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Research Article

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The Role of Delivery of the Use of Agricultural Techniques and Extension Services in Increasing the Capacity of Wheat Production to Achieve Food Security in Algeria

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Abstract

Wheat is a strategic food for many developing countries. Algeria, despite its high potential, is still unable to provide food security from grains, mainly related to a lack of a culture of competent government bodies accompanying farmers to help increase grain production while focusing on agricultural sustainability. First, comparisons are made between investments that apply these techniques and extension services on farms to bridge grain production gaps, and second, the development of sustainable agricultures is investigated. The research is based on official statistical data, and a field study with a questionnaire distributed to farmers and their families regarding agricultural development.

Keywords: Food Security, Agricultural Extension, Wheat

Introduction

Interest in food security is a relatively recent phenomenon in many countries. This is a complex concept, based on four main components: the volume of food production relative to population demand, human health, climate change and variability, and new production technologies relating to food [1].

In Africa, over 70% of the workforce is engaged in agriculture and this depends, to a large extent, on access to natural resources, including land, to meet food needs [2, 3]. In North Africa, agricultural production remains insufficient. Countries such as Morocco, Algeria, and Egypt are, indeed, zones of "high food seismicity", reflecting the chronic imbalances between agricultural production and the population's needs, which is compensated by importation from developed agricultural countries, especially in wheat production, which is the principal strategic food [4]. In fact, wheat is the world's most widely cultivated food crop. It can be grown from below sea level to 5000m altitude and in areas where rainfall ranges between 300-1130 mm annually. Wheat contributes more calories (20%) and more protein to the world's diet than any other food crop. There is considerable agreement that agricultural sectors around the world need to pursue modified strategies for 'sustainable intensification' if global food security requirements are to be met throughout this century [5]. FAO estimates that farmers will have to produce twice as much food as they do today in order to feed the expected 9.2 billion global population by 2050 [6]. With declining availability of water and production land per capita, lower productivity, stress induced by climate change and changing consumer patterns, farmers will have to intensify agricultural production. The challenge will be for them to do so sustainably [7]. Technologies for modern agriculture particularly associated with the Green Revolution have enabled farmers with access to sufficient land, machinery, and purchased inputs to cultivate ever-larger areas, raising production by relying on improved crop varieties and utilizing more water, capital investment, and agrochemicals. Agricultural management practices - for example, an increased use of agricultural chemicals or fertilizers - are often evaluated based on their benefits for economic efficiencies in production (e.g. reduction in total production costs and increased production yield) while less attention is generally given to their potential environmental effects [8]. For example, pesticide and fertilizer application plays a vital role in increasing agricultural production and ensuring the supply of agricultural products. Pesticide spraying can significantly reduce or offset the economic costs from plant diseases, insect pests, and weeds on agricultural production and fertilizer application can provide a variety of nutrients required for the growth of crops and for an increased yield in production [9]. However, many countries have reported alarming residues of agricultural chemicals in soil, water, air, agricultural products, and even in human blood and adipose tissue.

In recent years, something called the system of crop intensification has emerged in a number of Asian and African countries, raising the productivity of the land, water, seed, labor, and capital resources that farmers can invest in for growing a wide range of crops [10]. The system of Wheat Intensification (SWI) is one of the promising technologies to increase productivity which ultimately contributes

to food security. The system of wheat cultivation requires the use of chemical fertilizers, the use of manure and organic seed treatment that ensure higher yields, modern irrigation systems, and the reduction of weeds. Algeria, like other African countries, has adopted a system of crop intensification, especially in relation to winter cereals (wheat, barley and oats) which are the main crops. The rotation of cereal fallow land occupies each year nearly 80 % of the agricultural area [11]. The situation of cereal cultivation is very difficult however, and its production has increased only slightly in the last 50 years and today it responds only to one third of human needs. This situation requires the availability of certain forms of extension services for all farmers, including for small farmers who own small holdings, using methods of persuasion for farmers to use the varieties and productive methods to increase their agricultural productivity, to respond to farmers' questions about some production problems and to provide them with the necessary information to do so. If the goal is to diversify the agricultural pattern in particular, both pioneer farmers and mentors can play a convergent role in working on the production of new high-yield crops; this guidance in reality acts as an intermediary, and as a provider of information. The implementation therefore of the System of Wheat Intensification requires accompanying measures consisting of demonstration, extension and training actions that would have to be carried out in a sustained manner by the various organizations involved.

The main objectives of these actions to be carried out in relation to farmers are:

(i) The dissemination and generalization of the use of high-performance plant material;
(ii) Popularization of adapted cultural techniques; and
(iii) Animation, monitoring and evaluation of the implementation of the technical support program.

In this article, we review what is being done and seen on farmers' fields rather than on experimental stations because these innovations have been mostly developed empirically on the ground. Few researchers have been involved in this effort with scientific evaluations, but this is now changing. In this review, observed and measured outcomes are communicated as accurately as possible from on-farm situations. This article has two goals.

First, comparisons are made between the agricultural investments that apply these techniques and agricultural extension services and primarily private farms to bridge the gap in the production of grains and its causes, and Second, by investigating the planning and development of sustainable agricultures. The research is based on an analysis of the statistical data issued by the official bodies, and a field study based on a questionnaire distributed to farmers and their families related to the development of the agricultural sector.

Data and Methods

Study Area

Located between the 18th and 38th latitudes of the North, Algeria is characterized by its extent (2,381,741 km^2) which makes it the largest country in Africa. In terms of terrain, from north to south, the coastal strip of the Tell less than 80 km wide precedes a double mountain barrier (the Tellien Atlas and the Saharan Atlas). These two barriers are often separated by valleys, vast plains and the platform of the high plateaus with altitudes ranging from 1,000m in the west to 800m in the east. It is this set of valleys, plains and highlands that is home to most of the country's fertile land and forest areas (Figure 1).

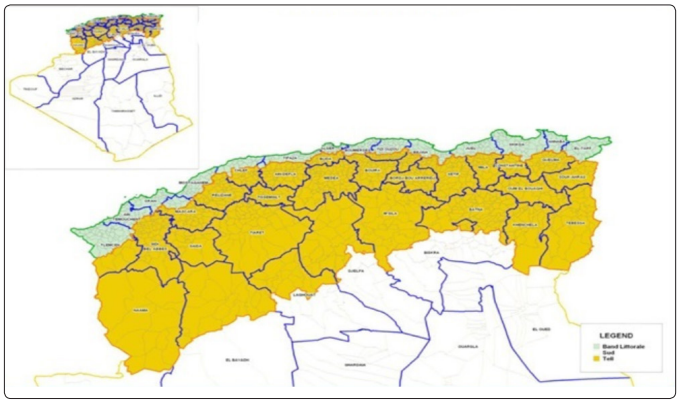

Figure 1: The Three Great Sets of the Algerian Physical Space

Source: By Bellout, Azzeddine.

Grain farming dominates northern Algeria. Durum wheat is sown in autumn between mid-October and late November, achieves its vegetative phase (tilling) in winter and its reproductive stage (heading-flowering) in spring, and ends its crop cycle with the grain filling and maturation phase which takes place between late May and late June [12].Natural conditions, especially climate, give Algerian agriculture its particular character, and largely determine the rural landscape and crop production processes [11].Governmental efforts to increase production through the use of more certified seeds, fertilizers, and technical support to farmers has proven effective. Production of wheat, barley and oats, which constitute the grain crops in Algeria, has during the last decade been higher than the nine-year average (1999/00-2007/08) equivalent of 2.97 million tons. However, it remains far short of the eight million tons needed for domestic consumption. Grain production heavily relies on climatic conditions. Currently, the irrigated areas devoted to cereals are estimated at 250,000 hectares, which remains quite minimal [13].

The Ministry of Agriculture forecasted in January that "if the climatic conditions are favorable", the current grain production could exceed the record achieved during the 2018/19 period (6.05 million tons). Table 1 presents data for Algeria's Average Cereal Production.

Table 1: Algeria's Average Cereal Productions (Million tonsin local crop planting season)

(1999/00)-(2007/08)	(2008/09)-(2016/17)	2017/2018
2.97	4.31	6.05

Source: Ministry of Agriculture, 2019.

Arable land represents only a small proportion of Algeria, where this rate is less than 3.5% [14]. Due to the water and on land constraints (population pressure), intensive agriculture is concentrated throughout the coastal areas in Algeria. For this reason, this type of agriculture based on the massive use of chemical inputs (fertilizers, plant protection, energy, seeds) is increasingly a subject of much debate [15]. Therefore, it must be substituted by another type of viable and sustainable agriculture which aims at reconciling agriculture with the environment.

Data Collection

The main data for this article were collected through field visits to farmers' farms in different parts of Algeria in the north (Eastern Part of the Mitidja Plain), the west (wlayaTiaret) and in the central regions (Beni Slimane Plain) so that we can obtain comprehensive data. The data were collected through dialogue with farmers because many farmers do not have a good level of education; the majority of farmers is over 60 years of age and this makes it difficult to distribute a field questionnaire.

The survey was conducted between April and July 2018, field interviews were conducted with 200 farmers and their families active in wheat cultivation, who owned small land holdings of 3 to 5 hectares, 50 farmers active in the eastern part of the Mitidja Plain, and also 50 in the wlaya of Tiaret. The largest number of farmers - 100 farmers – were interviewed in the Bani Suleiman plain in thewlaya of Médéa because of the proximity of the area to the researchers who collected the data. Through these visits, detailed information was collected about their socio-economic conditions, institutional support by the government, landholdings, distance of their land from the motor road, cropping patterns, labor use, how they prepare soil for agriculture, the type and amount of fertilizer use, irrigation facilities, and the status of extension services, and dialogues were also conducted with agricultural engineers working in the direction of guidance to provide help. Understanding the extent to which the agricultural awareness and extension policy is implemented in practice involved dialogue with 15 engineers in the field of agricultural extension of wheat crops in the areas studied in their work offices, without excluding the reports of international organizations published annually and Data published by the official agricultural bodies in Algeria, such as the Ministry of Agriculture and its entities. The government's efforts to reduce the number of people who have been forced to flee the country have been reported. This additional information was used in the analysis to supplement the information collected from the questionnaire.

Results and Discussions

To start with, we now introduce the most important types of wheat crop grown in the study area and its production capacity in three different regions of Algeria (the eastern part of the Mitidja Plain, the Beni Slimane Plain in Médéa and Tiaret), as illustrated in (Figures 2,3 and 4). The names of the wheat species shown in the figures are local names that reflect the climate of each region.

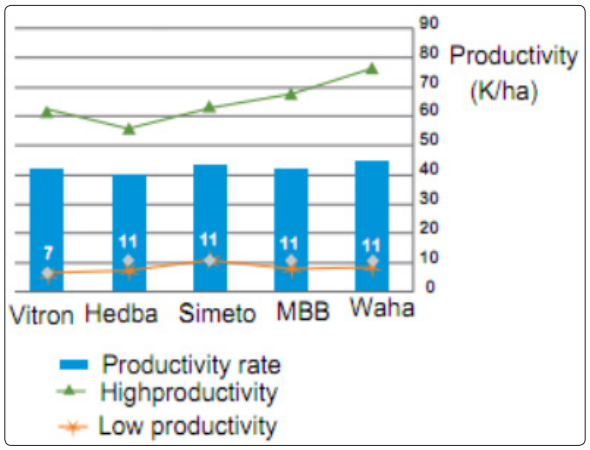

Figure 2: Comparing the yield of wheat varieties In the Bani Slaiman Plain-Medea (2010-2018)

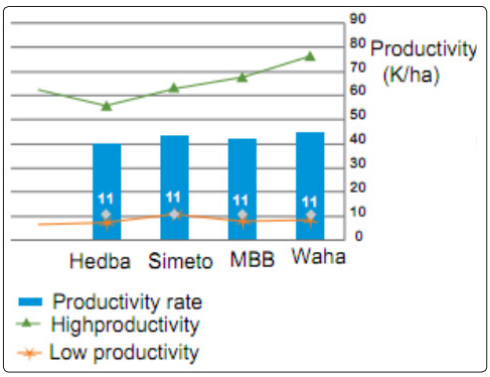

Figure 3: Comparing the yield of wheat varieties In the Bani Slaiman Plain of Mitidja (2010-2018)

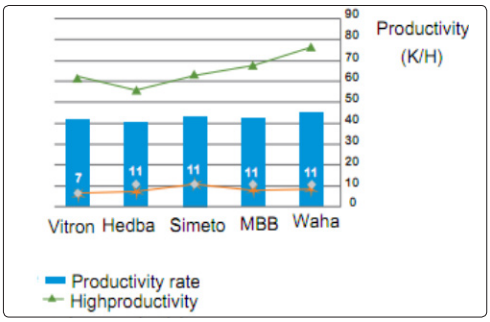

Figure 4: Comparing the yield of wheat varieties In Tiaret (2010-2018)

Source: By BelloutAzzeddine based on farmers' dat

Photo 1, 2: Types of wheat crops grown in Algeria

Source: ByBellout, Azzeddine, 2018

The Technical Institute for Field Crops in Harrach, Algiers, grows and produces cereals (soft wheat, hard wheat, barley, oats) in technical and information coordination with other institutes scattered across the national territory. This institute cultivates many types of grains that differ in their compatibility with the climate (Figure 2, 3 and 4) and the engineers, technicians and workers of this institute follow modern techniques and skills that make their test station more productive, and the Institute also improves local breeds of grain strains in general. These experiments have confirmed that a range of varieties can yield high returns, for example, Mohammed bin Bashir (MBB) durum wheat has achieved a yield of 35 quintals per hectare, and durum wheat waha Photo 2 of 45 quintals per hectare. Modern techniques have been applied from Land Preparation and seeding to harvesting, but most of these techniques are absent from farmers in their fields because of the lack of the appropriate farmer culture, as most farmers are unaware of the importance of modern techniques in improving agricultural yields and quality, and they usually resort to their own methods and experiences.

The following is a detailed presentation of modern Techniques and their impact on the cost-effectiveness of wheat production and comparing them to the methods practiced by farmers in their fields.

Land Preparation

The way soil preparation affects to some extent grain productivity is a key factor in increasing grain productivity. According to the field visit to private farms we discovered that the majority of farmers do not prepare soil during the appropriate period in September and October, but they till during the seeding date and this reflects negatively on the production of grain crops. This is due to farmers' lack of knowledge of the importance of preparing land at the appropriate time and its contribution to raising production, a process that requires additional financial costs, which affects farmers' low incomes (See Figure 5).

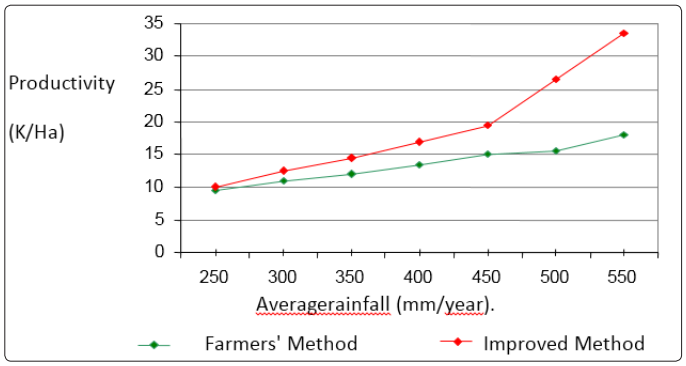

Figure 5: The impact of soil preparation on wheat productivity (kantar/ha)

Source: By Bellout, Azzeddine based on 2018 data from the Technical Institute of Field Crops in Harrach, Algeria.

Through this process, three main objectives can be achieved:

1. Store the largest amount of rainwater by improving the physical properties of the soil (permeability).
2. Fight weeds that begin to grow during the beginning of autumn.
3. Providing the right conditions for the use of nitrogen (ventilation, soil heating and bacterial activity).

Date of Agriculture

Based on the experience of agricultural experts and their scientific knowledge, early agriculture (October, November) is recommended for high, cold and off-sea areas, and late agriculture (December, January) for coastal areas. Farmers often wait for rain to begin agricultural processes, leading to delays in planting until December and January, and preventing the crop from benefiting from autumn and winter rains, which has a negative impact on wheat crop growth. Figure 6 shows the impact of the region and the date of agriculture on the productivity of wheat in different regions and parts of Algeria - Tiaret in the west, the Mitidja plain in the northern coastal section and Médéa in the interior.

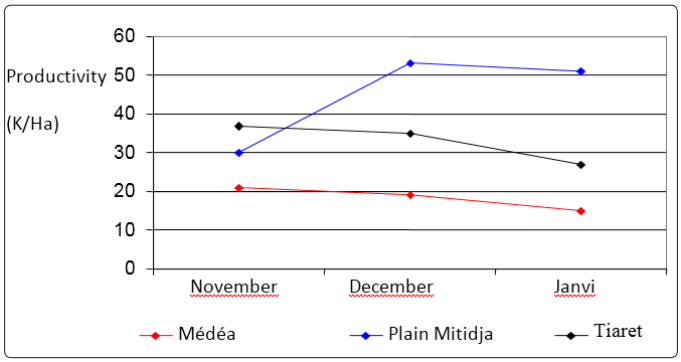

Figure 6: The impact of the region and the planting date of agriculture on the yield of wheat productivity (kantar/ha)

Source: By Bellout, Azzeddine based on 2018 data from the Technical Institute of Field Crops in Harrach, Algeria.

Figure 3 shows that the climate of the region has an effective role in the date of the planting process. With a mild Mediterranean climate, December is the most suitable month for wheat cultivation.

Farming Method

According to our field visit to farmers' farms, we learned about the methods that farmers use to plant seeds, and we found that the majority of farmers, especially in the private sector, follow the method of manual seeding (hand-seeding) and this process negatively affects the yield of grain crops; and in order to ensure that its returns are increased, it is recommended for private farmers to use a mechanical sowing machine because it guarantees:

1. Fast and homogeneous insinuating.
2. Being economical in time and effort.
3. It also avoids heavy or incomplete seeding.

Basic Fertilization

(October-November) It is recommended to conduct this fertilization before planting to ensure that nutrients reach the root area of the plant where they are easy to absorb and benefit from and these fertilizers can be added and scattered before the last tilling to be mixed and refilled in the soil. The different methods of fertilizer application are shown in Figure 7.

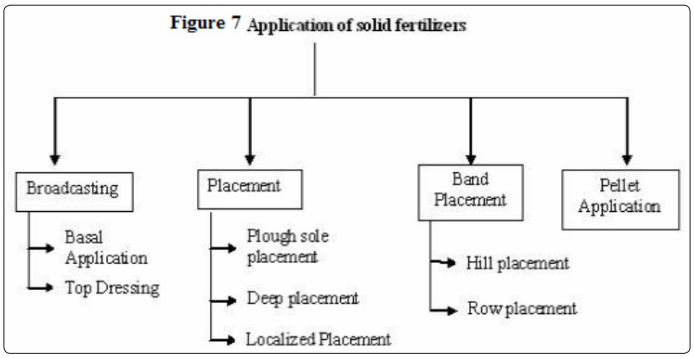

Figure 7 Application of solid fertilizers

Source: The Technical Institute of Field Crops in Harrach, Algeria

The fertilizer can be added when sowing using a sowing machine Double (See Photo 3). This places fertilizer and the seed in the same row but at different depths. Although this method has been found suitable for the application of phosphatic and potassic fertilizers in cereal crops, however sometimes germination of seeds and young plants may get damaged due to higher concentration of soluble salts.

Photo 3: Process of scattering fertilizer when sowing using a sowing machine.

Source: By Bellout, Azzeddine.

The fertilization is limited to the use of phosphorus fertilizer and potassium. The use of fertilizers often enables farmers to triple crop yields if added in the right quantity and with the appropriate method, and fertilizers also enable them to benefit greatly from agricultural areas and which the results of research on the importance of phosphate fertilization have confirmed The Azutti in [16,17]:

1. Improving wheat yields.
2. Giving the production elements of excellent seed varieties, rainwater, irrigation and herbicides to be more effective.
3. Improving the quality of grains.

Inefficient use of agro-chemicals, both pesticides and fertilizers, remains prevalent among small-holder farmers in Algeria. Vital ecosystem services provided by natural biological control and pollination are compromised as a result. Enduring and new concerns over farmer health, environmental pollution and food safety caused by indiscriminate use of agro-chemicals call for safer and more sustainable crop intensification and protection strategies [18].

Irrigation

The issue of the preservation and rational use of the water resource is at the heart of the sustainable agricultural development strategy [19]. However, a large part of the territories of North Africa is located in semi-arid or arid areas. In fact, the desert occupies a considerable part of the Tunisian and Algerian territories. This means that these countries have less than 10% of irrigated land. Moreover, climate change severely threatens the rain fed agriculture which predominates in most of the countries of the region [20].

The first irrigation is undertaken 15 days after sowing, as root initiation starts during this time. Unavailability of moisture in soil would prevent root initiation. The second irrigation is undertaken 25 days after sowing, and tillers start emerging at this stage. The third irrigation is undertaken 35-40 days after sowing. Subsequent irrigations are made at 60, 80 and 100 days after sowing, depending upon availability. During the flowering and grain-filling stage, appropriate moisture should be available in the soil.

Photo 4: Wheat irrigation methods in Algeria

Source: By Bellout, Azzeddine, 2018.

Weed Control

Weeds annually cause significant losses in terms of yield in relation to production quantity and crop quality [21]. Therefore, the integration of many preventive agricultural and chemical methods has become necessary to reduce and control the spread of weeds. From this balanced tillage and the use of excellent seeds, chemical control is the most widespread and widely used approach. In order to succeed with this process, early intervention from stage 2 to 3 leafs is important to control weeds (Figure 7) [22].Competition from weeds to wheat crop can lead to the loss of more than 50% of the production capacity of the wheat crop [23-25].

Identifying the most important herbs in the field and choosing the appropriate pesticide are undertaken while adjusting the sprinkler machine and taking into account the climatic conditions to carry out the healing process. The process of controlling weeds with pesticides requires the intervention of agricultural extension engineers in order to clarify and explain the amounts that can be used in rational ways; otherwise this can have serious negative effects on the environment, especially on water resources, and especially if the majority of those

who use these pesticides are farmers who have a poor educational level as previously noted in the methodology section. Weeds directly compete with crops for water leading to less water available for crops, and weeds are potentially responsible for 34 percent of crop loss worldwide [23,26]. Weeds consume water intended for crops. Therefore, proper weed control raises available soil water for crop production.

The loosening of soil results in better aeration for the root zone and increases the root length by letting them take more moisture and nutrient from the soil. The reform, i.e. the integration of many preventive agricultural and chemical methods, has become necessary to reduce and control the spread of weeds. From that balanced tillage and the use of excellent seeds, chemical control is the most widespread and widely used approach. In order to succeed with this process, the importance of early intervention from stage 3-2 leafs to the end of the recital must be emphasized (Figure 8), identifying the most important herbs in the field and choosing the appropriate pesticide while adjusting the sprinkler machine and taking into account the climatic conditions to carry out the healing process. The process of controlling weeds with pesticides requires the intervention of agricultural extension engineers in order to clarify and explain the amounts that can be used in rational ways, which otherwise can have serious negative effects on the environment, especially on water resources, and especially if the majority of those who use these pesticides are farmers who have a poor educational level as previously reported in the methodology section.

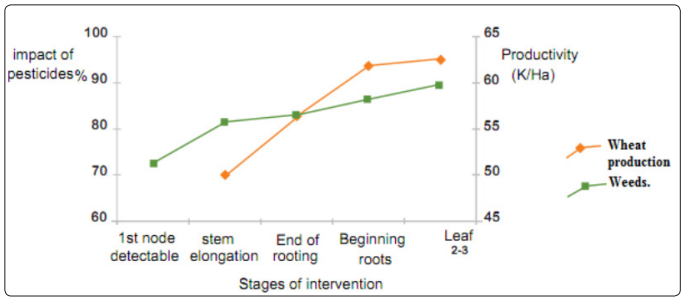

Figure 8: Early chemical control of weeds has an impact on wheat yields and pesticide efficacy

Source: By Bellout, Azzeddine based on 2018 data from the Technical Institute of Field Crops in Harrach, Algeria.

Crop Rotation with Legumes for Increased Productivity

Growing the same crops in the same field for many years depletes the soil fertility and helps to create pests and pathogens in the cropland. Thus, rotating legumes like soybean and pulses will help to improve productivity of wheat by adding nutrients to the soil and improving soil properties. Wheat crop yields more in rotation with legumes because legumes help to fix nitrogen in the soil and improve soil fertility. Legumes like soybeans have bacteria in their root nodules which take nitrogen from the air and convert them to usable forms [27].Crop rotation of major cereals with legumes have benefited from several advantages for sustainable agriculture in Algeria. Results show that an appropriate crop sequence improves soil fertility, reduces fertilizer cost, controls soil erosion, makes environment healthy, increases crop yields and develops sustainable crop production in the long run [28].

The results have shown that wheat productivity increases by 90% at the maximum based on these agricultural techniques; similar results were obtained from the demonstration experiments conducted at the field trial stations of the Technical Institute of Field Crops in the Harrach in the areas studied in this region. Figure 9 shows a large gap between the productivity of wheat in private farmers' farms and testing stations that rely on these techniques. This is due to the absence of application of these techniques in the agricultural reality of the majority of farmers due to the lack of accompaniment and guidance of farmers by agricultural engineers explaining the importance of applying these techniques, which are simple in terms of application in fact but are of great importance in raising the productive capacity in the farmers' fields, which contribute to the self-sufficiency of this strategic material for the Algerian population.

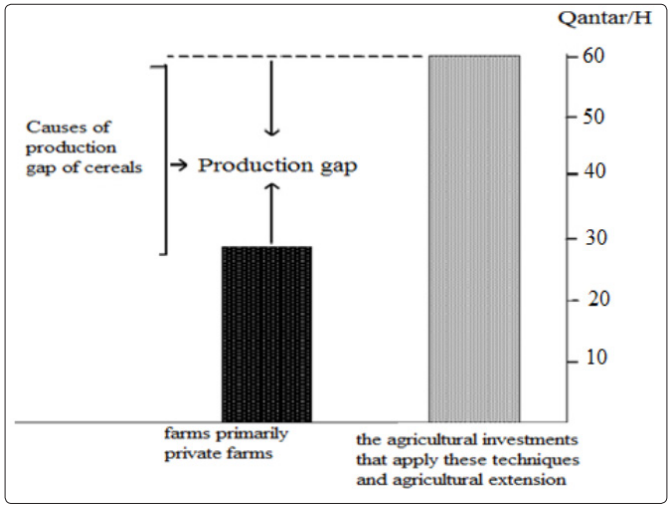

Figure 9: The gap in wheat productivity between field testing plants and private farmers' fields

Source: By Bellout, Azzeddine based on farmers' data and field-testing stations, 2018.

Agricultural extension is a link between farmers and the centers of agricultural research that serves to transfer various technologies and innovations in the agricultural sector, modern agricultural ideas, agricultural mechanization, agricultural pesticides, fertilizers, and new varieties of crop seeds, and the food industry. The transfer is undertaken from agricultural research centers to farmers to convince the latter to adopt these agricultural techniques in order to contribute to agricultural development and raise farmers' economic level. The profits are visible for the countries, mostly done in the work of offices and the farmers are gathered in halls, and then they are dictated to by agricultural instructions that may not be more effective for the peasants (Photo 5) too, because agricultural extension plays a great and important role in the course of agricultural and economic development [29,30]. This is done through training courses in various domains of agricultural extension and communication. The role of agricultural extension in Algeria is still far from the real coverage required in agricultural development in its various branches, and the number of peasant guides is small to meet the coverage and demand by the peasants. On the other hand, agricultural guidance is mostly done in the work of offices and the farmers are gathered in halls, and then they are dictated to by agricultural instructions that may not be more effective for the peasants (Photo 5).

Photo 5: Days of awareness for farmers about the importance of fighting harmful weeds and their impact on wheat productivity at the headquarters Of agricultural engineers.

Source: By Bellout, Azzeddine, 2018.

Table 2: Guiding visits and the organization of awareness days for farmers of the Wheat Agriculture Division

Agricultural Seasons		Eastern Part of the Mitidja Plain	Wlaya Taret	BeniSlimane Plain Médéa-
2014-2015	Number of field visits	05	12	07
	Number of Awareness days	03	07	03
	Number of farmers in attendance	30	60	40
2015-2016	Number of field visits	05	14	07
	Number of Awareness days	03	07	04
	Number of farmers in attendance	30	65	50
2016-2017	Number of field visits	06	16	12
	Number of Awareness days	06	10	04
	Number of farmers in attendance	40	65	65
2017-2018	Number of field visits	10	16	12
	Number of Awareness days	06	12	05
	Number of farmers in attendance	35	60	60

Source: By Bellout, Azzeddine based on data from agricultural extension engineers.

By going through Table 2, it is clear that the number of field visits and the organization of awareness days is small and insufficient compared to the area allocated and the number of farmers. On the other hand, we hear from the farmers that there are no regular field visits during the stages of agricultural crop growth, although field inspection is of paramount importance as some diseases that have been exposed in some crop fields can be revealed and the farmer can be guided in ways to eliminate those diseases.

The role of agricultural guidance is still far from the real coverage required in agricultural development in its various branches, and the effectiveness of agricultural guidance is linked mainly with the availability of well-qualified agricultural workers and the incentives to do the job. These incentives are mainly related to working conditions, salaries and wages, assessment and responsibility, achievement and supervision, and it can be said that, while agricultural guidance is important for agricultural activity, agricultural policy in Algeria has not attached sufficient importance to agricultural guidance.

Conclusion

This study has analyzed various agricultural techniques affecting wheat production and farmers' decisions in relation to the adoption of agricultural methods to intensify wheat production that contributes to food security in Algeria, and these results reinforce the notion that priority for irrigation and the use of fertilizers, pesticides, technology and intensive land use and conversion to high-value crops contribute significantly to increasing wheat production capacity by a maximum of 90% based on these agricultural techniques.

It should also be noted that the Algerian government, with the contribution of all agricultural bodies, must rethink family farming, which could increase the production capacity of the country's agricultural crops. More than 50% of agricultural land holdings are owned by these families [13]. Therefore, it must be reincorporated and given greater importance in the policy of financial and technical support to the government in order to activate its role in the agricultural reality of Algeria and contribute to reducing the problem of food insecurity in Algeria, which is estimated to be more than 30.1%, and this is the subject of our next research on rethinking agriculture [6]. The family in Algeria is a supplement to this article.

The great challenge facing the agricultural technology transfer is not just how to approach the end users, but how to sustain the use of technology to meet the future challenges. Using appropriate research technologies to promote food security is a major priority for many developing nations including Algeria [30]. It is a known fact that farmers differ in their socio-economic background, educational levels, learning needs and problems. These technologies must be disseminated to the farmers using modern extension education teaching methods and strategies. Extension teaching deals with the conveyance or passing across of new skills, technology, techniques or new methods of production in agriculture that will ultimately improve the living standard of the target audience. To be successful in technology transfer, extension workers must understand the farmers' learning needs and know how to deal with farmers. This is done through training courses in various areas of agricultural extension and communication. However, the role of agricultural extension in Algeria is still far from the real coverage required in agricultural development in its various branches.

Typically, market-driven technological progress has led to the intensification of farming systems, the use of more industrial inputs and the adoption of management methods that stress low costs and high yields. However, this pursuit of productivity and efficiency has, in many cases, put pressure on the natural resource base. It has also led to significant consumer concern about the safety and quality of food produced in modern, intensive agricultural systems; intensification, rather than the extension of agricultural land, has been the prime driver of increased per capita food production globally [31].Today, the adoption of new technology in agriculture is looked upon much more critically than it is in most other sectors. In many OECD countries, farmers are faced with consumers who are skeptical about the sustainability of modern farming systems. Many consumers, in fact, would prefer to go back to using more traditional farming methods.

Despite great progress, and now with the emergence of the term 'sustainable intensification' and its component parts, there is still much to be done to ensure that agricultural systems worldwide can increase productivity fast enough whilst ensuring impacts on natural and social capital are only positive.

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