively, while areas of less than 05 ha and more than 50ha are

a minority (Fig. 5). However, more than half of the respondents (57.2%) declare that they are concessionaires of their (state) land, (35.1%) are owners and (7.7%) are tenants (Fig. 6). (Although the areas of the farms are more or less large, generally part of these areas are exploited in a non-regulatory manner (Hiaza), which reduces the chances of obtaining subsidies and bank loan allocated by the State for the totality of the exploited areas). Otmane & Kouzmine (2013), add that the revaluation of the purchase price of cereals by the state in 2008 (purchase prices were set in June 2008 at 4,500DA per quintal for durum wheat, 3,500DA per quintal for soft wheat and 2,500DA per quintal for barley) has nevertheless led to a multiplication of cereal acreage in the Algerian Sahara, confirming the fluctuating aspect of this activity, which is strongly correlated with price variability. Furthermore, in the region of Sétif (Algeria), 96.55% of the total number of farms studied by Bendiab (2012) are privately owned, of which 59.77% grow cereals. On the whole, Maghrebian cereal growing remains poorly productive and very irregular, due to the major structural constraints, aridity and the land tenure structure (Jouve et al., 1995). The latter is considered the main obstacle to innovation by cereal farmers in Aïn Defla (Algeria) and Tiaret (Algeria) (Bouzid et al., 2020). According to Belaid (2016), the policy of agricultural land concessions in Algeria has allowed the installation of new farmers. Hattab & Gaouar (2016) point out that the proper functioning of agricultural development projects in Algeria hinges mainly on clarifying the legal nature of farms.

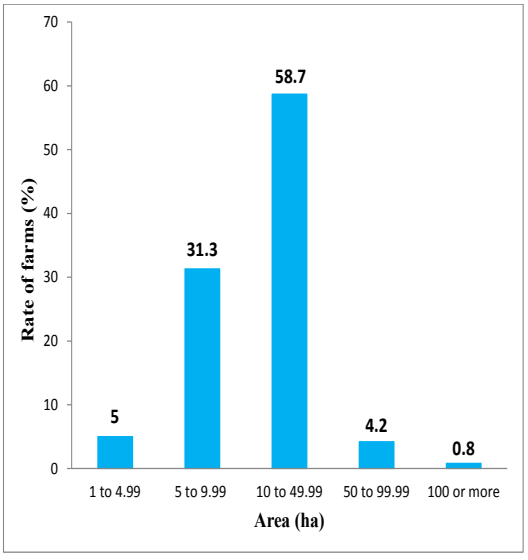

Fig. 5. Areas of surveyed farms

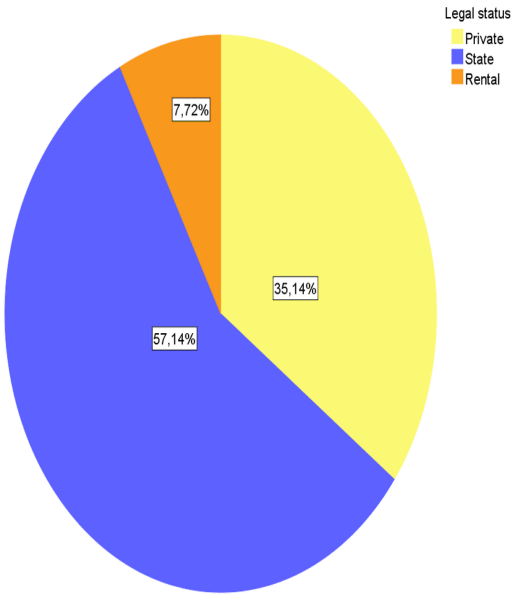

Fig. 6. Legal status of surveyed farms

Agricultural equipment

The results summarised in Table 2 show that farmers use equipment for soil preparation (62.93%) including disc ploughs, cover crops and others coupled to the tractor, which are most often rented. According to Kheyar et al. (2010), the abusive use of disc tools as a means of turning and mixing the soil contributes to its degradation. The direct seeding technique recaps the technical itineraries and agricultural equipment used in the farm, allowing to minimise mechanisation costs, improve soil fertility, save water and avoid ploughing (Belaid, 2016).

Indeed, the respondents prefer to irrigate their plots by the traditional method (submersion) (62.93%), while water-saving irrigation systems such as pivots, sprinkler kits and drip irrigation are less used. Furthermore, Doumandji-Mitiche (2014) notes that pivots and foggaras (underground water supply) are two irrigation systems used in cereal cultivation in the region of Adrar (Algeria). For the latter and with data extracted from Landsat8 and sentinel2 satellite images between 2014 and 2018, Hamrelaine et al. (2021) note that the number of pivots sown by maize increased from 45 in 2013/2014 to 135 pivots in 2017/2018 with an increase of 300% for a corresponding area of 1075.34 to 3297.42 ha. On the one hand, the pivot remains the specific equipment for the irrigation of cereals during the whole cycle in Saharan areas (Chadouli, 1991). On the other hand, the sustainability of the cereal

agro system under pivot in the Algerian Sahara is conditioned by its management, the improvement of the technical itinerary and especially the conduct of irrigation, which will allow the maintenance of soil salinity at a low level and consequently, the increase in the efficiency of the use of water and soil, which will lead to good production for the current population without compromising the needs of future generations (Benbrahim et al., 2016).

TABLE 2. Rate of use of agricultural equipment on cereal farms

Operations	Agricultural equipment used	Number of farmers surveyed (n)	Rate of farmers surveyed (%)
Soil preparation	Disc plough and covercrop	96	37,07
	Disc plough, covercrop and others	163	62,93
Irrigation	Drip	5	1,93
	Sprinkler kit	15	5,79
	Sprinkler kit and drip	15	5,79
	Pivot	21	8,11
	Pivot and drip	1	0,39
	Pivot and submersion	2	0,77
	Submersion	163	62,93
	Submersion and drip	10	3,86
	Submersion and sprinkler kit	25	9,65
	Submersion, Sprinkler kit and drip	2	0,77
Sowing	Manual (on the fly)	172	66,41
	seeder	72	27,80
	Manual and with seeder	15	5,79
Fertilisation	Fertiliser spreaders	64	24,71
	Manual	141	54,44
	None	54	20,85
Phytosanitary Product application	Ramp sprayer	92	35,52
	Manual sprayer	97	37,45
	Ramp sprayer and manual sprayer	10	3,86
	None	60	23,17
Harvesting	Manual	2	0,77
	Harvester	95	36,68
	Reaper	32	12,36
	Manual and harvester	8	3,09
	Manual and reaper	6	2,32
	Harvester and reaper	108	41,70
	Manual, harvester and reaper	8	3,09

The sowing is generally done manually (66.41%), also more than half (54.44%) of the farmers do fertilization manually. For pesticide application, it is clear that (35.52%) of the farmers surveyed use tractor-mounted boom sprayers to save time and effort in covering large areas of cultivated fields. However, a significant proportion (37.45%) of farmers prefer to use manual spraying with a gun attached to a long hose and motor, as the crop has reached advanced growth stages and does not allow the tractor to enter. the field, in addition to the ignorance of sprayer adjustment techniques, adding financial reasons to this situation. However, harvesting is generally carried out using harvesters (36.68%) in the case of grain harvesting or harvesters and reaper (41.70%) for producers of cereal grains and crushed grains (Frik and Mermez) by the cereal growers surveyed. The reaper is a tool developed by farmers in the Zribet El Oued area (Biskra, Algeria) to minimize labor and save time.

On the whole, cereal farms in the Maghreb regions are poorly equipped technically, and a cereal intensification strategy requires the development of mechanization by increasing and improving the stock of existing agricultural equipment (Jouve et al., 1995). In Algeria, particularly in Tizi Ouazzou, the lack of positive developments in the choice of seeds, mechanization, fertilization and irrigation during the period 2000-2006 were a hindrance to increasing durum wheat yields (Chedded, 2015). Similarly, in Aïn Defla and Tiaret (Algeria), mechanization also appears before 2012 but remains underdeveloped in cereal cultivation (Bouzid et al., 2020). According to the FAO (2014), mechanization of agriculture has allowed the expansion of cultivable areas and increased yields, mainly by improving the precision of cultivation techniques.

Seeds

More than three-quarters (81.47%) of the cereal farmers surveyed prefer to use certified seed, although a proportion (16.60%) of farmers resow their farm-saved seed. While ordinary seed is rarely sown (1.93%) (Fig. 7). However, the majority of the surveyed farmers are aware of the benefits of using certified seed, but there are still others who resow part of their grain harvest. Belaid (2014) notes that despite the increased capacity of the Cereals and Pulses Cooperative (CDVC), the causes of reseeding with clean farm seeds can be numerous. Namely, unavailability of CDVC seeds, late delivery, remoteness, prohibitive transport costs and sometimes the desire to reseed local varieties abandoned by the CDVC.

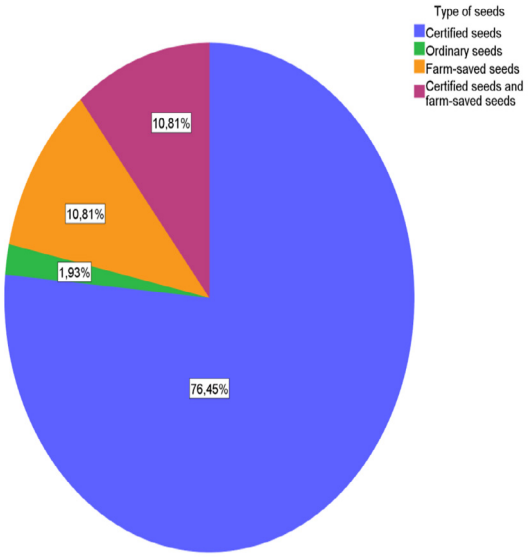

Fig. 7. Kinds of seed used on cereal farms

Agricultural inputs

According to Fig. 8, the majority of farmers give importance to the use of agricultural inputs, especially fertilizers (90.5%) and phytosanitary products (89.6%) which are important factors in improving cereal production. In addition, the purchase of fertilizers and plant protection products is dependent on the farmer's financial means. To this end, these farmers use very small quantities of fertilizers and pesticides compared to the recommended doses. These insufficient quantities do not ensure satisfactory yields of cereal crops. According to Otmane & Kouzmine (2013), Saharan soils are characterized by their low organic matter content, small water retention and high leaching caused by heavy irrigation, which requires the application of large quantities of fertilizers. In Aïn Defla and Tiaret (Algeria), the level of innovation in conventional agricultural techniques is significant. Among them, the introduction of new phytosanitary products, herbicides and fertilizers for durum wheat, this was encouraged by the Rfig credit (interest-free) and the supplier credit which allows farmers to finance agricultural inputs and equipment (Bouzid et al., 2020). The fertilizers frequently used are TSP 46% (0-46-0), UREE 46% (46-0-0) and potassium sulfate 50% (0-0-50). To have good yields of durum wheat, soft wheat and barley in the region of Biskra, the fertilizer requirements

are 4 qx/ha of TSP 46%, that is 180 fertilizing unit of P2O5/ha, 4.5 qx/ha of UREE 46%, that is 200 fertilizing unit of N /ha and 2 qx/ha of Sulfate of potassium 50%, that is 100 fertilizing unit of K2O/ha (ITDAS, 2018)

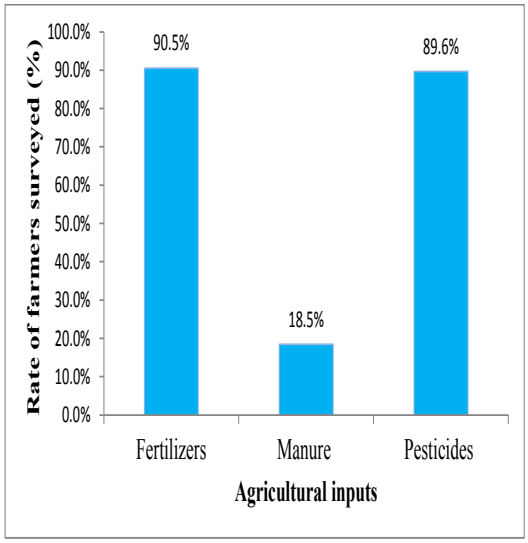

Fig. 8. Rate of agricultural input use on surveyed farms

Labor force

Agricultural activity in the farms of Biskra region is provided by salaried labor (44.40%). They constitute the bulk workforce during the ploughing, sowing, fertilization, weeding and harvesting campaigns. These operations are done randomly without taking into account the technical itineraries suitable for cereals because the workers are untrained. A rate of (37.45%) of the farms requires help from family labor to paid labor, this form involves women during the period of production of crushed grains (Frik and Mermez). A proportion of (18.15%) farmers surveyed resort to family labor only, if there is a shortage of workers or money (Fig. 9). According to Otmane & Kouzmine (2013), the presence of women has become common on family farms, but the work of paid day laborers on other farms is rare in Algeria, except for Kabylia. Hattab & Gaouar (2016) note that in the region of El Gor (Tlemcen-Algeria), farms only need paid labor during two periods, the soil preparation-seed period and the harvesting-threshing period. From the same authors, the scarcity and high cost of salaried labor in this region have become an alarming problem that is making it very difficult for farmers to manage their farms in good conditions.

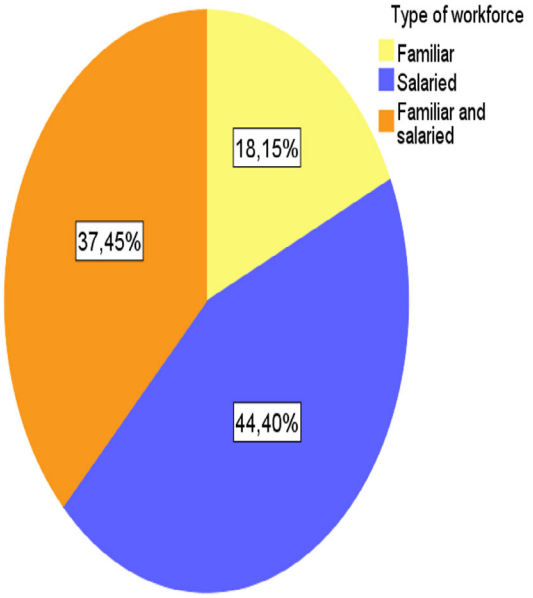

Fig. 9. Types of labor employed by cereal farms

Conclusion

The diversification of the production system on cereal farms in Biskra region (south-east Algeria) is explained by the extension of their agricultural areas and the availability of irrigation water, where the cereal-market gardening and/or date palm cultivation-ruminant breeding system is the most common. Despite the extension of irrigated areas, many administrative and technical efforts remain to be made to make cereal growing more profitable. To this end, the regularization of the legal status of most cereal farms is a very important step and this is achieved by encouraging farmers to integrate into the policy of agricultural land concessions created by the State, to obtain subsidies and bank credits, in particular, the R'fig credit and the supplier credit. The latter allows farmers to modernize their agricultural practices through the acquisition of new agricultural equipment and the supply of the various inputs necessary for cereal crops as well as certified seeds.

Other efforts remain to be deployed in terms of extension by agricultural advisers to encourage farmers to strictly apply the technical itinerary for the management of cereal crops to make cereal growing intensive and profitable in the region to achieve the desired objective, which is the yield threshold ensuring food self-sufficiency.

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