Comprehensive Overview of the Agricultural Sector in Jordan

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Authors Livia Perosino (LAM),
Institut français du Proche Orient (Ifpo)
Coordination Nicolas Tremblay (AFD),
Yasmine Harras-Pelletier (AFD)

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Authors

Livia Perosino
Les Afriques dans le Monde (LAM)/ Institut français du Proche Orient (Ifpo)

Coordination

Nicolas Tremblay (AFD)
Yasmine Harras-Pelletier (AFD)

Abstract
Agriculture in Jordan is a particularly constrained sector given the dry climate and the limited endowment in water resources. However, the sector is connected to several strategic issues, such as food security, employment, rural development and environmental preservation.

This study offers a complete overview of the sector, reviewing geographical, economical and political factors. After describing the agroecological areas present in Jordan, it drafts the main agricultural systems present in each zone. It then portrays landtenure and the problematics connected to it. Sociological profiles of agricultural producers and their commercialization strategies are essential to understand power dynamics in the sector.

In conclusion, the study outlines broad recommendations to orient policy making and development projects.

Key-words:
research, agriculture, climate change, environmental preservation, employment, food security.

Areas :
Jordan, Middle-East.

Résumé
L'agriculture en Jordanie est un secteur particulièrement contraint étant donné le climat sec et la dotation limitée en ressources en eau. Cependant, le secteur est lié à plusieurs enjeux stratégiques, tels que la sécurité alimentaire, l'emploi, le développement rural et la préservation de l'environnement.

Cette étude offre un aperçu complet du secteur, passant en revue les facteurs géographiques, économiques et politiques. Après avoir décrit les zones agroécologiques présentes en Jordanie, il esquisse les principaux systèmes agro-écologiques présents dans chaque zone. Il dresse ensuite le portrait du foncier et des problématiques qui s'y rattachent. Les profils sociologiques des producteurs agricoles et leurs stratégies de commercialisation sont essentiels pour comprendre la dynamique du pouvoir dans le secteur.

En conclusion, l'étude présente des recommandations pour orienter l'élaboration des politiques publiques et des projets de développement.

Mots-clés :
recherche, agriculture, changement climatique, préservation de l'environnement, emploi, sécurité alimentaire.

Géographies :
Jordanie, Moyen-Orient.

.الأردن، الشرق الأوسط

خلاصة

تعتبر الزراعة في الأردن قطاعا مقيدا بشكل خاص نظرا للمناخ الجاف ومحدودية الموارد المائية.

ويرتبط هذا القطاع مرتبط من القضايا الاستراتيجية، مثل الأمن الغذائي والعمالة والتنمية الريفية والحفاظ على البيئة

تقدم هذه الدراسة نظرة عامة كاملة على القطاع ، ومراجعة العوامل الجغرافية والاقتصادية والسياسية. بعد وصف المناطق الزراعية الإيكولوجية يحدد الأنظمة الموجودة في الأردن ، الزراعية الإيكولوجية

الرئيسية الموجودة في كل منطقة. ثم يصور حيازة الأراضي والمشاكل المرتبطة بها.

تعد الملامح الاجتماعية للمنتجين الزراعيين واستراتيجياتهم التجارية ضرورية لفهم ديناميات السلطة في .هذا القطاع

وفي الختام، توجز الدراسة توصيات لتوجيه عملية وضع السياسات العامة .والمشاريع الإنمائية

الكلمات الرئيسية

البحوث، والزراعة، وتغير المناخ، والمحافظة على البيئة، والعمالة، و الأمن الغذائي

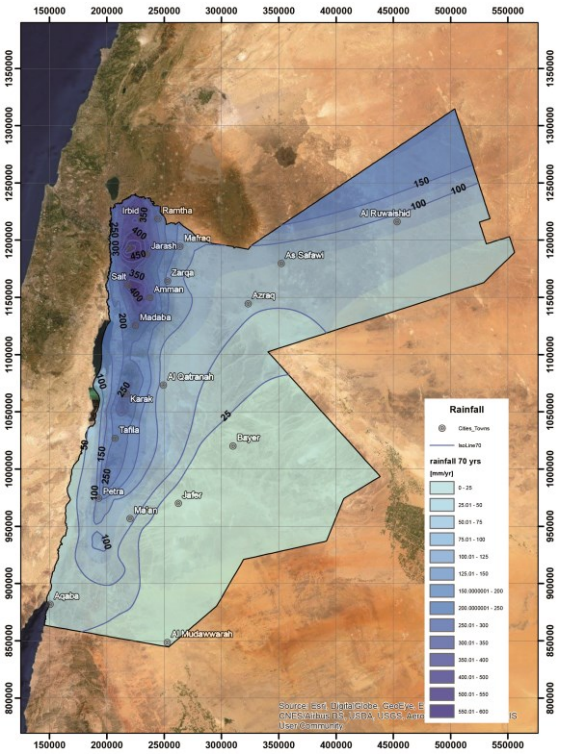
المناطق

Introduction

Agriculture in Jordan is a particularly constrained sector given the dry climate and the limited endowment in water resources. Most of the territory is arid or semi-arid. Only 8% of the territory receives more than 200 mm annually (Table 5) and only 10% of the land is cultivated (World Bank, 2022). However, agriculture has been a major source of livelihoods for the population until recently. Grazing small livestock is a traditional activity that is still very present today. Moreover, in the North-Western regions, that receive consistent rainfall, subsistence agriculture was the main source of livelihood until the 70s-80s.

During the British mandate, and more rapidly after the independence, the agricultural systems radically changed. The contribution of the sector in relative terms has drastically decreased since the 50s, but has consistently increased in absolute terms (Europaid, 2012). Agriculture represents today 5.9% of the GDP of the country (World Bank, 2022), but the percentage is generally estimated to be closer to 30% when considering activities related to agricultural production upstream and downstream of the value chain. It is also an important employer: even though the sector employs officially only 3.2% of the population (Department of Statistics, 2021), the percentage does not consider casual agricultural labor, home-based income generating activities and small-scale farming and livestock keeping (IFAD, 2017), which constitute most of the employment in the agricultural sector. Agriculture is the main source of employment in rural areas, where 25% of the total poor live (Europeaid, 2012). It was among the five sectors that were formally open to refugees in 2016 in the context of the Jordan Compact. In the Northern governorates of Irbid and Mafraq, respectively 13 and 24% of all Syrians formally employed work in the agricultural sector. However, work conditions in the sector are particularly difficult: the jobs provided are often temporary, with low pay, workers are not covered by any insurance and there is no defined minimal wage, while working conditions are particularly difficult (ILO, 2018).

Map 1. Average rainfall distribution 1943-2013



Source : MARGANE, A. & DWAIRI, M. [edts.] (2020), Rapid Assessment of the Consequences of Declining Resources Availability and Exploitability for the Existing Water Supply Infrastructure. – Technical Cooperation Project 'Management of Water Resources – Third National Water Master Plan', prepared by GIZ, p. 365, Amman

Food dependency and its risks

Agriculture is a potentially strategic sector to ensure greater levels of food security. As many other Arab countries, Jordan has opted for a food security strategy that mostly relies on food imports. Jordanian agriculture is today mostly specialized in high value crops oriented towards foreign markets. The Monarchy is self-sufficient in a most varieties of vegetables but lacks food-processing industries. If most countries of the Middle East and North Africa (MENA) region are extremely dependent on food imports (less than 50% of food consumed is produced locally), Jordan counts amongst the most dependent. Even though there is no accurate number available on the percentage of imported foodstuff in the overall consumption, imports are considered to account for between 80 and 95%. The Monarchy is entirely dependent on imports of basic foods

such as sugar, corn, rice, and vegetable oils (if we exclude olive oil). It imports 98% of its wheat and 95% of its barley. The country depends on imports for 97% of its wheat consumption. Dependency on food imports makes Jordan extremely vulnerable to food spikes in prices of basic foodstuff. Before the Ukrainian war, the food crisis of 2007-2008 had already raised fears concerning the risks associated with increase in prices in terms of food access. Even though Jordan does not count amongst the most important importers of Russian and Ukrainian wheat (FAO, 2022), it will be affected by repercussions on the global market. Furthermore, the rise of wheat prices, coupled with the rising prices of fertilizers, will have a spill over effect on most foodstuff. For the prices not to be directly reflected in the consumers' expenses, the State must implement costly strategies that might be fundamental to maintain social stability. The subsidy on bread, that provoked great social turmoil when threatened, is the most important example of such strategies.

Food security is too often understood only in terms of availability of food. The most problematic factor, however, is the capacity of vulnerable populations to access food because of economic constraints. As an example, despite the difficulties in transporting goods and brief bans on exports from major producers, food availability was only marginally affected during the first year of the Covid-19 pandemic. Food access for vulnerable populations, however, worsened considerably: according to a rapid needs assessment on vulnerable Jordanian and Syrian refugees' populations, it is estimated that 32% of the households declared not having access to enough food, 83% of which associated this hardship to the lack of financial resources (WFP, 2020).

Evolution of the sector since the independence

After the 50s, Jordanian agriculture rapidly changed from a peasant agriculture, labor intensive, dominated by field crops, and mostly relying on rain and surface water, to a commercial model extremely dependent on inputs from foreign markets and mostly irrigated. The extension of irrigated surfaces contributes greatly to over abstraction of groundwater: in 2020, groundwater abstraction was three times higher than its recharge (GIZ, 2020), and wells need to be deeper while the quality of the water extracted decreases. Regional agreements over water resources, especially the Wadi Araba agreement in 1994, were unfavorable to Jordan's water endowment (Blanc 2010). The lack of agreement is also detrimental, as it is the case for the partition of the Disi groundwater, shared between Jordan and Saudi Arabia. In both cases, the scarce endowment compared to its neighbours reflects a lack of agency on the geopolitical level. If Jordan consumes very little water per capita when compared to its neighbors (World Bank, 2022), the management of the resource is inefficient at many levels. When it comes to agriculture specifically, water for irrigation is subsidized in many areas and farmers are not encouraged in any way to spare it. Jordan is characterized by scarce rainfall, with an average of 95 mm. However, some areas are much better endowed than others, notably the Northern areas around Irbid, Ajloun and Jerash (between 300 and 500 mm/year). Commercial agriculture, however, tends to be developed in areas that receive little rainfall, while most urban areas expand unregulated over arable land. The fragmentation of land is a major issue in areas that receive consistent rainfall and discourages agricultural production and investments (we will further develop this aspect in section 3).

Since the beginning of the Syrian crisis, the agricultural market has plummeted and does not seem to be getting any better. Because of its embeddedness in regional dynamics, the Jordanian market is systematically affected by regional geopolitical instability and turmoil. The invasion of Iraq in 2003 was a major plunge for Jordan, that lost its main commercial partner. In a similar way, the closing of the Syrian borders rendered impossible exporting via land towards Turkey and Eastern Europe. The Gulf countries are today the most important export market reachable via land. The demand of Gulf countries for agricultural products, however, is more and more limited because of attempts to rely on internal production for food security. Exports via air are very expensive when compared to other neighboring countries, and are profitable only for a few niche high-quality products. Given that most of the Jordanian agricultural production is perishable foodstuff, exporting through the Haifa port is often problematic because of the recurrent delays in shipments.

The port of Aqaba constitutes a similar obstacle, as products need one day to arrive to Aqaba and then between three and five days to cross the Suez Canal (Interview 1). Thus, the overproduction of perishable agricultural products, which was already an issue in the early 2000s, became a systematic problem in the price formation on the central market. Jordanian products also face issues in fulfilling quality requirements for export markets, notably the European ones.

Structural issues, lack of infrastructures and institutional setting

Jordan has signed a great number of international treaties (including bilateral free trade agreements with commercial partners) and strategies for policy-making are regularly issued by governmental institutions. However, only a small number of policies are actually implemented efficiently. Several inefficiencies can be identified in the institutional setting regulating the sector: poor management, overlapping competencies, lack of transparency, cooperation and resources are major obstacles that partially explain the absence of public intervention in the sector. Today, Jordan's public spending on agriculture is far lower than that of most countries, about half the regional average (World Bank, 2022). A few subsidies still exist, despite the pressure from international financial organizations, most notably on animal feed and on the price of wheat. Subsidies on water are the most controversial. Infrastructures are lacking, with extension services, transportation, and storage structures being insufficient or hardly affordable by a number of farmers. By law, all producers must sell their production on the central market of fruits and vegetables (as we will see later, there are exceptions). The institution however lacks transparency despite the prices being regularly published on the internet website of the institution not all producers are offered the same prices. As we will see in section 4, bypassing the institution is a common strategy to obtain better prices. Overproduction in the horticultural sector is also a reality: many farmers have focused on the same varieties (especially tomatoes) with the objective of exporting them to foreign markets. The lack of structures in the agri-food industry to process food is a major limit to the outflow of perishable foodstuff. Finally, financial inclusion is very limited. The Agricultural Credit Corporation (ACC) is the only existing institution specialized in agricultural finance. The reach of the ACC is limited as many farmers do not own the land they cultivate, which is required as collateral. Most of the credit issued are around 1,000 jordanian dinar (jd), resembling microfinance practices. No other private commercial bank or credit institution in Jordan issues credits specific to agricultural activities, as the sector is characterized by much higher risks and longer terms than any other sector. Thus, most producers resort to informal credits from intermediaries and traders to keep their activity afloat.

Methodology

The study outlines the main issues concerning the agricultural sector (environmental and climate constraints, obstacles to economic profitability, land tenure) and surveys the dominant agricultural systems existing in Jordan, divided by governorate. The research focuses on the governorates of Irbid, Mafraq, Jerash, Ajloun, Zarqa, Balqa, Amman, and Madaba. The Jordan Valley (JV) that is divided between the Irbid and Balqa governorates was treated as a single geographical unit for reasons that will be explained later. Even though some governorates encompass very different Agricultural Ecological Zones (AEZ) and agricultural systems, we abide by this division as it is the most used by national and international institutions and NGOs.

The study draws on several sources. First, the author has been conducting field research in Jordan on the agricultural sector for two years for the purpose of completing her own PhD thesis. A review of both academic and grey literature produced by researchers, international organizations, NGOs and public institutions was used to extract pertinent information and data. Further interviews were selectively carried with officials and experts, to cover specific topics such as land tenure and livestock. Finally, a questionnaire was run virtually amongst farmers to crosscheck the information collected. Circulating the questionnaire over all governorates was more difficult than expected, and it could not be representative of different agricultural systems in all governorates. It was useful to understand to identify specific problematics that affect

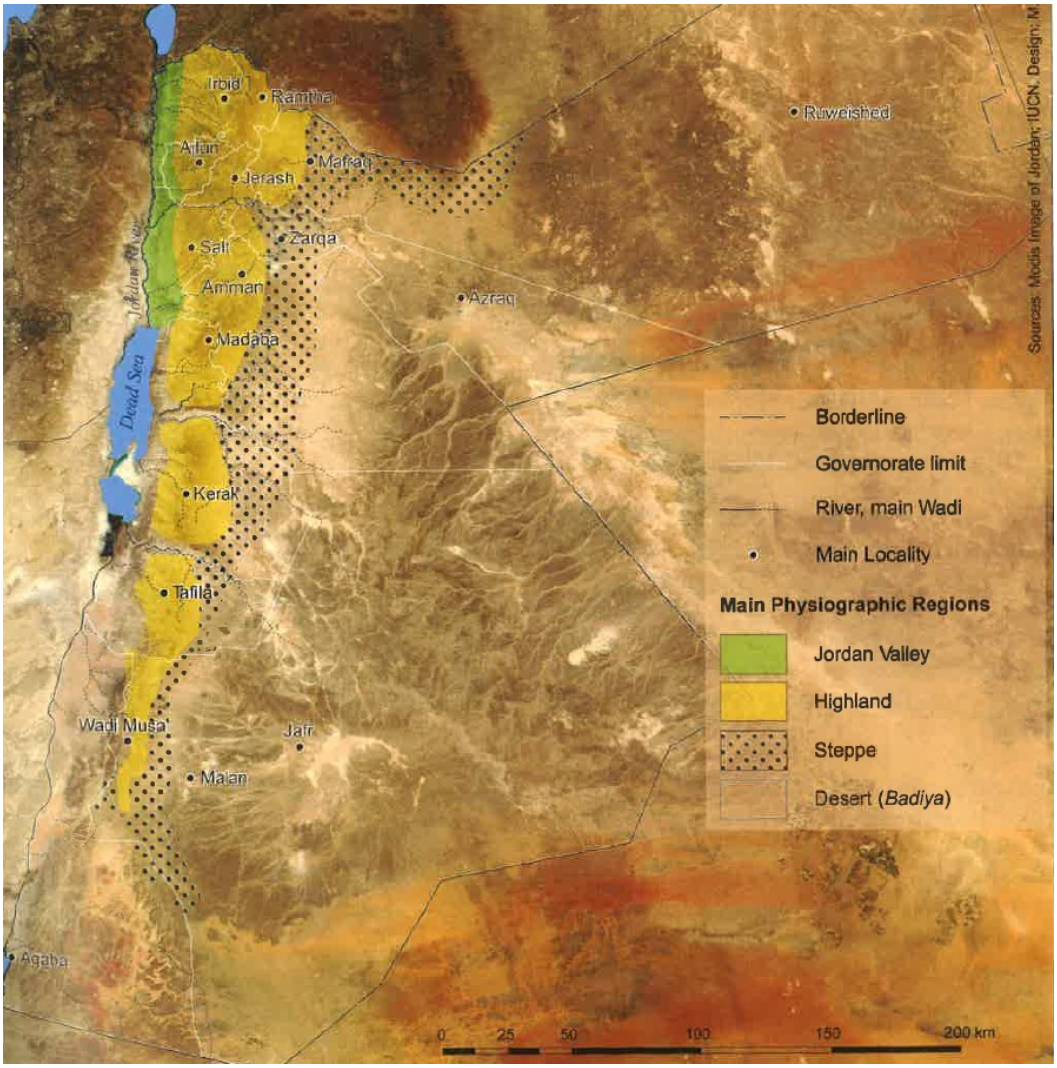
certain areas and to confirm general trends that had been observed by the author. The main results are summarized in annex 1. The data of the Department of Statistics (DoS) was particularly useful in obtaining pertinent figures and in recouping the qualitative approach adopted by the author in her own doctoral research. DoS provides data about the sector until 2020 and published the latest agricultural census in 2017, providing the most updated figures. In describing dominant agricultural systems by governorate and type of producers, we give insights about the main trends that drive Jordanian agriculture today. We use as a measure unit for the cultivated areas the donum (0,1 hectare), as it is the most common measure unit in Jordan. One should consider that the average size of farms in Jordan is inferior to the European one. Small farms are limited to surfaces from 5 to 20 donums (0.5 to 2 hectares). Medium farms vary between 20 and 150 donums (2 to 15 ha). Over 150 donums (15 ha) farms are considered large. A small number of farms extends on much larger surfaces (several thousands of donums).

This study is divided in four sections. The first section gives a general overview of the different climate zones present in Jordan and their characteristics. We then detail the main agricultural systems existing in each governorate. The second section treats separately the question of livestock. In Jordan, farming systems including both cultivation and livestock are not very common anymore. Livestock farms can be divided in three categories: intensive (all cattle and part of the sheep) and extensive systems (sheep and goats), and domestic livestock (small livestock largely oriented towards self-consumption). In the third section, land tenure is analyzed from a historical perspective. The different and often overlapping land tenure systems are outlined to consider the main issues that affect agriculture nowadays. Section 4 describes the main sociological categories of producers existing in the analyzed geographical areas. The great majority of Jordanian farmers produce for commercial purposes, but great differences exist in terms of social origins, profitability and constraints. Section 5 sheds some light on the functioning of the Central Market for Fruits and Vegetables, and on the different ways in which producers relate to it or avoid the institution. Finally, section 6 sketches recommendations aiming at considering agriculture holistically, in its environmental, social and political impacts.

1. Climate zones and agricultural systems in different parts of Jordan

Jordan can be divided in four main Agricultural Ecological Zones (AEZ) based on the topography, soil, and rainfall. The most peculiar is the rift valley running from the Northern Jordan Valley to Wadi Araba. Known to encompass the lowest point on earth (approximately 419 m below sea-level), this area is characterized by particularly elevated temperatures. It is on average 15 km wide and reaches 210 m below sea-level at the level of Tiberias Lake. On the East of the rift valley, we find the highlands, where average altitudes range from 600 m in the north to 1,000 m in the middle and 1,500 m in the south (Europeaid, 2012) and precipitations range between 300 and over 500 mm. Vegetation is very dense and varied, and it is the most inhabited area in Jordan. The third zone is the steppe that extends from the highlands to the badya. Rainfall ranges between 200 mm in the East and 350 mm in the West. The last zone is the badya region, or the North-Eastern desert. This AEZ is the most extended one, covering 90% of the kingdom, and has historically been used for grazing. Most of the area is a plateau with an altitude varying between 600 and 900 m, except the Azraq-Wadi Sirhan depression that used to collect water from adjacent wadis and was considered as an oasis of great importance for nomads and merchants trading between the highlands and the Arabian Peninsula.

Map 1. Climate zones in Jordan



Source: Ababsa, Myriam. Atlas of Jordan: History, Territories and Society. Presses de l'Ifpo, 2014. p. 45

1.1. Jordan Valley (JV)

As mentioned before, the Jordan Valley is a very specific geographical unit. Because of the high temperatures – especially during winter – and the convergence of water from the highlands through several wadis, it has historically been the food basket of the region. Its role of borderland and its importance in hosting the first waves of Palestinian refugees, explain the existence of a governmental institution that is specific to the valley. The Jordan Valley Authority (JVA) is an entity that was created in 1977 to manage the valley at many levels and was long considered "a state within the state" because of the extent of its functions. Its functions were reduced over time, but it is still the main entity in charge of agriculture and water.

In 1962, a land reform was implemented in the JV by the JVA. The reform was only partially successful in its aim of redistributing land and giving access to property to newly arrived Palestinian refugees, but has successfully limited the fragmentation of land. All plots in the JV are on average 35 donum (3,5 ha) – they vary between 25 and 50 donums.

Agriculture in the JV was strongly marked – and changed – by the construction of King Abdallah Canal (KAC), the largest scale irrigation project in Jordan. The construction started in 1959 but was interrupted several times because of conflicts. It was extended two times, in 1969 and 1987, to reach areas further south. The KAC conveys the surface water from the Yarmouk River and from other sources present in the North, and distributes it in the agricultural areas from the North to the South of the JV. Contamination is very frequent, as it is not a closed canal. Moreover, the water from the canal is supplied with water coming from the King Talal Dam (KTD) at Deir Alla' (central JV). The KTD provides a blend of freshwater and treated wastewater coming from the Samra wastewater plant. Thus, the water conveyed through the KAC from Deir Alla' towards the South is of a much lower quality than the one in the North and much more saline. Such water should only be used for certain cultures and is considered as dangerous for consumers' health if used to irrigate leafy plants, while risk hazard is considered much lower in the case of trees or for animal feed. However, extension services are generally lacking, and no program or subsidy were implemented to help farmers switch to cultures that are more adapted to the use of treated wastewater. Thus, many of them keep producing crops that are not necessarily safe for consumers. Many farmers of the JV couple the use of the KAC with private wells, especially in the dry season when the quantities distributed by the JVA are not sufficient. Groundwater in the Valley can be very saline and is not always suitable for irrigation. Many farmers in the South use it for cultivating palm date trees (very tolerant to salinity), while some others install desalination plants to cultivate different varieties (notably bananas). The desalination plants are not regulated and there is no data about the number of exploitations that use private desalination plants, that produce residues of extremely saline water. Depending on how much the salinity needs to be decreased, the amount of water rejected is more or less important, but it can easily reach 30 or 40% of the water extracted. In most cases, the extremely saline water is thrown back in the soil with no regulation or supervision.

Even though temperatures are generally high, climate in the valley changes considerably from North to South. Precipitations are also more abundant in the North (350 mm) with lower levels of evapotranspiration, while the South is more arid (280 mm of rainfall with higher evapotranspiration) (Teissier and Vallin, 2001). Most agriculture in the valley is irrigated and oriented towards an intensive, specialized, and commercial production. Two exceptions are the mountain slopes at the East and the land bordering the Jordan River on the West. The latter is a military area where access is restricted, making it more difficult to cultivate. We find more extensive systems and more rainfed crops. The mountain slopes are also characterized by more extensive and rainfed systems (olives trees and field crops) and are used for grazing small livestock (mostly sheep and goats).

Most intensive farming systems using localized irrigation and depending on the water of the KAC have an irrigation pool, where it is common to have fish that contribute to enriching the water with natural fertilizers. The production of fish is not for commercial purposes. Using pools to store the water is a way to limit the dependency on the supply from the JVA pipes and helps eliminating the biggest particles.

1.1.1. Northern JV

In this part of the valley, we mostly find fruit trees (grenades, citruses, bananas). It is estimated that fruit trees need twice the amount of water that vegetables need, while bananas need four times the amount of water of vegetables (Teissier and Vallin, 2001). Many of these exploitations belong to absentee landlords or investors. Absentee landowners either employ a manager or entrust the land to sharecroppers. As these orchards are very demanding in water, licenses have been slowly distributed by the JVA until the end of the 80s, when they were completely frozen. Specifically, the plantation or replantation of bananas was forbidden because of the need of even higher amounts of water. This did not prevent influential personalities to plant further surfaces, with or without the permission of the JVA (Teissier and Vallin, 2001). The majority of fruit tree plantations use localized irrigation, even though some still use flood irrigation. We also find open field vegetable farms.

1.1.2. Central JV

Deir Alla' is the hearth of the JV, both as an urban and agricultural center, featuring mostly vegetable farms. The adoption of techniques such as greenhouses, plastic mulch and drip irrigation has been massive and has considerably increased the productivity. Greenhouses have become the main characteristic of the landscape in this part of the valley. Small tunnels used during winter and open field plots are also common. Different systems are rarely associated on the same plot, but we find associations between greenhouses and open field vegetable cultivations (Millet and Moreau-Richard, 2004). The dominant crops are the main vegetables used in the Jordanian cuisine: tomatoes, cucumber, bell peppers, red peppers, eggplants, tomatoes, zucchini, green beans, lettuce, cabbage, spinach, onions. It is common to associate several vegetables on the same plot, and to rotate different crops according to the season. Most vegetable farmers are tenants (either short term leases renewed every year, or long term, typically twenty years).

1.1.3. Southern JV

In this part of the valley temperatures and evapotranspiration are more elevated, soil is sandier and more saline. Banana and date farms are the main cultures. Specifically, Medjhoul dates (dried dates) have been expanding since the 90s. The high temperatures of the Southern JV are particularly suitable for the drying process. Given the nature of this crop (initial cost, first harvest, labor etc.) it is generally an investment for urban elites that do not solely rely on that income and that can afford buying the land. Dates are particularly adapted to the saline water available in this part of the valley, but the amounts provided by the KAC are not always sufficient to maximize the production. Date palm trees are still in expansion in the areas to the South of Karameh. Bananas, on the other side, are much more water-consuming, and need high-quality water. Under the pressure of international organizations, the government has been trying to shrink the production. Banana producers being a powerful lobby, attempts were unsuccessful.

1.2. Irbid, Ajloun, Jerash and Balqa

Irbid, Ajloun, Jerash and Balqa are mountainous areas, where precipitations are more consistent than in other parts of the country. Altitude ranges from 300 to 1,200 m, and the governorates border to the West with the JV and to the East with the steppe. The governorate of Irbid encompasses the northern half of the JV, while the Southern JV is part of the Balqa governorate. The analysis of these two governorates excludes the JV. Nowadays these regions are largely dominated by rainfed fruit trees (mostly olive trees), while arable lands are cultivated with cereals (wheat, barley, and pulses), chickpeas and lentils. These systems are generally associated with livestock (sheep and goats), that feed on cereal stubbles after the harvest, and do not necessarily belong to the owner of the land.

Jerash, Ajloun and Balqa are mostly characterized by steep slopes and narrow valleys. Over 1,000 m the hillsides alternate between forests of oaks and pistachio trees, and scrubland, both grazed by small livestock. At altitudes between 500 and 1,000 m, we find monocultures of olive tree, supported by

drywall terraces. The foothills are the areas in which the agricultural system is the most diverse. At these altitudes (below 300 m) olive trees are often mixed with fruit trees (mostly apples, plums, pears, apricots, figs and vines). The flats are planted with cereals and pulses, and livestock grazes after the harvest. Balqa being more in the south, hills are less elevated and vegetation (especially forests) is less present. This region is rich in water sources: the river Zarqa provides surface water to the surrounding areas ahead of the KTD, and several other minor streams and natural sources exist.

Agricultural systems in these governorates were characterized by a combination of polyculture and livestock, and evolved to farms specialized in olive trees or different types of orchards between the 60s and the 80s. Over the years field crops and livestock diminished and are today marginal. Family farming gradually ceased, as youngsters were looking for employment in the public sector or in the army, and production changed towards a less labor-intensive and more market-oriented agricultural system. In these three Northern governorates agriculture constitutes a marginal or complementary source of income. The fragmentation of the land is a major issue that will be analyzed in section 3. The minimal size of a plot of land is established by law at 10 donums, but numerous municipal exceptions have reduced this limit to 4 donums. The plots, even very small ones, are generally owned by several owners. This has discouraged agricultural production as the plots are not sufficient anymore to feed a family or to turn a profit, and their management has become more difficult because of the increasing number of owners. The value of these farms is not necessarily associated to an economic rationale, as they are not always profitable. This is particularly true for olive trees that are often valued mostly for their symbolic and emotional significance. Investors need to gather sufficient trees to produce oil with a commercial purpose. The inflation of the land market has made agricultural profit minimal compared to the cost of plots or to investments in the real estate market. Nevertheless, as prices have been relentlessly rising, owners are not in a hurry to sell as they might obtain a better price waiting.

Irbid, on the other hand, is characterized by plains where water sources and surface water do not exist. Rainfed orchards are still very present but larger surfaces are cultivated with cereals and pulses. The area around Ramtha is the only one where agriculture is more intensive, with commercial farms producing mainly vegetables (both open fields and greenhouses) and fruits. These farms systematically rely on irrigation through groundwater. Small livestock and extensive systems are not particularly present compared to other governorates, while the amount of cattle is relevant.

1.3. Mafraq

Mafraq is a very extended governorate, that comprises three different AEZ: it starts on the slopes of the highlands, then the main urban area (also called Mafraq) marks the beginning of the steppe, while most of the territory extends towards the East in the badya. Because of its proximity with Syria, Mafraq is marked by the presence of Syrian refugees, many of whom live in the Zaatari refugee camp.

Mafraq is considered to be the region for investments in commercial agriculture *par excellence*. We find horticulture, in both greenhouses and open fields, and irrigated orchards (the majority of fruits in Jordan are produced in Mafraq according to Al Naber and Molle, 2017). This might appear rather surprising given that precipitations are not particularly abundant and that the landscape appears as extremely arid. However, given the possibility of accessing cheap groundwater and the climate allowing to cultivate most of the year, most relatively new agricultural investments are based in Mafraq. The reliance on groundwater is extremely problematic as it is provoking a rapid depletion of the increasingly saline aquifer. Wells are already very deep and the MWI (Ministry of Water and Irrigation) receives more and more permit demands to increase the depth of existing wells. According to Nabil Assaf (FAO – Food and Agriculture Organization), this will make agricultural production in Mafraq impossible in the medium or even short term. The cost of initial investments in Mafraq is very high because of the low level of the water table. The price of water is marginal, but the price of electricity for pumping water is considerable. Salinity is increasing but is still suitable for most crops. Nineteen percent of wells are legal and titles of property are clearer and more secure than in other arid areas.

Barley, clover trefoil and wheat are the most common annual crops. Fruit trees (mostly olive and grape) are irrigated. Horticulture is present in both open fields and greenhouses. Livestock is also consistent, for both small animals and cattle. Small livestock relying on grazing most of the year is a traditional activity in the badya, while intensive farms of cattle are a more recent phenomenon. Farms in Mafraq are bigger on average than in other governorates (Table 2). Big farms often rely on different type of agriculture that are not necessarily combined on the same plot.

1.4. Amman, Madaba and Zarqa

The governorates of Amman, Madaba and Zarqa are situated more in the South, and constitute the transition from mountainous areas to plains. Precipitations are between 100 and 250 mm and the altitude varies between 500 and 1,100 m. The governorate of Zarqa, however, needs to be divided in two parts: the Western part, closer to Amman, where the climate is closer to Amman and Madaba, and the arid area of Azraq in the East. As agriculture is also present in Azraq, we will address it further on in this section.

Most of the cereal production in Jordan was concentrated in these areas (Amman, Madaba and the Eastern part of Zarqa's governorates) until the 60s. Jordan was then famous for its varieties of hard wheat that exceeded the national consumption and were partially exported. The unregulated urban sprawl, however, limited the arable surfaces in these areas extremely suitable for agricultural production (جبريل 2018).

Today we find mostly commercial agriculture, especially around Madaba and in the South of Amman, even though barley and wheat are still cultivated on limited surfaces. Irrigated and rainfed crops and orchards are present, most fruit trees being olives and grapes. Horticulture is practiced in both greenhouses and open fields. Commercial cultivation of strawberries in greenhouses is a growing business. Intensive farms breeding cattle abound in the Zarqa governorate, especially in Dhlail (20 km East of Zarqa). Around 40% of the total cattle in the country is found in this governorate. Both Zarqa and Amman concentrate considerable amount of the national livestock: if put together, these two governorates amount to 29% of total sheep and 23% of total goats in the country. One must however consider that Zarqa and Amman are much larger in size than Irbid, Ajloun, Jerash, Balqa and Madaba.

The area of Azraq, in the Eastern part of Zarqa governorate, is a very specific ecosystem. It used to be an ancient oasis, but the abundant groundwater was diverted in the 60s in favor of the urban population of Amman. In 1978, the Royal Society for Conservation of Nature (RSCN) established Azraq's wetlands natural reserve, but the spring dried out in 1992. Today RSCN artificially pumps groundwater to maintain 10% of the original wetland.

Agriculture developed as investors were attracted by cheap land prices and accessibility of water. In the early 2000s the level of the water table had decreased considerably, and the salinity increased. Water productivity is now 5 to 10 times lower than in Mafraq (Al Naber and Molle, 2017).

The government tried to limit groundwater abstraction in the early 2000s. All wells built after 2005 are considered illegal. Despite the great number of illegal wells that are still in use today, the government has succeeded in limiting the expansion of cultivated surfaces in Azraq. Moreover, because of the harsh weather conditions, agriculture in Azraq is limited to 2 or 3 months of the year. Most farms are also not very large (around 20 donum), which makes them unattractive to big investors. Thus, agricultural investments in Mafraq are much more profitable despite the considerably higher initial costs.

2. Livestock

Livestock is a fundamental component of the Jordanian agricultural sector because of the employment opportunities that it provides and as it constitutes a major share of the output of the sector (55% according to IFAD 2017). It also contributes to agricultural exports. The DoS has updated numbers by governorate about existing livestock until 2020 (see table 1). Sheep is the most important type of livestock, with about 3 million heads in 2020, followed by goats (approximately 800,000) and cattle (80,000). The governorates where most sheep are bred are Mafraq and Amman, while for cattle it's Zarqa, Mafraq, Irbid and Amman. Goats are more evenly spread across governorates. Contrary to most sheep and goats, cattle is mostly bred in intensive structures with imported varieties.

Table 1. Number of Sheep, Goats and Cattle by Governorate as on 1/04/2020 and 1/11/2020

Governorate	Number on 1/4/2020			Number on 1/11/2020		
	Sheep	Goats	Cattle	Sheep	Goats	Cattle
- Total	3,188,870	811,830	78,080	3,002,290	762,750	77,890
- Amman	605,140	94,400	11,020	580,170	87,030	10,180
- Balqa	138,560	66,750	2,120	141,540	66,140	2,430
- Zarqa	319,550	90,540	31,830	314,650	86,690	33,060
- Madaba	163,820	39,290	1,840	161,320	37,720	2,020
- Irbid	284,930	55,470	13,550	251,030	54,470	12,740
- Mafraq	855,020	69,380	14,070	789,530	67,540	13,720
- Jarash	25,180	32,790	2,120	20,290	30,490	2,140
- Ajloun	19,670	41,630	1,260	15,550	31,340	1,310
- Karak	358,610	91,500	120	334,610	84,990	130
- Tafilah	111,810	24,920	40	98,820	23,430	40
- Ma'an	243,730	98,170	100	235,690	92,420	120
- Aqaba	62,840	106,990	0	59,090	100,510	0

Source: Department of Statistics, November 2022

Grazing small livestock has historically been a major and traditional activity in Jordan and is still practiced in all governorates. The sheep outnumber the goats, as their meat is more appreciated and is directly associated with Jordan's most traditional dish, Mansaf. It is not uncommon to see herds of both sheep and goats. Pastoralism employs Jordanians and Syrians alike, as owners generally do not herd their animals themselves. Economically, small livestock constitutes 32% of livestock sector, but is most important for poor rural communities, especially in the Badya (IFAD 2017).

During wintertime, some herders feed their small livestock in enclosures. Other, especially medium and large herds, practice the transhumance, moving from the highlands to the JV, where feed is more available over winter and the temperatures are more adapted. They remain there for three months/year, and come back to the highlands in February. If it is often presented as an unsustainable activity ("overgrazing"), the radical dismissal of the ecological value of such activity has seriously been questioned in the academic literature. In fact, many experts consider pastoralism to have a positive impact on the environment, while being an essential source of livelihood for poor rural populations. Contrary to what we will see with cattle, endemic races are still in use and constitute most of the heads in Jordan. The Awassi sheep is the main local breed in use. It is highly resistant to the summer heat and to the winter conditions. For all type of livestock farms, feed availability and price are the greatest challenge, and have been at the origin of protests amongst herders. Subsidized feed meets about 15% to 20% of the feed used by small-scale herders. Despite attempts, the Government has been unable to withdraw subsidies because of political pressure.

As already mentioned, cattle is mostly characterized by intensive breeding. Local varieties of cows have virtually disappeared, replaced by high yielding exotic varieties (mostly Holstein Frisian). The average farm counts about 80 heads (Alqaisi, unpublished). An inferior number of heads would hardly be profitable because of the high costs associated with inputs. Most farms are in Dhlail (20 km East of Zarqa, Zarqa governorate) because of the cheap price of land, available water and the distance from urban areas. The production is mostly destined to the national market. As cattle constitutes a major investment it is generally managed by a family for which it is a major source of income. Family members oversee the management of the farm, while the labor consists of migrant workers (often Egyptians).

3. Land tenure management and related issues

The management of land in Jordan is centralized and based on a Western model of land tenure, but only for a small share of the Jordanian territory. State land constitutes 75% of the whole territory. Compared to other countries of the region, Jordan has a fairer division of land, that favoured small and local investors and small-holders (Fischbach, 2000; al Naber and Molle, 2016), with some exceptions of very large lands that were granted to investors or companies (notably in Disi, 2022 سلامة).

Table 2. Size of farms by governorate.

	Livestock			Crops			Total		
	Area	N°	Average	Area	N°	Average	Area	N°	Average
Amman	8060	3021	2.667991	200603	7239	27.71142	442492	11273	39.25237
Balqa	2487	1713	1.451839	201668	6314	31.93982	208215	8229	25.30259
Zarqa	22459	1968	11.41209	233584	1755	133.0963	273847	3942	69.46905
Madaba	3790	1161	3.264427	65845	3329	19.77921	79280	4899	16.18289
Irbid	16912	5109	3.310237	398185	28427	14.00728	439662	34889	12.60174
Mafraq	3704	3658	1.012575	498240	4544	109.6479	557364	8807	63.28648
Jerash	317	1004	0.315737	89451	6906	12.95265	98099	8398	11.68123
Ajloun	294	706	0.416431	56552	6166	9.171586	60376	7140	8.456022

Source: Developed by the author on the base of data from the Agricultural Census of 2017, Department of Statistics (DoS).

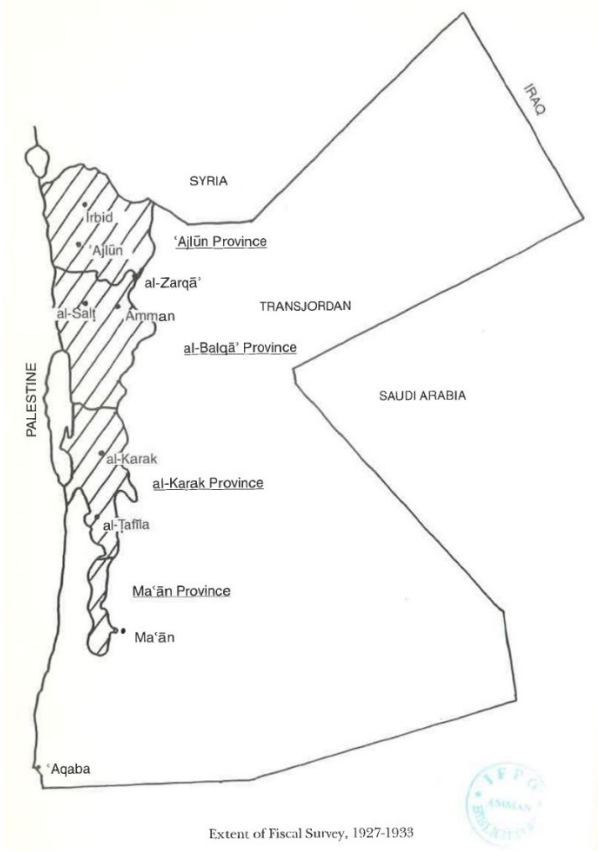
3.1. Overlapping Legal Systems

However, land tenure is a very complicated issue because of the legal pluralism that exists in different areas. This pluralism is the result of overlapping legal systems and informal practices that have never disappeared. The major division that needs to be considered is between the land that was surveyed by the British during the second half of the 1920s, and that has been divided in individual property and recorded at the Department of Land and Surveys (DLS). One of the major objectives of the British survey was to create a base for taxation (to increase state revenues) and was thus carried where agricultural activity was more intense and rainfall more consistent

All the other territories, mostly arid and semi-arid areas in the East and the South (the white area in Map 3) were of limited interest for agriculture, and most of it became state land. Today, state land still constitutes around 75% of Jordanian territory, but as we will see, individuals have implemented several strategies to appropriate it, which complicates the status and the usage of such land. Agricultural activity has been central to the appropriation of state land by individual users. A major exception to this division is the JV, as the JVA implemented its own land reform in the valley and has long managed the land independently from the DLS.

By law, all land transactions have to be registered by the DLS, which has computerized a big share of its procedures and cadastral database (the land in the JV was managed autonomously by the JVA until the early 2000s but is now also registered by the DLS). However, the data recorded and the conclusions that can be drawn from it are relatively limited: different owners might have the same name, while some individuals are registered under more than one name; the cadastral plans do not show details – not even names or buildings; there are discrepancies between the plans and reality. Moreover, land tenure in Jordan is a multi-layered issue, where the market is also regulated by informal practices. The hijja (see Al Naber and Molle, 2016) is the most common vernacular agreement still in use, and the most common example of legal pluralism in Jordan. The hijja is a traditional oral agreement to carry out transactions over land property that falls outside the legal ownership system officially recognized by the State. The validity of the hijja is sometimes recognized by justice institutions, but the recognition depends on the context: they are generally not recognized on lands close to urban areas, where the price is much higher, while their value is often acknowledged to settle disputes in rural areas.

Map 3. Areas subjected to the British Survey



Source: - Fischbach, "State, Land and Society in Jordan", 2000.

3.2. Fragmentation of land plots and access to State land

The DLS was created in 1927 in the wake of the colonial land division and registration imposed by the British administration. The division of land was based on private and individual property and cancelled any legal form of collective land tenure, which is highly problematic for agricultural land today. Most agricultural plots have shrunk over time because of the fragmentation process caused by inheritance. The plots shrank at a fast pace in the decades after the land reform, threatening rural livelihoods as plots were not large enough for a family to sustain itself, and became too small to be tilled effectively. Ajloun is the area in which plot sizes are the smallest, and already by 1953 most plots were less than 10 donums. Soil erosion emerged as farmers started tearing down communal erosion banks and windbreaks to focus on their new individual plots of land. Erosion became a consistent problem by the 50s (Fischbach 2000, p. 135-8).

The problems associated with undersized plots are particularly present in areas that receive consistent rainfall (Irbid, Jerash, Ajloun, Al Balqa, Madaba, Amman, al Karak and Maan) as the British surveys in the late 20s focused on the main agricultural lands of the time and excluded altogether the Eastern and Southern parts of the country. The land in the JV is an exception as it was reformed in the 60s because of the resettlement of Palestinian refugees. The JVA bought the land to operate a redistribution between Jordanian families and Palestinian newcomers. The reform did not succeed in favoring Palestinians in accessing land but favored a class of urban merchants that invested in agriculture, still very present in the valley. It succeeded in limiting the division of land, with plots ranging between 30 and 50 donums. In the rest of the governorates that were subject to the British survey, the division of plots was limited by law to ten donums, but exceptions became common, mostly for construction purposes.

The fragmentation of land in these areas (that exclude the JV, as it has undergone a specific land reform in the 60s) thus discouraged agriculture and favored urban expansion. Agricultural development was concentrated in the semi-arid and arid areas officially belonging to the crown. By law, state land can be laid hold if it has been cultivated from an individual for five years (even though, also by law, state land cannot be used). The land can then potentially be regularized with the DLS after the approval of a specific committee. Increasing land prices accelerated the cultivation of state land in arid areas (Madanat, 2010). This phenomenon partially explains why most commercial agriculture in Jordan today is based in arid areas entirely relying on groundwater.

3.3. The political use of land and larger landowners

As we have seen, land management in Jordan did not favor big landowners. However, we nuance this statement with three counterexamples. A few families have historically been large landowners – for example the Bisharat and the Abu Jaber families in the South of Amman – (Ababsa, 2012) but have then used their assets to invest in the construction sector (as it has become more and more profitable) or rented out the land instead of farming themselves, and the properties are more and more scattered. Tribal rights to land (wajihat) are also associated with large areas in which members of the same tribe own most of the land. Much of the state lands are claimed by tribes that never registered but have historically used those lands. However, it would be simplistic to consider tribes as a single power unit. Finally, land redistribution has historically been a key strategy of the Monarchy to pacify the kingdom. In short, accessing state land has become “a key avenue of capital accumulation” and "the politics of land allocation are deeply enmeshed in wider national politics and games of influence and power.” (Al Naber and Molle, 2016).

3.4. Rising land prices and other issues

Rising land prices created much more pressure around land access, pushing tribes to be more vehement about their claims on land and exacerbating rivalries over land tenure. Speculation on the increasingly profitable land market has become particularly significant after 2005, when many investments from the Gulf countries were redirected from Lebanon to Jordan (Ababsa, 2012). Between 2005 and 2008 specifically, the “land market bubble delivered a hard blow to agriculture, whose financial yields became negligible compared with the profits realized by speculations” (Madanat, 2010). In Mafraq for example, a donum of land went from 30 jd in 1995 to 1000 jd in 2016 (Al Naber and Molle, 2016). The increase in rural areas is nevertheless not comparable to urbanized areas, where prices have skyrocketed, encouraging uncontrolled urban development over historically agricultural rainfed areas (2018 جبريل). Access to land is also connected to other issues, such as the access to agricultural equipment and work permits. It is common that work permits in agriculture are then resold to the construction sector for profit. Finally, owning land is the only way to obtain agricultural loans from the ACC.

4. Main Sociological Profiles of Producers

4.1. Noncommercial agriculture

Peasant agriculture oriented towards subsistence has virtually disappeared. The peasants (individuals that practice subsistence agriculture) that are left own or rent extremely limited surfaces of land and are forced to sell their labor outside the farm. Subsistence, family-based agriculture still persists in the mountainous areas of Ajloun, Jerash and Irbid, but only constitutes a minority. In these areas, some families still cultivate their own land, but do not aim at making profit. Often the principal motivation is emotional attachment to the land. Moreover, the price of the land having been rising, keeping the land is sometimes seen as an investment while waiting for the price to increase further.

4.2. Complementary incomes and sharecropping

Pensioners from the army are a type of producer that is very present in the governorates of Ajloun, Jerash, Irbid and Balqa (even though they are also found in different governorates). Pensions from the army are not sufficient to sustain a family, and ex-militaries often look for extra sources of income. Some of them invest in buying the land from neighboring farms, to produce olives, olive oil or other fruits. If they own an insufficient plot of land, or no land at all, they establish a sharecropping agreement with landowners from the area who are not interested in managing the land themselves. The head of the family then works the different plots, often employing other family members. External labor is sought during harvesting or planting seasons on a daily or hourly base. Most sharecropping agreements require the farmer to share half of the harvest or half of the income with the owner of the land.

"Foreign" sharecroppers are present in commercial agriculture.

"Pakistani"[1]

sharecroppers have been present for generations and invest in the agricultural sector in all the main commercial areas (Ramtha, Mafraq, JV, South Amman and Madaba). This is a very specific type of farmers, as they do not use their profit to improve their lifestyle, but to save and possibly reinvest in their country of origin. "Pakistani" sharecroppers rent the land and reduce costs to the minimum by living in tents on the farm and by employing all family members in working the land. The sharecropping agreement is also on a base of dividing outcomes (profit or harvest) on a 50/50 base. Since the beginning of the Syrian crisis, some families of Syrian farmers practice agriculture on similar basis.

4.3. Entrepreneurial, Commercial Agriculture

Today most agriculture in Jordan is entrepreneurial (or commercial) agriculture: production is oriented exclusively to the national or international market, producers' main goal is the maximization of profit, and the farming system that they operate is entirely dependent on external inputs (not produced in the farm) (Ploeg, 2009). Except the two cases mentioned above, farmers employ labor external to the family. Workers in the agricultural sector are migrant workers, mostly Egyptians, while Syrians are more present (especially in Mafraq) since the beginning of the Syrian crisis. There are Jordanians and Palestinians working in agriculture, but they are few and mostly come from extremely impoverished social settings.

[1] "Pakistani" is in quote here as these sharecroppers are widely referred to as Pakistani, but in reality most of them have been in Jordan for at least one generation and they are said to speak Jordanian Arabic perfectly.

Agricultural investors can be differentiated in two classes. On one hand, we find producers for whom farming is the main or only source of income, and that have become more and more precarious. Indebtedness is a very common feature, even though it is difficult to quantify the percentage, as most of these debts are informal. These producers take informal credits from traders and intermediaries that cumulate year after year, and only rarely succeed in reimbursing them fully. Farmers specialized in vegetables are the most affected by the decreased profitability of the sector.

The second class of commercial farmers are entrepreneurs that have the means to develop strategies that allow them not to depend on credit. In many cases, they have another source of income that allows them to keep the farm afloat during bad years. It is not uncommon for these farmers to be involved in the sector otherwise: they can be traders, intermediaries that sell inputs, or agricultural engineers. These individuals use their contacts and knowledge of the sector to identify profitable sectors or crops. In the case of very profitable and prestigious products such as medjhoul dates, the owners might be investors that have a primary source of income that is not necessarily connected to the sector.

5. Understanding the Central Market and alternative marketing strategies

The Central Market of Fruits and Vegetables is an institution that was created in 1995 to centralize the trade of agricultural products, both imported and produced locally, to facilitate transaction and ensure the application of a free market system. There are several central markets in Jordan based in other important cities, but it is through the one in the Southern suburb of Amman that the great majority of products transits. The State taxes producers at the entrance and at the exit of the market, but only exerts a limited control over transactions. Price formation is based on the weighting of products entering and exiting, and is made public on the website of the central market. A limited number of traders (85 according to the official website) own shops inside the market, and are responsible for the transactions with the producers. Traders are an important source of informal credit, which creates a constraining relation for farmers that are indebted.

Because of the low prices on the central market, selling the production elsewhere is a major strategy for farmers that are not bound by debt. A common way is to establish contracts with big supermarkets or multinationals such as Carrefour, Careem or Del Monte. This however requires fulfilling certain quality standards that are not achievable by more vulnerable farmers. Other strategies include selling through online apps, Whatsapp groups or informal shops. These strategies require strong personal connections and knowledge of the market. Farmers who do not manage to sell the entirety of their production through alternative strategies might resort to the Central Market to sell remnants. Nowadays, and especially since the closing of major export routes, marketing strategies are central in ensuring the profitability of a farm.

6. Recommendations and Conclusion

The agricultural sector is connected to many increasingly problematic issues that might threaten the stability of the Hashemite Kingdom. The evolution of the agricultural system towards an intensive and commercial model, as well as the deregulation of the agricultural market and prices, have contributed to the depopulation of rural areas and to current skyrocketing levels of unemployment. It is at the origin of the degradation of the soil quality and of the pollution of the scarce water resources. The expanding irrigated surfaces accelerate the depletion of groundwater resources. The concentration of agricultural investments (both private and governmental) in arid and semi-arid areas contributes to worsening the abovementioned issues. The perpetuation of a commercial model focused on high value crops hardly helps strengthening food security or reducing unemployment. The fragmentation of land in the areas that receive consistent rainfall, and the overlapping and contradictory legal systems applied in the badya are major structural issues. The disengagement of the State from the sector and the lack of institutions and infrastructure also affect producers and consumers negatively. As an example, the overuse of pesticides provoked by the lack of extension services has a negative impact on soil and water resources and creates an important health hazard for the population (the recent increase in prices for agricultural input may however have impacted the amounts of pesticides used by farmers). The high levels of dependency on food imports are an important factor of risk, especially for the poorest segments of the population. Countries highly dependent on food imports are more vulnerable to the volatility of prices for basic foodstuff on the international market, as dependency considerably reduces the room for manoeuvre to mitigate the price increase on the national market. In a context in which levels of poverty are rising, spikes in the price of wheat might considerably threaten social stability, or compel the government to invest more in subsidies to artificially keep the prices down. Grain reserves can be a temporary solution, but will not be sufficient in a context of generalized and protracted inflation.

A greater presence from the State seems central to solve structural issues that have been negatively affecting producers and the sector at large. More regulation is necessary both in terms of control over practices and support to producers. A combination of these could result in improved quality and healthier produce. A greater outreach capacity of extension services is essential to reducing the overuse of chemical fertilizers, pesticides, and water, which are very common practices amongst producers, which have severe consequences on both resource degradation and consumers' health. The survey that was carried out during this study also revealed a lack of information amongst farmers, especially concerning alternative and sustainable practices and the existence of organic pesticides and fertilizers.

More coordination at the national level over crops could also result in better prices and shrink overproduction, while reducing the amount of water destined to irrigation by limiting water intensive crops in favor of drought resistant varieties. Wider long-term public policies as well as more public spending in the sector are necessary to such goals. Negative incentives and fines have already showed their limits in the case of regulation of ground water use (Molle, 2009). Positive incentives, on the other hand, might be much more efficient in promoting sustainable practices and to improve the overall impact of the sector on the environment. However, the regulation should not be limited to agriculture: the loss of arable land for construction purposes contributes greatly to soil degradation and reduces the possibility of developing an agricultural system that relies less on irrigation based on ground water.

Development in the sector should not simply be understood as an opportunity for economic growth but firstly as a tool for preserving and improving the quality of resources and restoring soil quality. Alternative techniques that are more and more recognized such as agroecology and permaculture, offer a set of tools and practices that could reduce soil degradation and the quantities of irrigation water necessary. Several projects in Jordan have already proven the potential of such techniques that yet require a few years before showing results. However, in the wake of the current environmental crisis, the priority cannot be given to economic profitability, and the implementation of these techniques should be considered as a long-term investment for future generations. As vulnerable farmers cannot

afford to undertake such a process, and as it is not immediately profitable for entrepreneurs to do so, financial incentives might facilitate the transition towards an agricultural system capable of impacting positively the resources and the environment. This type of long-term investment can also be seen as a form of compensation for farmers and rural communities that are enduring the most noticeable effects of climate change.

Technological improvements such as soil-less agriculture, that have been considerably advocated for both by national and international institutions, often hide social or environmental side issues. With no support from the state, most vulnerable farmers cannot afford transitioning to hydroponics, or invest in drought resistant profitable crops like the date palms. Soil-less agriculture specifically, encourages further cementation of arable land and use of energy in order to create the protected environment necessary to this type of cultivation. Moreover, the varieties that can be cultivated are extremely limited. It might however produce more positive outcomes in urban areas than it would in rural ones.

Discouraging commercial agriculture in arid areas is necessary to stop over abstraction of underground water. Despite the generalized adoption of water saving techniques (drip irrigation is the most common technique), the extension and maintenance of surfaces that systematically need to be irrigated appears as a non-sustainable trend. Reinvesting areas that receive important rainfall and that have been gradually marginalized in terms of agricultural production with less commercial-oriented practices might entail social and environmental benefits. The issue of land fragmentation is certainly central and can only be solved through extensive public policies. However, the involvement of local communities in forms of association or cooperatives might mitigate the negative impact of the fragmentation. The integration of small scale, agroecological agricultural production into short local commercial circuits, and basic forms of food processing (tomatoes drying, olives and aubergines processing etc.) might be a way of revitalizing local communities and providing employment opportunities.

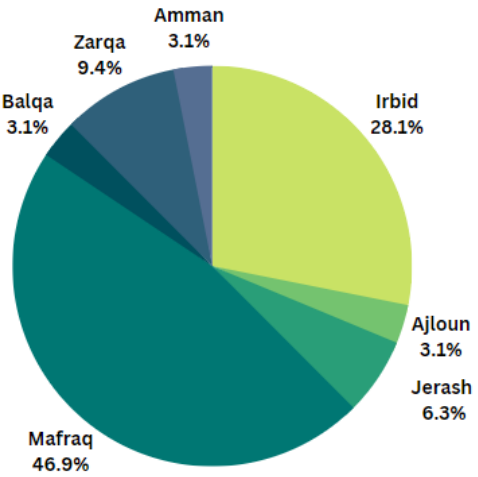
A radical reform of governance in agriculture could thus help mitigate urgent environmental and social issues, while reducing dependency on imported foodstuff. A more important presence of the state appears as fundamental to orient the production and support the sector. Less intensive agricultural systems should not only be valued for food production, but also for their capacity in restoring the environment and for their potential in revitalizing rural communities.

Annexes

Annex 1 - Online Questionnaire's Results

The questionnaire was circulated between October and December 2022 but could only reach 32 respondents. Despite the attempts to make it circulate through WhatsApp and Facebook groups, including through direct elicitation of farmers in specific areas, a more consistent number of respondents would require a much greater investment of time. Most of the respondents were beneficiaries of Smart Desert Project and are based in Mafraq (15), followed by farmers based in Irbid governorate (Ramtha) (9). Zarqa, Jerash, Ajloun, Balqa and Amman were also represented.

Figure 1. Location of the farms by governorate



Source: Original creation of the author, L. Perosino.

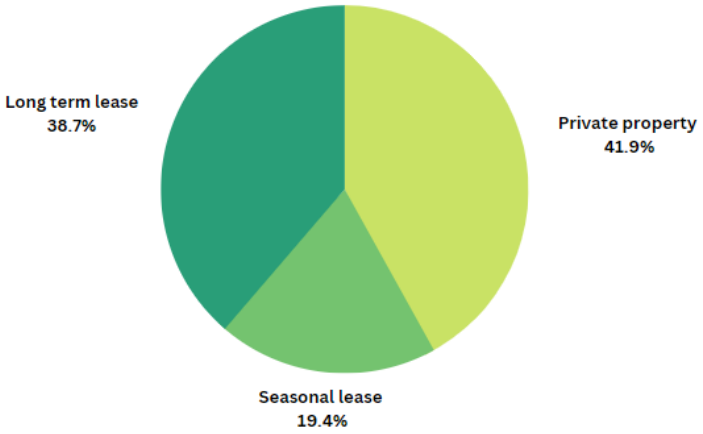
About 69% of the participants produce vegetables, most of which in open fields, many of which cultivate both vegetables and fruit trees. Only three out of all participants also had livestock. Hydroponics systems are used by 28% of them. Almost 60% reported selling their products on the central market, 40% sell on the national market and 22% to local traders (they do not transport the products to the central market themselves).

Surface and land tenure

All respondents have very small farms, the smallest being half a donum. Only two respondents having farms that range respectively between 100 and 250 donum and 250 and 500 donum. The rest of the participants have surfaces that are under 70 donums, the majority being comprised between 1 and 10 donum (14/32).

Land tenure can be divided in two major groups: about 40% of the participant owns the land that they cultivate (which is not surprising given that it is mostly small or very small farms). Almost the equivalent number of participants has long-term rent leases. A less important group accesses the land through sharecropping agreements.

Figure 2. Type of Lease or Ownership of the Farm

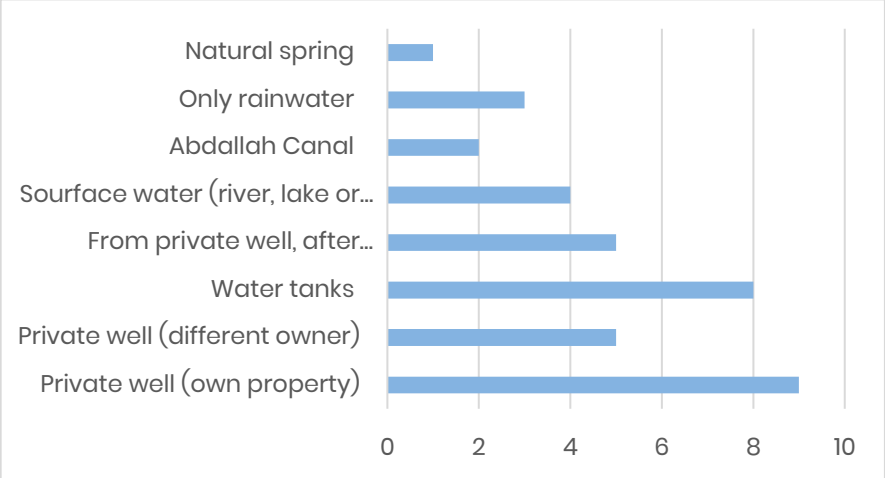


Source: Original creation of the author, L. Perosino

Water Source and Irrigation Systems

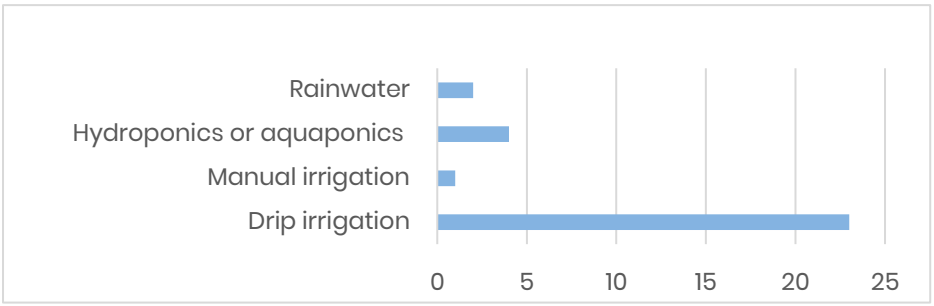
Most participants rely on groundwater for irrigation, 28% through wells present on the farm, and 12.5% use the water from a neighboring well, while 16% declare having to desalinate the water after pumping it to the surface (this is mostly the case for producers based in Ramtha, Irbid governorate). A considerable number (22%) rely on water tanks to provide the farm with irrigation water. The results confirm that drip irrigation is the most common type of irrigation (72% of total respondents).

Figure 3. Irrigation Water Source (more than one choice)



Source: Original creation of the author.

Figure 4. Type of irrigation used



Source: Original creation of the author, L. Perosino

Main Reported Issues

All Participants were asked to rate on a scale from 1 to 10 how much a certain problem affected them. Water counted amongst the most important answers, both in terms of quantity and quality (66% of participants gave a score equal or higher than 6 to how much the amounts of water available affected them, while 53% considered the quality of water available to be in issue). Marketing of products and demand was rated 6 or more by 56% of the participants and 54% report being negatively affected by debts from previous years. Cost of fuel, productivity of the seeds, sickness of plants and impact of pests were also reported to be issues.

The questionnaire revealed a lack of information on the availability of alternative and organic pesticides and fertilizers. The productivity of the soil was not reported as affecting negatively the production, which might translate the existence of misinformation around phenomena like soil erosion and loss of fertility.

Annex 2 - Holdings by land tenure type and main source of income of holders

Table 3. Number and Area of Agricultural Holdings by Type of Land Tenure and Total Area Size Class of the Holding

جدول 6.1: عدد ومساحة الحيازات الزراعية حسب حيازة الأرض وفئة المساحة الكلية للحيازة، الأردن 2017 (المساحة: دونم)

Table 1.6: Number and Area of Agricultural Holdings by Type of Land Tenure and Total Area Size Class of the Holding, Jordan, 2017 (Area: Dunum)

Class of Total Area of Holding	أخرى Other		مستاجرة مقابل حصة من المحصول Leased in return for portion of the crop		مستاجرة مقابل مال Rented for mony		وضع اليد Appropriation		مملوكة Owned		فئة المساحة الكلية للحيازة
	عدد No.	مساحة Area	عدد No.	مساحة Area	عدد No.	مساحة Area	عدد No.	مساحة Area	عدد No.	مساحة Area	
Less than 2	2	2	25	24	280	247	142	129	36650	21199	أقل من 2
2-5	7	27	83	294	461	1710	250	824	28379	93584	5-2
6-10	4	40	65	554	511	4404	126	1035	13470	110839	10-6
11-20	4	75	42	676	592	9470	79	1243	9458	148565	20-11
21-30	13	377	30	821	742	21106	29	782	4171	111930	30-21
31-40	4	153	14	515	752	26765	20	744	2439	89234	40-31
41-50	3	150	14	681	283	13178	12	561	1581	75611	50-41
51-100	1	85	27	2210	735	54392	28	2218	2693	203881	100-51
101-200	2	330	10	1359	368	55265	23	3616	1172	178950	200-101
201-500	0	0	13	4151	224	74426	20	6994	966	323570	500-201
501-1000	1	900	4	3401	94	70841	9	6031	329	239860	1000-501
1001-2000	0	0	2	3202	30	44574	7	11605	118	166053	2000-1001
More than 2000	1	4100	3	10027	11	35898	3	8801	76	564312	أكثر من 2000
Total	**42**	**6240**	**332**	**27914**	**5083**	**412275**	**748**	**44582**	**101502**	**2327588**	**المجموع**

Source: DoS, Agricultural Survey 2017

Table 4. Number of Holders by Main Source of Income and Total Area Size Class of the Holding

جدول 16.2: عدد الحائزين حسب المصدر الرئيسي للدخل وفئة المساحة الكلية للحيازة، الأردن 2017 (المساحة: دونم)

Table 2.16: Number of Holders by Main Source of Income and Total Area Size Class of the Holding, Jordan, 2017 (Area: Dunum)

Class of Total Area of Holding	Main Source of Income		المصدر الرئيسي للدخل	فئة المساحة الكلية للحيازة
	مصادر أخرى Other Sources	حيازات زراعية Agricultural Holdeings	المجموع Total	
Less than 2	28 039	6 302	34 341	أقل من 2
2-5	26 342	1 189	27 531	5-2
6-10	12 369	1 095	13 464	10-6
11-20	8 393	1 473	9 866	20-11
21-30	3 418	1 397	4 815	30-21
31-40	1 746	1 353	3 099	40-31
41-50	1 307	525	1 832	50-41
51-100	2 077	1 338	3 415	100-51
101-200	834	696	1 530	200-101
201-500	474	685	1 159	500-201
501-1000	151	260	411	1000-501
1001-2000	53	106	159	2000-1001
More than 2000	28	58	86	أكبر من 2000
Total	**85 231**	**16 477**	**101 708**	**المجموع**

Source: DoS, Agricultural Survey 2017

Table 3 gives some information about land tenure type by number of holdings and surface. If most holdings are owned, most owned holdings are beneath 10 donums. Table 4 shows that it is more common for holdings with surfaces inferior to 10 donums not to be the main source of income for the holder, as the surface is not sufficient to generate a sufficient income. Information about the main activity of the holder and then type of land tenure where not published in the agricultural survey.

Annex 3 – Sources of irrigation of agricultural holdings

Table 5. Number and Area of Agricultural Holdings by Source of Irrigation and Governorate

جدول 1.4: عدد ومساحة الحيازات الزراعية حسب مصدر المياه والري والمحافظة 2017 (المساحة:دونم)

Table 4.1: Number and Area of Agricultural Holdings by Source of Irrigation and Governorate, 2017 (Area:Dunum)

Governorate	الشبكات العامة Public Networks		سدود ترابية وحفائر Soil Dams		سدود Dams		ينابيع Springs		بئر تجميع Collective Well		بئر نزاز Shallow Well		بئر ارتوازي Artesian Well		المجموع Total		المحافظة
	عدد No.	مساحة Area	عدد No.	مساحة Area	عدد No.	مساحة Area	عدد No.	مساحة Area	عدد No.	مساحة Area	عدد No.	مساحة Area	عدد No.	مساحة Area	عدد No.	مساحة Area	
Amman	1972	2691	2	40	0	0	131	936	118	1079	8	320	400	75772	11273	442492	العاصمة
Balqa	1095	1920	34	28	215	4613	104	1857	34	125	0	0	242	18245	8229	208215	البلقاء
Zarqa	815	504	0	0	0	0	36	386	30	190	1	250	665	168282	3942	273847	الزرقاء
Madaba	329	458	0	0	6	473	18	128	53	155	0	0	59	1738	4899	79280	مادبا
Irbid	2720	4701	36	20	649	21340	216	2506	468	1955	7	85	65	11696	34889	439662	اربد
Mafraq	1335	1487	302	166	0	0	0	0	172	2375	0	0	497	181330	8807	557364	المفرق
Jerash	760	1028	0	0	0	0	118	1847	89	1079	17	7	36	10217	8398	98099	جرش
Ajloun	341	260	0	0	0	0	184	3888	145	732	0	0	0	0	7140	60376	عجلون
Karak	2279	5077	109	13	20	192	305	2848	333	1597	55	8	47	4688	10225	271105	الكرك
Tafielah	956	2663	0	0	0	0	195	1728	31	1885	0	0	6	1628	3026	57258	الطفيلة
Ma'an	1973	7647	40	2	0	0	42	697	26	191	0	0	213	111198	4406	234520	معان
Aqaba	961	941	0	0	0	0	5	120	25	325	0	0	180	80101	2473	96380	العقبة
Total	**15536**	**29376**	**554**	**237**	**26618**	**890**	**16940**	**1354**	**11688**	**1524**	**728**	**31**	**664894**	**2410**	**2818598**	**107707**	**المجموع**

Contd/...

وتتبع/...

Source: DoS, Agricultural Survey 2017

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List of Abbreviations and acronyms

ACC Agricultural Credit Corporation

AEZ Agricultural Ecological Zones

DoS Department of Statistics

DLS Department of Land and Surveys

FAO Food and Agriculture Organization

IMF International Monetary Fund

Jd Jordanian Dinar (1 jd = 1.41 US Dollar)

JV Jordan Valley

JVA Jordan Valley Authority

KAC King Abdallah Canal

MENA Middle East and North Africa Region

MoA Ministry of Agriculture

MWI Ministry of Water and Irrigation

NGO Non-Governmental Organization

RSCN Royal Society for Conservation of Nature

SAP Structural Adjustment Programs

WB World Bank

WFP World Food Program

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