

Final Report

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USAID /Jordan

Water Innovations

Technologies

Farm Survey Report



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To whom it may concern,

Enclosed, please find a draft report for the Farms' survey conducted by Mercy Corps. This report presents analysis of the data collected from the farms to measure their Knowledge, Attitudes and Practices as well as a farm audit exercise.

A handwritten signature in blue ink, appearing to read "Tarawneh", is written over a horizontal line.

Signed: _____

In the capacity of: Managing Director

Name: Tarek M. Tarawneh, Ph.D.

Duly authorized to sign for and on behalf of: interdisciplinary research consultants

Dated on: 23rd of December, 2018

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TABLE OF ABBREVIATIONS:

Acronym	Definition
WIT	Water Innovation Technologies
KAP	Knowledge, Attitudes and Practices
ACC	Agricultural Credit Corporation
CWR	Crop Water Requirement
WSDs	Water Saving Devices
NGOs	Non-Governmental Organizations
CBOs	Community based organizations
CSOs	Civil Society Organizations

1.0 INTRODUCTION

WIT Agricultural Project Component is aiming at increasing water conservation in Northern Jordan (Azraq and Mafraq), by enhancing the adoption of water innovation technologies. The original approach focusing on stimulating the market of irrigation hardware and agricultural inputs will allow WIT to achieve its target of sustainable adoption of water innovation technologies. The market development requires a study of the baseline of the demand (farmers) and suppliers (retailers of irrigation equipment) sides. Therefore, WIT shared the baseline survey data set that was conducted by ICBA. The baseline and water audit survey was co-designed by MC-WIT staff and ICBA, and was conducted in two phases by ICBA. Phase one was the baseline and water audit survey covering 105 farms in both Azraq and Mafraq. The second phase was the water audit phase covering 45 farms in Azraq only. In total the baseline and water audit survey covered 150 farms in Azraq and Mafraq.

A comprehensive survey tool with questions covering Knowledge, Attitudes and Practices along with Farm audit was developed and used for the KAP baseline study. This instrument consisted primarily of close-ended questions with open-ended options included for respondents to provide additional information on their perceptions, practices and experience. The survey items were arranged in four sections: demographics, knowledge, attitudes and practices.

In close collaboration with the WIT agriculture Leader, M&E Manager and M&E team, id:rc led the Agriculture baseline survey analysis and the subsequent report that resulted from it.

Agriculture survey objectives:

- Assess the demand side
- Identify top opportunities to link pioneer farmers to suppliers for using water saving technologies and inputs.
- Identify technology early adopters willing to host demonstration sites and/or receiving technical advice.

Baseline survey report objectives:

The present baseline survey is the demand-side detailed market assessment that is conducted for a proper market characterization to:

- Have a decent verification of the findings of the initial assessment based on a representative sample of farms (demand side market).
- Identify top opportunities to link pioneer farmers to suppliers for using water saving technologies (irrigation hardware), inputs (improving soil water holding capacity) and practices (irrigation scheduling).
- Identify potential early adopters willing to host on their expenses (or that of suppliers) demonstration sites and/or receiving technical advice (from WIT through suppliers).
- Constitute a sales information database about the customers portfolio for the suppliers.

2.0 EXECUTIVE SUMMARY

This summary highlights the survey findings as the following:

Technical Findings:

- Keeping records of water use and agricultural inputs use was found to be not popular among farmers. Most farmers do not keep such records. The same was found for the written financial records, around 75% of interviewed farmers in Azraq and 69% in Mafraq do not keep written financial records of revenues and expenses despite their impact on the agricultural business if they were kept consistently. Surprisingly around 100% of farmers in both areas stated that they do not keep those records because they would not use them. Which indicates their unawareness of the importance of keeping records.
- Almost all interviewed farmers do not use any scientific methods for estimating the Crop Water Requirement (CWR), for example water meters, and weather soil sensors. Around 90% of the respondents in Mafraq indicated that they use visual methods (Observation and checkup). On the other hand, around 70% of respondents in Azraq are using scheduled irrigation based on crop growth stage. These two methods are considered to be primitive methods of irrigation.
- Most interviewed farmers in Mafraq and in Azraq indicated that they upgrade their laterals on annual basis with (87% and 65%, respectively). On the other hand, only 13% of interviewed farmers in Mafraq and 35% of the interviewees in Azraq responded that they do not upgrade their laterals on annual basis.
- One interesting finding is that around 70% of respondents in Azraq indicated that they upgrade their laterals if they were broken or damaged. Moreover, the estimated laterals lifetime seems to be shorter in Azraq than in Mafraq (between 2-4 years in Azraq and 4-8 years in Mafraq). This may be attributed to the low quality of equipment provided by laterals suppliers in Azraq. Additionally, in Azraq 99% of respondents stated that laterals suppliers do not provide any services.
- Farmers in Azraq (75%) believe that they do not experience any soil salinization and 86% indicated that the salinity level is low, while several/recent studies has pointed out that the salinity level is growing in Azraq. Additionally, respondents in Azraq (77%) do not use any filtration system, which ultimately affect the quality of the equipment and reduce the lifetime of laterals. All these findings can conclude that Azraq farmers possess very humble knowledge that relate to the salinization level, and its impact on equipment, as well as the importance of using quality equipment.
- Most of the respondents in Mafraq are currently using water saving technologies. On the other hand, 88% of respondents in Azraq answered that they do not use any water saving technology, however 87% of respondents in Azraq showed their interest in implementing WSDs. Reasons of not adopting water saving devices were mainly related to the high cost of the WSD and the lack of knowledge of water technologies.
- Less than 10% of respondents in both areas depend on PC Drip irrigation in their block's management. Explaining the high percent (around 94% of both areas) that stated they wish to install PC drip irrigation equipment.
- More than two-thirds of respondents in each area clean their laterals, indicting a certain level of awareness regards cleaning of laterals and emitters. However, more than half of respondents in each area clean laterals and emitters on a monthly or seasonally basis.

- Surprisingly, less than 10% of the respondents in both areas indicated that they did, in fact, conduct feasibility studies. Despite that a feasibility study can help farmers to determine the viability of their idea before proceeding with it.

Financial / Economic Findings:

- Choices to financing the working capital and new fixed investment significantly varied between the two areas. More than half of respondents in Mafraq depended fully on **retained earnings** to finance the working capital and new fixed investment. On the other hand, only 9% of respondents in Azraq indicated the same, with 60% stating that they do not depend on any retained reasoning. Dependence on external funding sources also varied between the two areas, around 58% of respondents in Azraq fully depend on external funding sources, while 56% of respondents in Mafraq stated that do not depend on external funding sources.

Most farmers do not usually buy credits or take loans when buying new irrigation equipment. Only small percentage in Azraq and Mafraq (19% and 12%, respectively) stated that they took credits or loans. All Azraq farmers usually buy credits from wholesale market agents. On the other hand, 17% in Mafraq buy credit from wholesale market agent, 83% buy from suppliers.

- For those who buy on credit, the main good aspects are allowing farmers to supply their needs until the end of the season, and the delight payments. However, the bad aspects in this way are increasing costs for farmers and in the case of bad weather and weak seasons, they will not be able to pay the due installments.

The survey showed that less than 10% of the respondents in Azraq and Mafraq stated that they borrowed from ACC or a commercial bank. Most of them had access to loans 4 to 5 years ago.

Communication and outreach Findings:

- Jordanian farmers are heavily dependent on selling their products to the local market due to political conditions in the region, specifically after closure of border crossings with Syria and Iraq.
- A high percentage of farmers do not take advantage of the services provided by organizations who work on marketing produce.
- Farmers of both areas prefer to receive technical information from the private sector like input suppliers. Competition among suppliers is always present, making some suppliers more competent and trustworthy than any other stakeholders. Some indicated that they prefer to get technical information from other farmers. Interestingly, none of the respondents in Mafraq stated that they use internet for getting technical information. A very small percentage in both areas (not exceeding 4%) stated that the government is a source of technical info for them.
- Only 13% of respondents in Mafraq and none in Azraq reported that lateral suppliers provide up to date of the most efficient new practices.
- Survey findings indicated that 59% of respondents in Azraq and 87% in Mafraq choose their suppliers according to the quality of equipment. An interesting finding is that none of the respondents indicated that they choose their supplier based on after sales services. Similarity a confirmation from farmers came by stating that suppliers do not provide any services (98% in Azraq and 40% in Mafraq).

- It is quite evident that farmers in both areas are willing and interested in supplier connection, that could provide equipment with a good quality. The vast majority have expressed their interest in being linked to suppliers that possess technical expertise. Providing a robust starting point to design an intervention that can greatly benefit farmers on so many levels.

Challenges:

The study discussed some **primary challenges and barriers for the following topics:**

1. Barriers / Challenges to improving crop production levels.

Challenges were divided into four categories:

- **Environmental:**
 - Water quality, weather conditions and climate change: weather conditions are one of the vital barriers to improving crop production levels. Of the interviewed farmers in Azraq, 37% indicated that weather conditions are one of the barriers to improving crop production levels. Also, 22% of respondents in Mafraq stated the same.
- **Governmental:**
 - Governmental policies and Tax: 18% of respondents in Azraq stated that governmental policies are a barrier for farmers to improve their crop production levels, while none of the respondents in Mafraq indicated that governmental policies are one of the barriers.
- **Financial:**
 - Lack of financial support, financial issues and high costs: 18% of the respondents in Azraq stated that high costs are a barrier to improving crop production. With around 4% of respondents in Mafraq saw that high costs are one of the barriers
- **Services:**
 - Electricity and labor: 16% of respondents in Mafraq stated that access to labor is one of the primary barriers.

2. Barriers / Challenges to investing in decent irrigation system.

Challenges were divided into four categories:

- **Environmental:**
 - Weather conditions, and water quality were stated to be barriers to investing in decent irrigation systems.
- **Governmental:**
 - Governmental policies were perceived as a barrier to investing in decent irrigation systems
- **Financial:**
 - Lack of funding, financial issues and high costs: 48% of Mafraq respondents and 38% of Azraq respondents saw that high costs are a primary barrier to investing in decent irrigation system. Moreover, 31% of respondents in Azraq indicated that financial issues are the main barriers for the investment with none in Mafraq reporting financial issues to be a barrier
- **Social and cultural:**
 - Lack of knowledge about new technologies

3. Barrier / Challenges to saving money:
Challenges were divided into four categories

- Environmental:
 - Water quality and weather conditions: According to 35% respondents in Azraq weather conditions is one of the main challenges to saving money.
- Governmental:
 - Governmental policies and Tax: In Azraq, 22% of respondents indicated that governmental policies are barriers to saving money, while 7% of respondents in Mafraq stated that Tax is one of the barriers to saving money.
- Financial:
 - High costs: 36% of respondents in Azraq and 15% of respondents in Mafraq stated that high costs are one of the primary barriers and challenges to saving money.
- Services:
 - Electricity and labor: Respondents in Mafraq stated that Electricity and labor are primary barriers to saving money with (33%and 35%, respectively).

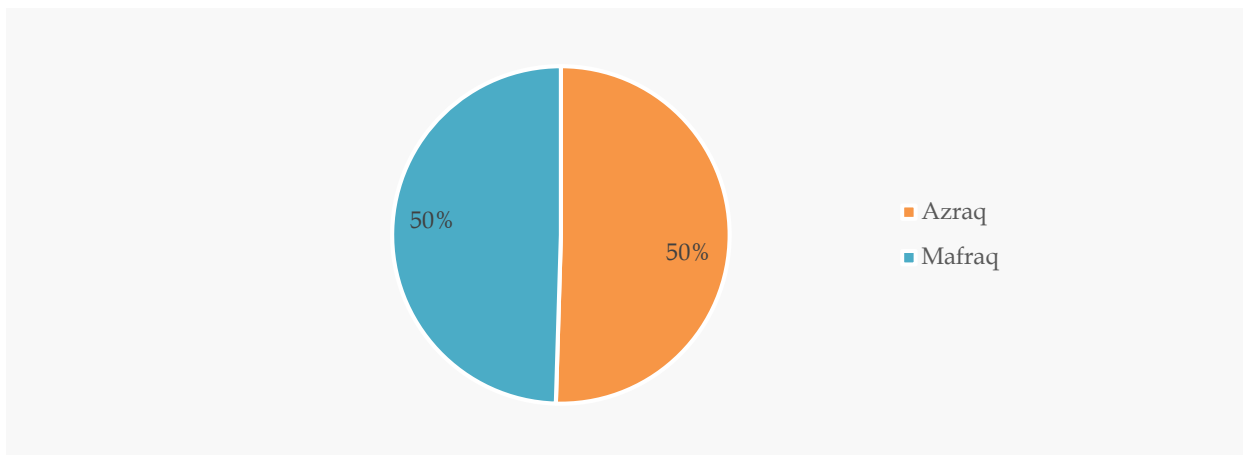
3.0 DATA ANALYSIS

Statistical analysis of the data collected from the pencil and paper survey instruments was conducted. Frequencies were run to explore missing responses and out-of-range values for each of the demographic variables as well as those used for the main analysis. Nominal demographic variables were analyzed and reported using frequencies, counts and valid percentages.

Some of the described figures in the analysis are presented by the corresponding questions from the survey.

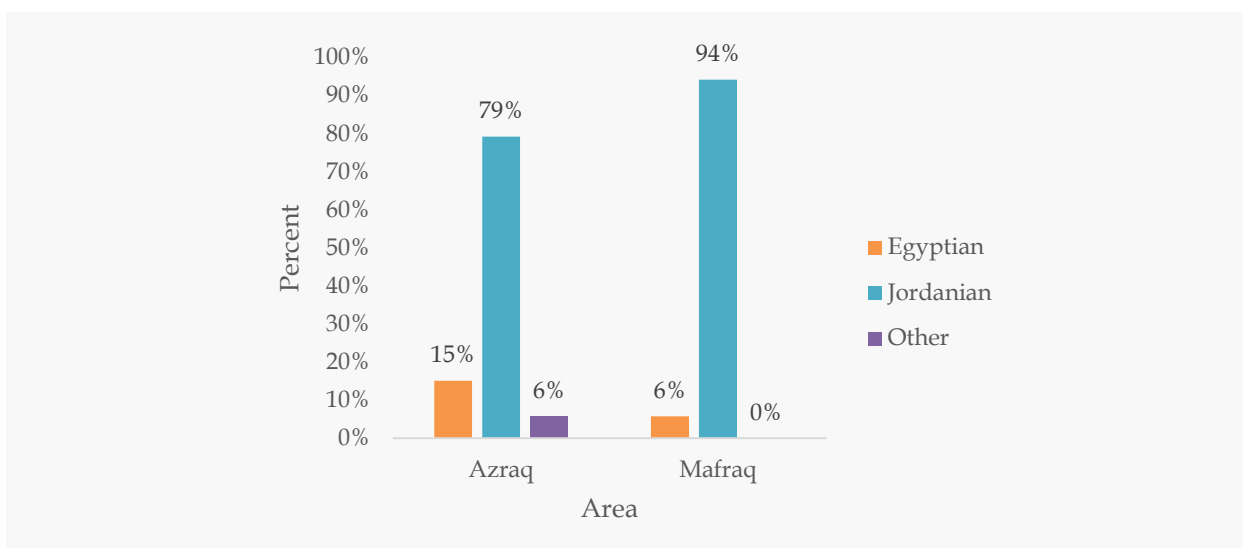
3.1 DEMOGRAPHIC

Study Population Per Farm Location (KAP)

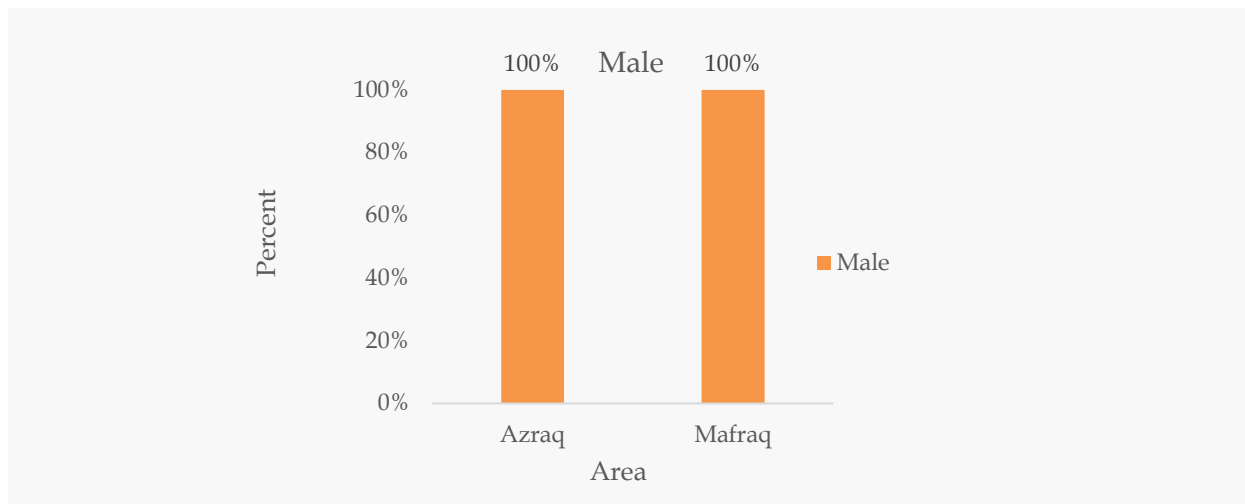


The total sample of the KAP Survey was 105 farms, 53 in Azraq and 52 in Mafrq.

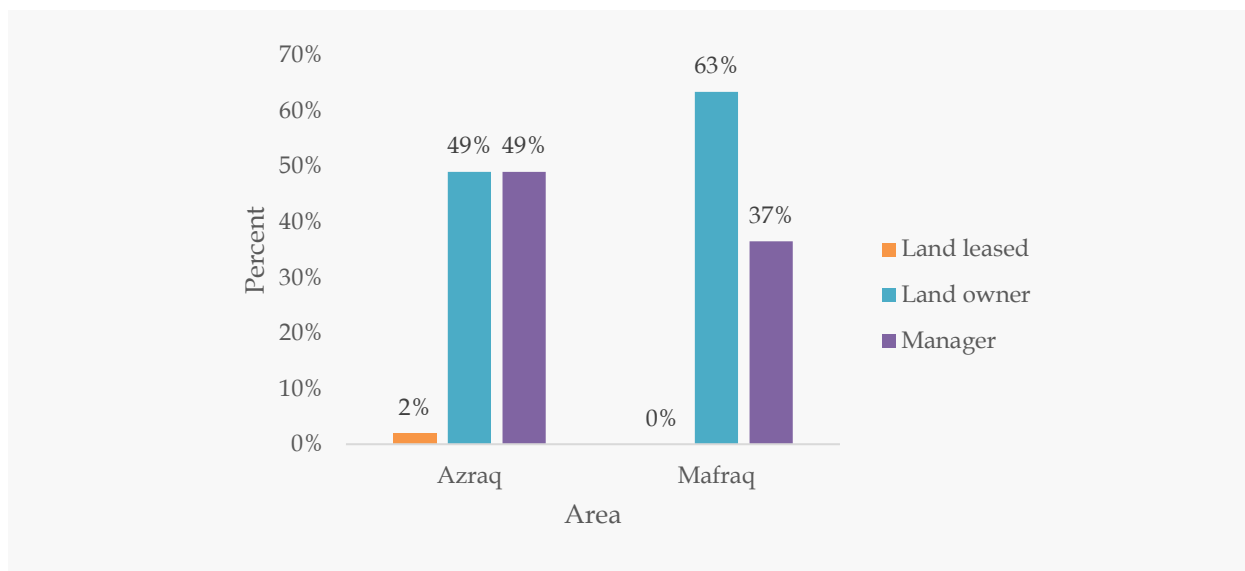
Interviewee Nationality (KAP)



As illustrated in the above figure, the majority of the interviewees were Jordanians. Nearly 94% of interviewees in Mafrq were Jordanians, and 6% were Egyptian. As for the respondents in Azraq, Jordanians represent 79% of the total sample, 15% were Egyptians, and only 6% had other nationalities.

Gender of Interviewee (KAP)

Above figure presents a summary of respondents' gender for each location. The figure shows that the males are dominant in the agriculture sector. This is supported with DoS report for the year 2016, where only 5% of females tend to work in this sector. (Labor Statistics in Jordan Report 2012 – 2016)

Relationship to the Farm (KAP)

As portrayed in the above figure, about two thirds of respondents (63%) in Mafraq are land owners, the remaining 37% of the sample were managers. As for Azraq, 49% of interviewees are land owners, the other 49% are managers. The remaining 2% are land leased.

3.2 TECHNICAL ASSISTANCE

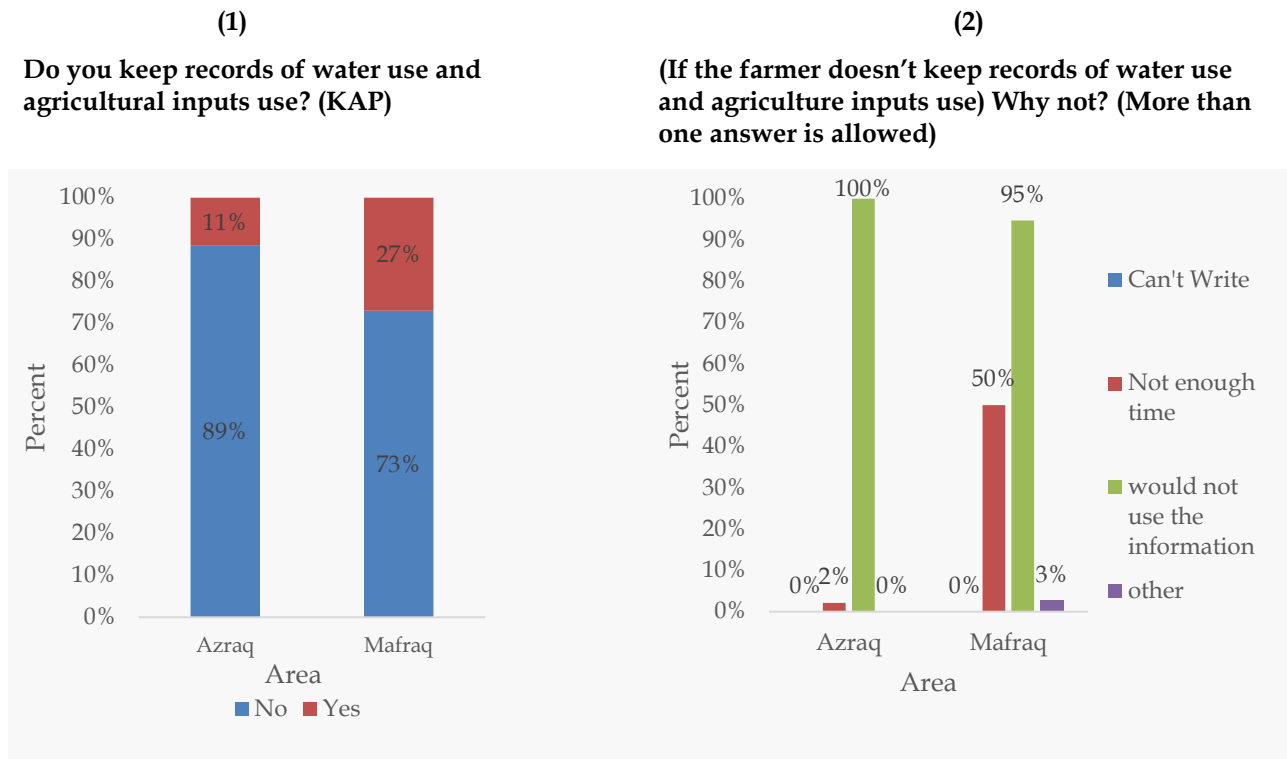
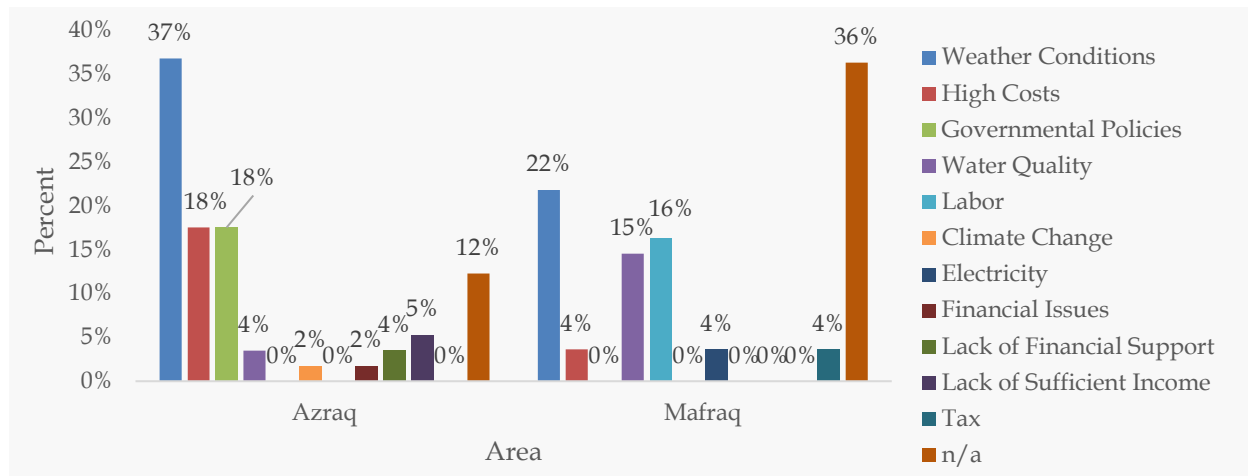


Chart (1): Surprisingly around 90% of respondents in Azraq, and 73% in Mafraq do not keep records of water use and agricultural inputs use. Chart (2): Respondents who answered that they do not keep records of water use and agriculture inputs use pointed out that the main reason is that they will not use this information. The backbone of any agricultural revolution is access of farmers to modern agricultural inputs. These agricultural inputs range from improved seeds, fertilizers and crop protection chemicals to machinery, irrigation and knowledge. Record keeping is an essential tool to any business or activity. The benefits/importance of keeping farm records are helping the farmer or manager in planning improvement for the business and making proper management decisions. Also, farm records assist farmers in keeping a track of both performing and non-performing farming ventures. Moreover, this will help the farmers in making productivity projections for the venture.

What is the primary barrier to improving crop production levels? (KAP)

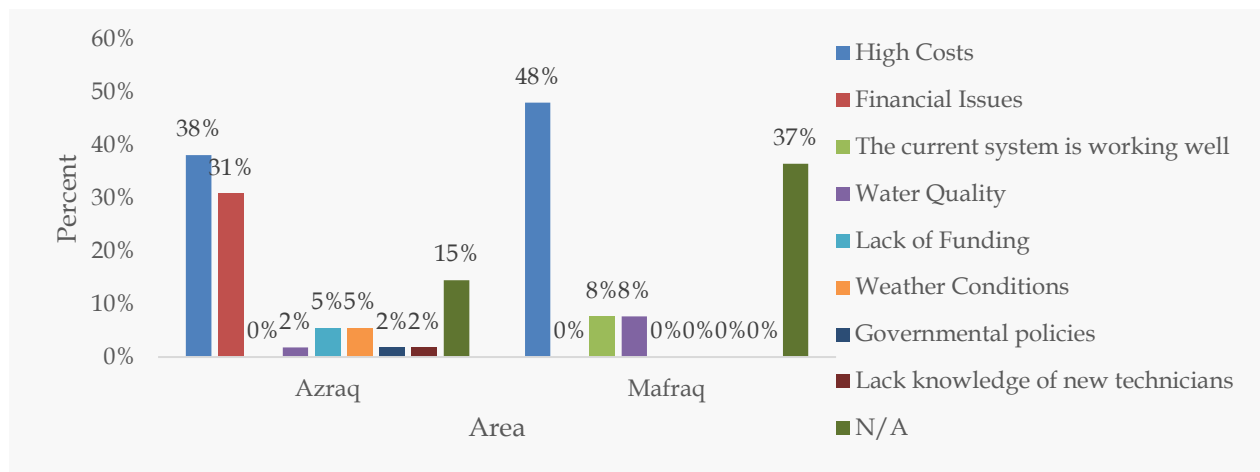


As can be seen from the above graph the primary barriers to improve crop production levels are divided into four sub divisions:

- Environmental barriers: Weather conditions and climate change, water quality
- Gov barriers: Gov policies, Tax
- Financial barriers: Lack of financial support, financial issues, high costs
- Services: Electricity, labor

Of the interviewed farmers in Azraq, 37% indicated that weather conditions are one of the barriers to improving crop production levels. Also, 22% of respondents in Mafrq stated the same. Moreover, 18% of the respondents in Azraq stated that high costs are another barrier. Despite that the average costs of laterals in Mafrq is higher compared to Azraq (represented in financial/economic assistants section), only 4% of respondents in Mafrq saw that the high costs are another barrier. 18% of respondents in Azraq indicated that governmental policies are one of the barriers to improve their crop production levels, while none of respondents in Mafrq indicated that the governmental policies are barriers to improve their crop production levels. On the other hand, 16% of respondents in Mafrq stated that access to labor is one of the primary barriers to improve their crop production levels.

What is the primary barrier to investing in decent irrigation system? (KAP)

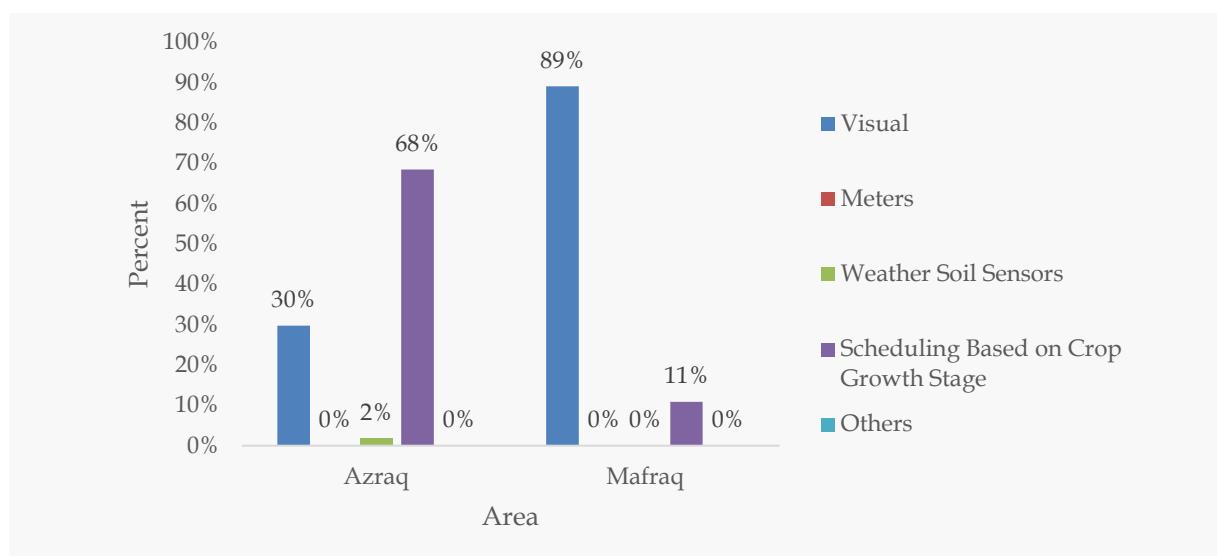


The primary barriers to investing in decent irrigation system are divided into four sub divisions:

- Environmental barriers: weather conditions and climate change, water quality
- Governmental barriers: Governmental policies
- Financial barriers: Lack of funding, financial issues, high costs,
- Social and cultural: Lack knowledge of new technicians/technology's

Innovative irrigation systems can enhance water efficiency and help farmers gain an economic advantage. Nevertheless, the survey showed that 48% of Mafraa respondents and 38% of Azraq respondents saw that high costs are primary barriers to investing in decent irrigation system, while 31% of respondents in Azraq indicated that financial issues are main barriers for investment. It is worth noting that this graph solely portrays reasons that explain why farmers refrain from investing in decent irrigation systems; it still lacks information whether farmers are aware of the return of investment of these systems, which needs further investigation.

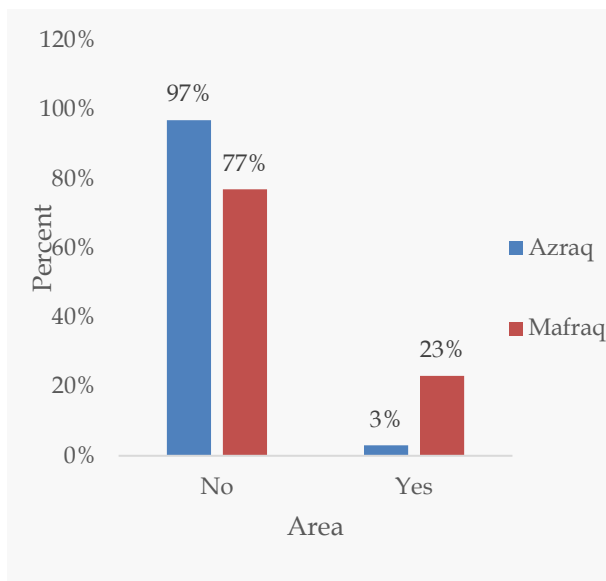
Estimation Method of Crop Water Requirement (CWR) (Farm Audit)



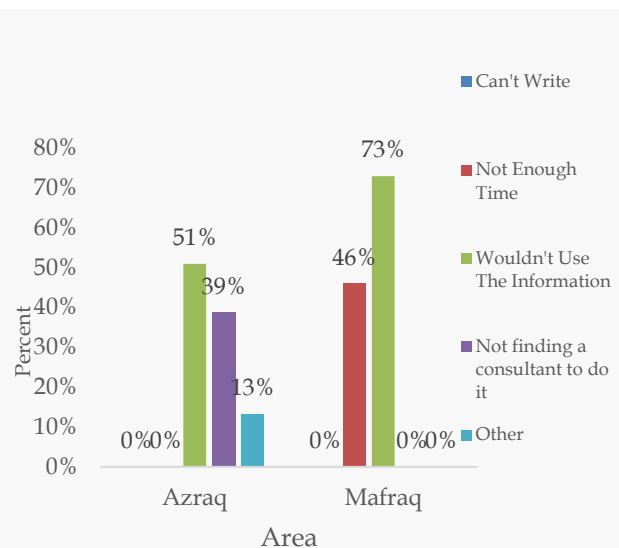
Almost all interviewed farmers do not use any scientific method for estimating the CWR, such as water meters and weather soil sensors. Around 90% of respondents in Mafraa indicated that they use

visual methods. On the other hand, around 70% of respondents in Azraq are using scheduled irrigation based on crop growth stage. These two methods are considered to be primitive methods of irrigation. From these methods, farmer cannot know the exact amount of water needed for plants. Farmers need to be exposed to the irrigation methods and keep records for the crop water requirements in their area. Thus, he/she can compare his current practices with the best practices of irrigation.

(1)
**Do you keep [records of your water usage]?
(Farm Audit)**



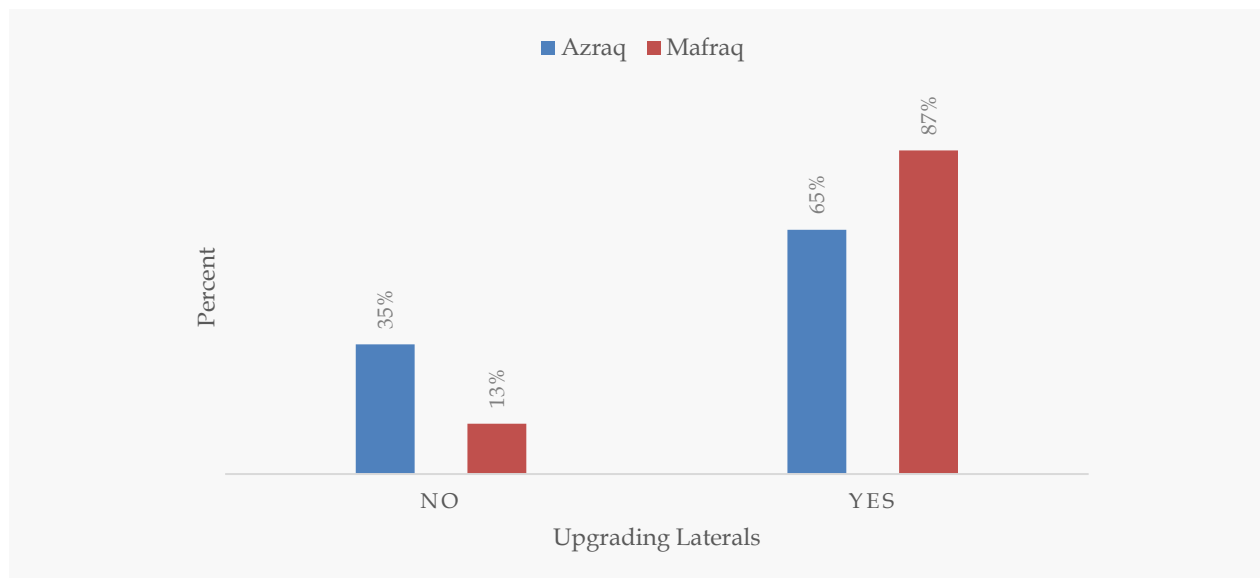
(2)
If the previous question is no, WHY don't [you keep such records]? (More than one answer is allowed) (Farm Audit)



Surprisingly, in chart (1) most farmers in Azraq and Mafrq (97% and 77%, respectively) do not keep water usage records. This is due to the farmers' ignorance of the importance of records keeping. Contrary to their belief, this leads to a lack of awareness of the amount of water used for irrigation, which consequently will negatively affect the amount of water consumption, overestimating the required water quantities.

As illustrated in the chart (2), the majority of the respondents stated that they do not possess the technical know-how that helps them use records in predicting expenditure revenues the records. Moreover, some respondents believe that they would not use their records, nor would they have the time for such calculations. In Azraq 13% of the farmers don't realize the importance of water records.

Good farm management requires having a good useful set of farm records. Good records do not ensure the farm will be successful, however, success is unlikely without them. With a farm report card, farmers can tell how well they are managing their operations. They can also see strengths and weaknesses in their irrigation system. It is therefore recommended to carry out an awareness-raising training program on the importance of keeping a water record.

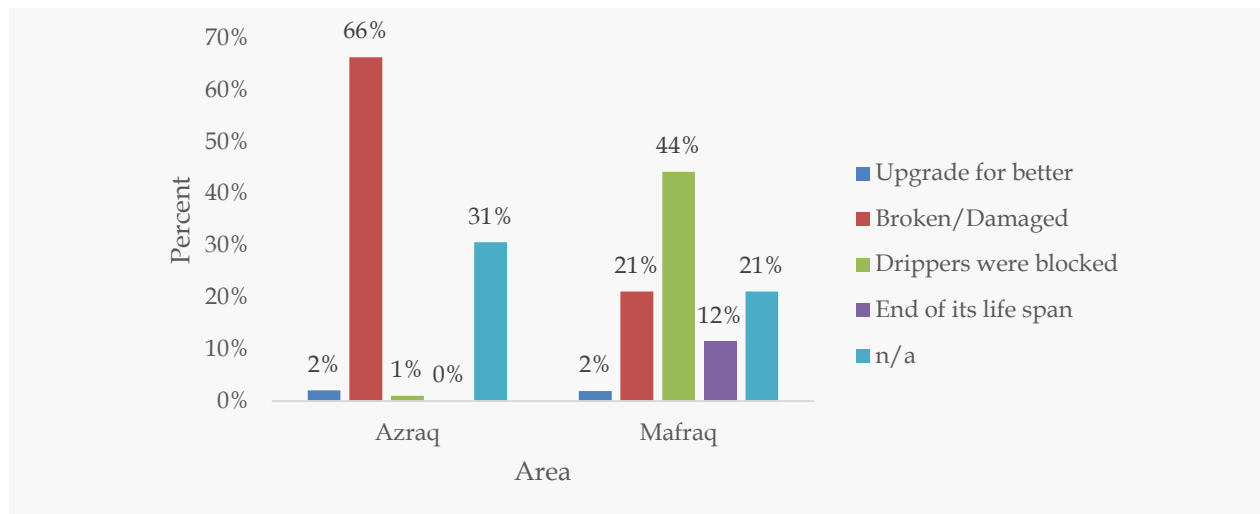
Do you upgrade the laterals on annual basis? (Farm Audit)

Most interviewed farmers in Mafrq and in Azraq indicated that they upgrade their laterals on annual basis with (87% and 65%, respectively). On the other hand, only 13% of interviewed farmers in Mafrq and 35% of the interviewees in Azraq responded that they do not upgrade their laterals on annual basis. This entails high levels of knowledge about the importance of upgrading the irrigation water system. There are several advantages for upgrading the laterals, for instance, the irrigation system efficiency will not decrease, and the amount of time spent in repairing the irrigation water system would be greatly reduced along with the maintenance costs.

Average Dunums Upgraded with Laterals Annually

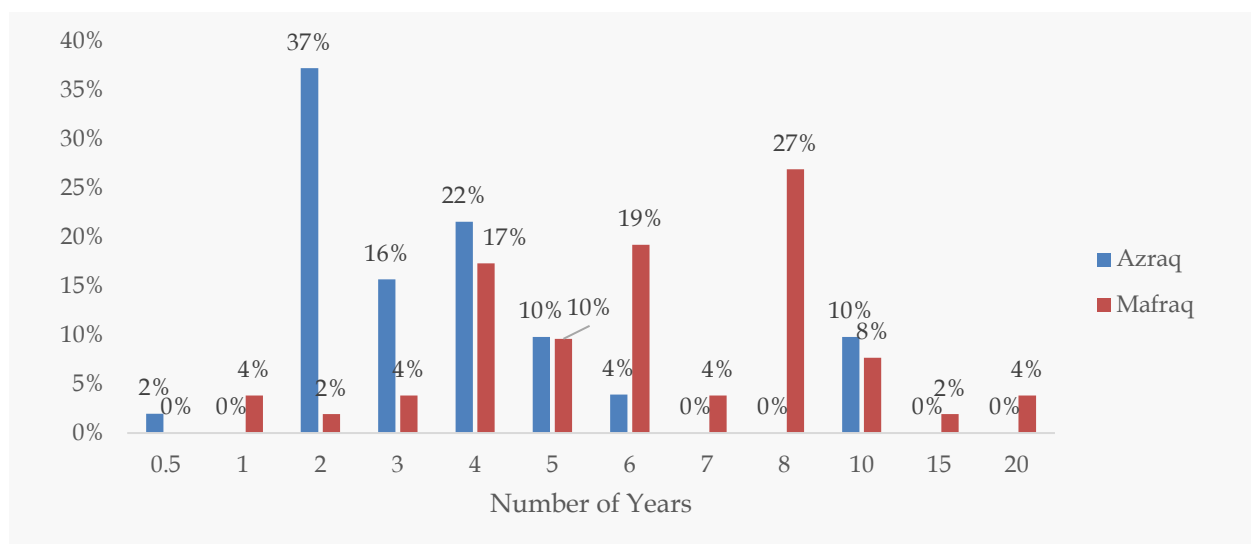
The responses from the interviewees were calculated as percentage of the total farm area, and the average of all responses was then calculated. The result averaged to be around 25% for both Azraq and Mafrq

Why do you upgrade the laterals (hoses)? (Farm Audit)



In Azraq, 66% of the interviewed farmers indicated that they upgrade the laterals because they were broken or damaged, while 21% of the respondents in Mafraq had the same answer. 44% of interviewed farmers in Mafraq agreed that the reason behind upgrading the laterals is that Drippers were blocked. Damage to laterals is commonly caused by the low quality of irrigation water network, weather conditions, external factors that can't be controlled by the farmer and the lateral itself might be made of recycled materials. Thus, it is recommended for farmers in Azraq to focus more on the quality of their laterals. Moreover, the quality of irrigation water, poor design which lead to variations in pressure-heads along the lateral ends and most importantly the absence of filtration system is some of the main reasons behind the blocked drippers. Hence, farmers in Mafraq need to increase their knowledge in how to use pressure levels appropriately and the importance of using filtration systems with regular cleaning.

What is your estimation of laterals duration life (in years)? (Farm Audit)¹

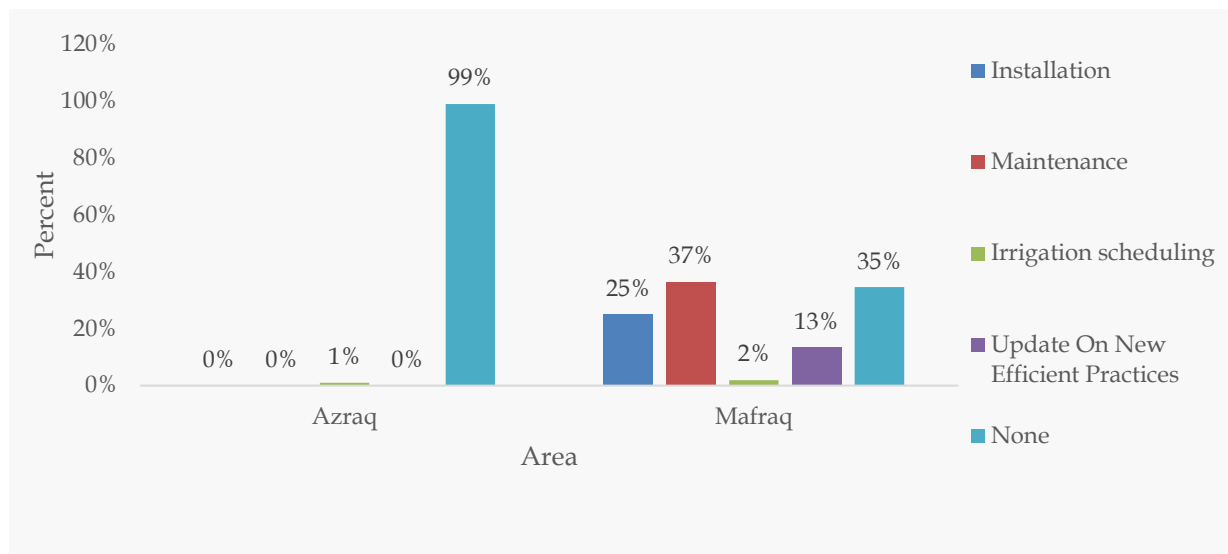


According to the majority (85%) of the interviewed farmers in Azraq, the estimated lifetime of laterals ranged between 2-5 years. On the other hand, it is ranged between 4-8 years according to respondents

¹ The X- Axis presents the actual answers not ranges.

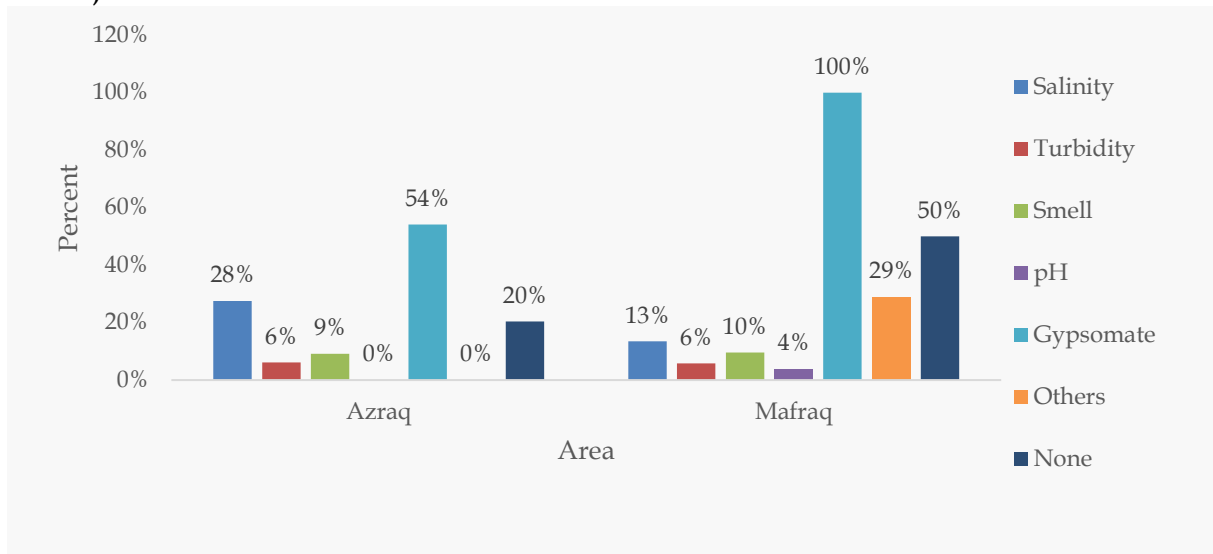
in Mafrq (77%), as shown in the figure above. One reason for the responses in Mafrq of a longer lifetime is that more farmers upgrade their laterals annually. Moreover, the highest market share of irrigation supplier in Mafrq are Mais, Al Jabali, Al Watnyeh. They are considered as high-quality lateral providers. Whereas, in Azraq the highest market share is Al Karama which produce low-quality irrigation equipment. Additionally, farmers in Mafrq pay more attention to the maintenance services provided by the suppliers after sales, as shown in the following figure.

What services are provided from the laterals supplier? (Farm Audit)



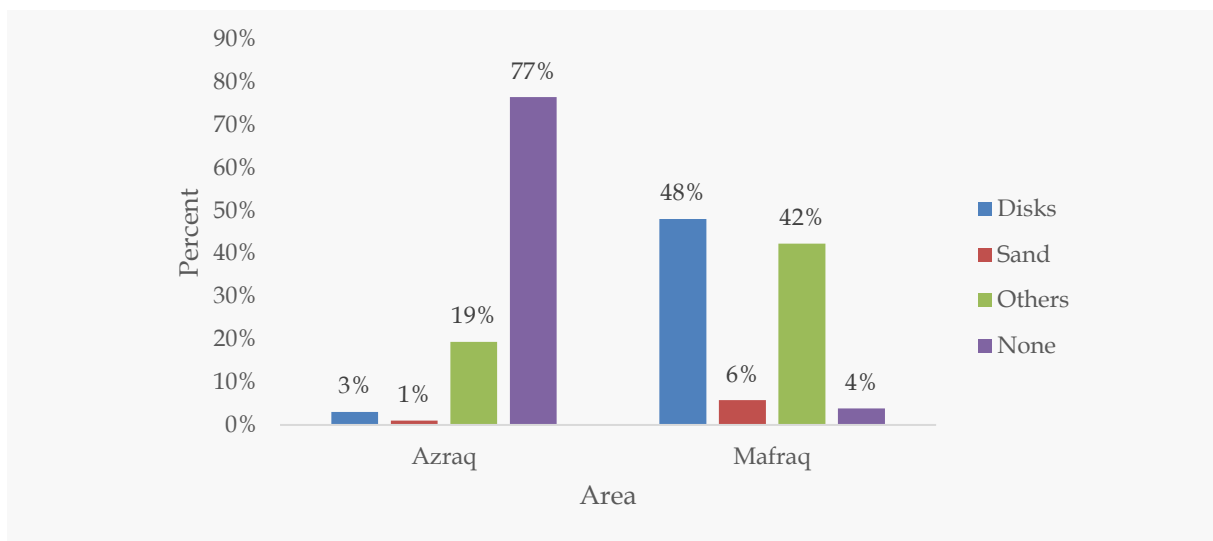
Almost all of the interviewed farmers in Azraq indicated that the lateral suppliers do not provide any service, which is alarming. On the other hand, only 35% in Mafrq indicated that lateral suppliers do not provide any service, 37% of them indicated that lateral suppliers provide maintenance, and the other 25% indicated that lateral suppliers provide installation services. Lateral suppliers in Azraq must pay more attention on after sales services since all interviewed farmers agreed that they do not provide services. As mentioned in the above question, the highest market share of irrigation supplier in Mafrq are Mais, Al Jabali, Al Watnyeh which are considered as high-quality lateral providers. On the other hand, the highest market share in Azraq is Al Karama which produce low-quality irrigation equipment. This can explain the results in the above question in which Azraq respondents estimated lower life time for laterals than in Mafrq, in addition to the lack of services provided by suppliers in Azraq.

What, if any, water quality issues are experienced? (More than one answer is allowed) (Farm Audit)

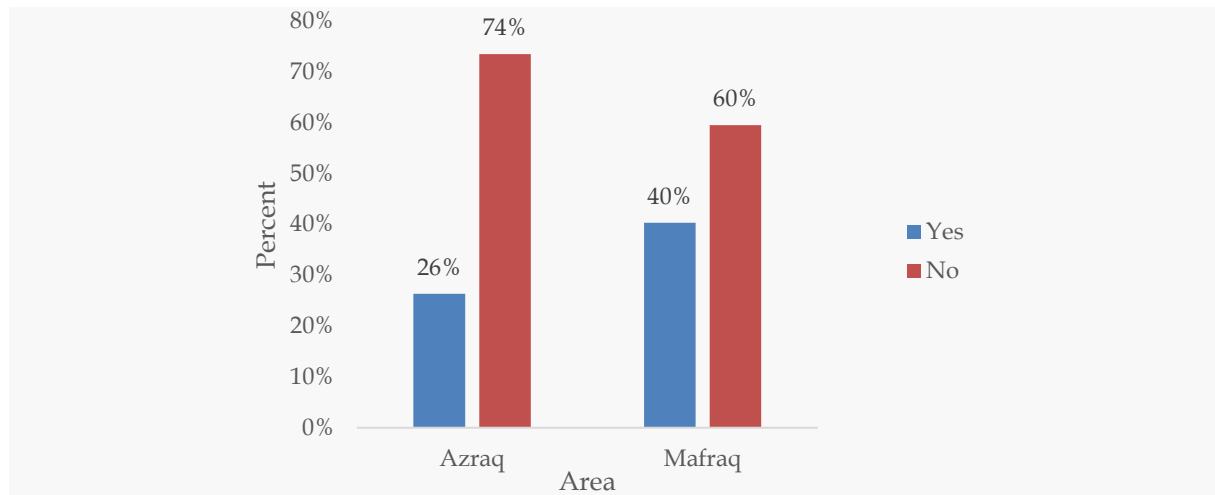


All of the interviewed farmers in Mafrq are facing Gypsum issue as a major water quality issue, and 29% said they are facing other issues like i) Sand, ii) Algae, iii) Organic Matter. On the other hand, 54% of the interviewed farmers in Azraq indicated they are facing the same issue.

What type of filtration is used? (Farm Audit)



The figure above portrays multiple types of filtration systems used by farmers in Mafrq and Azraq. In Azraq, the majority of respondent farmers (77%) do not use any filtration system. In Mafrq, 48% of the respondents use disks, while 42% use other filtration types like hydro cyclones, screens, and others. Importance of filtration systems are; decreasing emitters blockage, increasing the laterals network lifetime, and improving the farm productivity level.

Have you experienced soil salinization in the last 5 years? (Farm Audit)

Avoiding soil salinization mainly requires frequent monitoring of ground water levels and salinity, accompanied by proper drainage in order to ensure clean irrigation of the soil. The majority of farmers

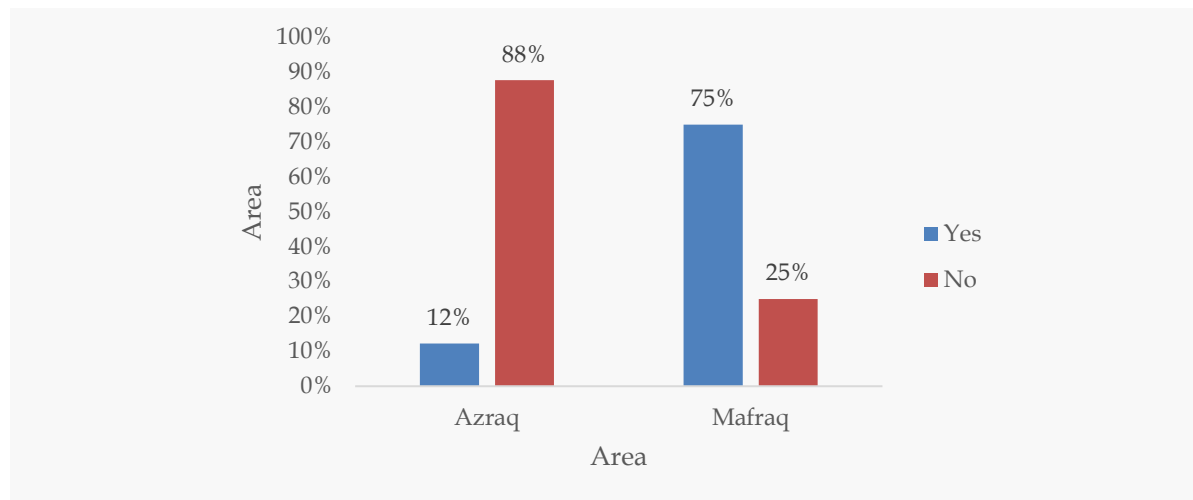
Production factors	Azraq Basin	
	Azraq	Mafrq (North Badia)
Land	Frequent speculation; buy legal; buy illegal; inherits	land in general private and legal (official titles); high prices
Water	Shallower wells, both legal or illegal; illegal drilling curbed but not stopped. Salinity growing and problematic in some areas; higher water fees for wells with permits, discouraging tariffs for (registered) illegal wells	Deep wells (almost) all licensed; illegal drilling rare. Generous free block; water charges minimal in production costs. Good water quality
Energy	Diesel, electricity, solar energy as the emerging cost-effective solution for isolated (and/or illegal) farms	Electricity
Capital (investment)	Moderate	High
Labor	Brokers, permits for permanent (foreign) workers; seasonal workers from nearby areas or (increasingly) from Syrian refugee camps.	

*As summarized by Al Naber study

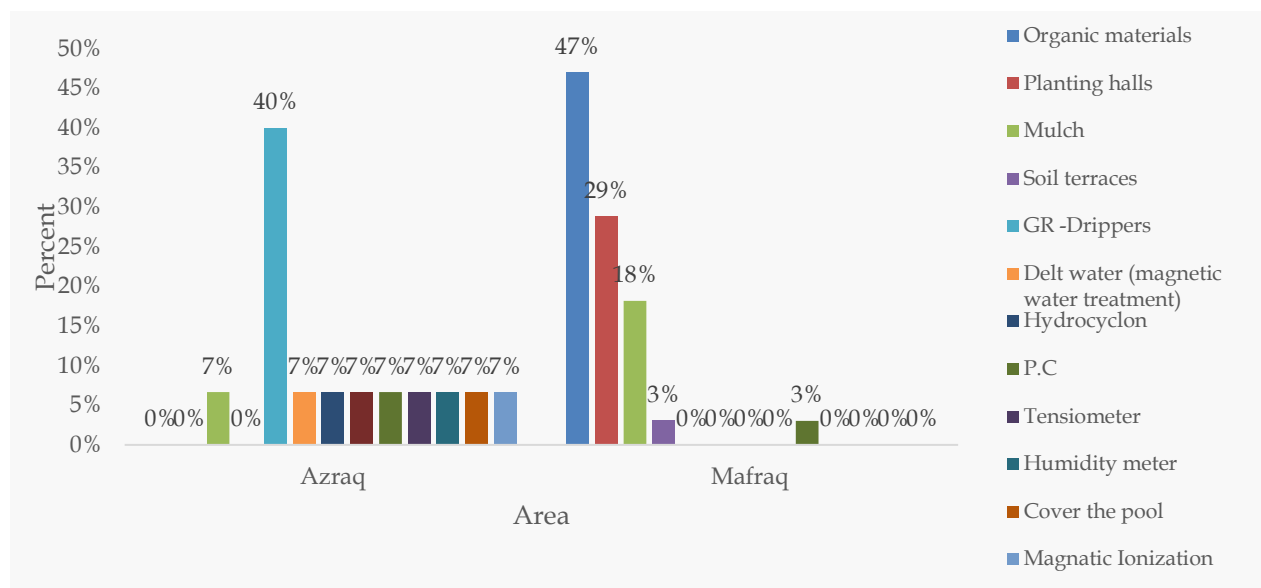
in both areas (74% in Azraq, 60% in Mafrq) believe that they do not experience any salinization. This might entail that they have taken preventive actions to reserve the salinity level of the soil or that they are not fully aware of the issue. According to a recent study by (Al Naber, 2018)², many farmers in Azraq noticed a reduction in their farm productivity and profitability due to the drop in the water table and an increase in salinity. Further investigation is encouraged to confirm the conclusion.

² Majd Al Naber, 2018 Groundwater-Based Agriculture in Arid Land: The Case of Azraq Basin, Jordan,

Majd Al Naber, 2018 Groundwater-Based Agriculture in Arid Land: The Case of Azraq Basin, Jordan

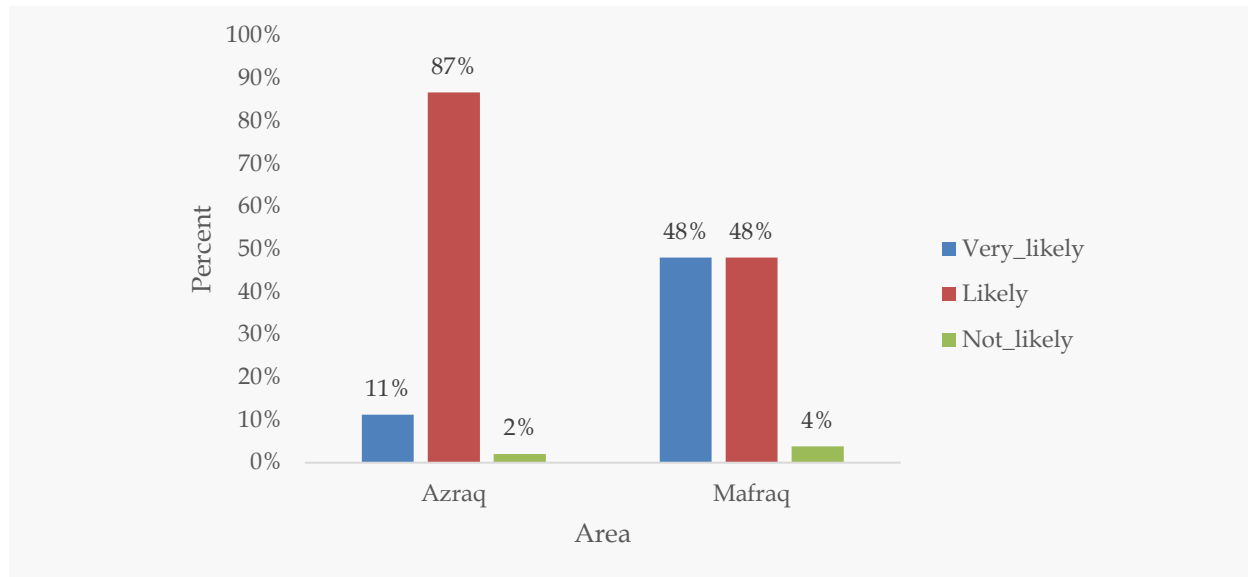
Are you using any water saving technologies/methods in your farm? (Farm Audit)

The majority of the respondents in Mafraq (75%) indicated they are currently using water saving technologies. On the other hand, only (12%) of respondents in Azraq stated that they use water saving technologies and the other (88%) stated that they do not use any technology to save water at their farms, despite the importance of these technologies on the long run, along with their return on investment. Reflecting on other questions in the survey, farmers have stated alarmingly high costs of irrigation, making these technologies a necessity rather than luxury products.

If Yes, What types of used technologies/ practices? (Farm Audit)

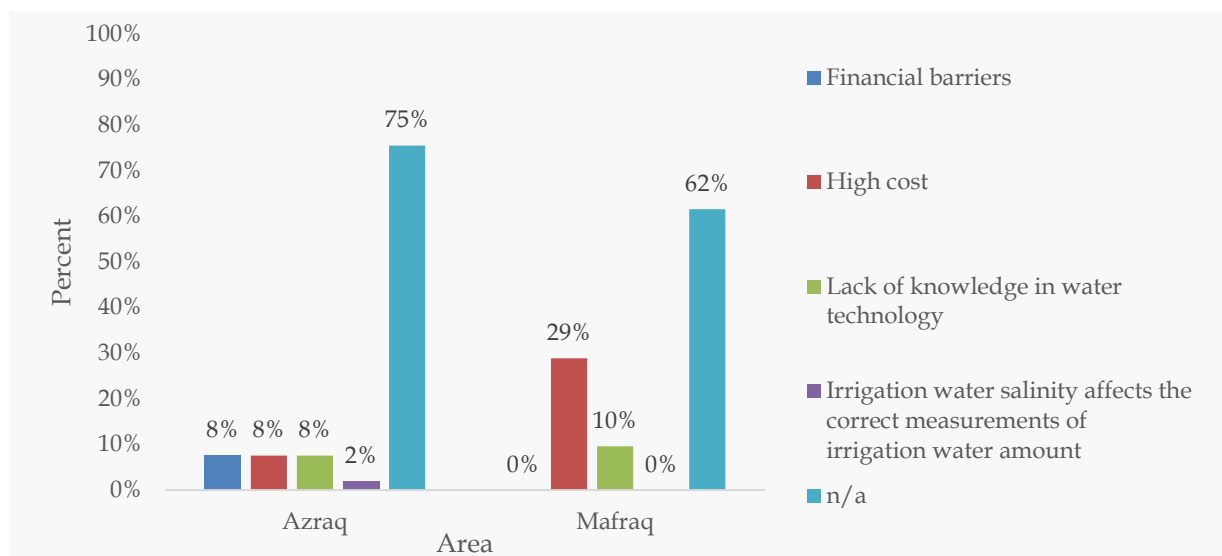
The most used technologies in Azraq (40% of respondents) are GR-Drippers. Furthermore, 47% of interviewed farmers in Mafraq considered the organic materials as a primary practice in saving water.

Would you be interested in implementing water saving technologies in your farm? (Farm Audit/KAP)

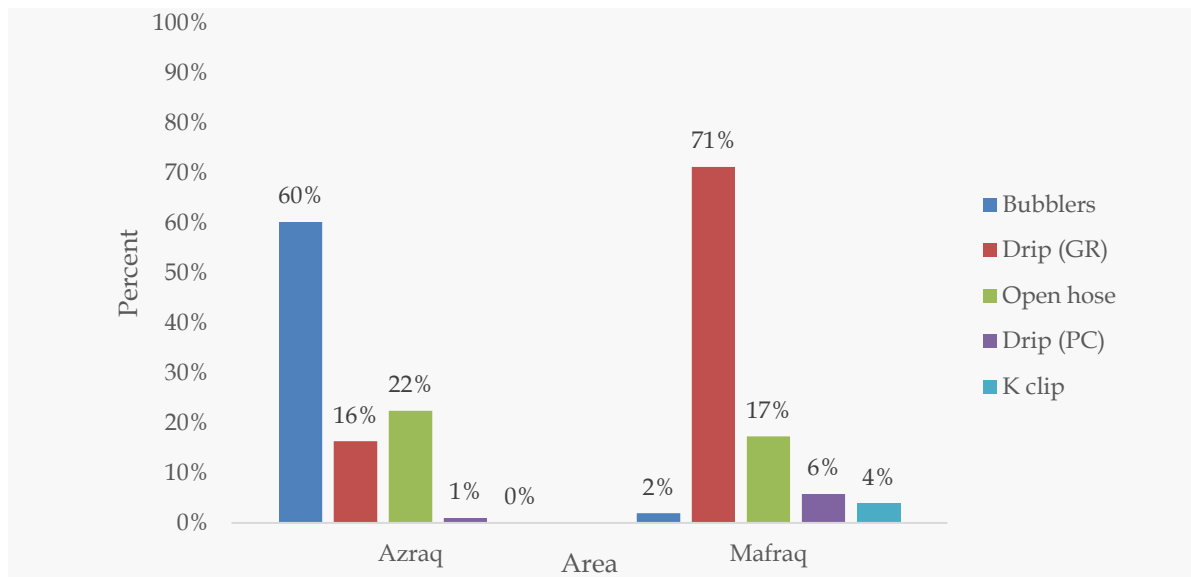


As shown in the figure, the majority of respondents in both Azraq and Mafraq show interest in WSDs. The level of enthusiasm supporting the proposition of WSDs depend on the farmers' understanding of the concept of water saving devices. It is also affected by the skepticism/belief in the effectiveness of such devices.

Why Farmers do not adopt water saving technologies? (Farm Audit/KAP)

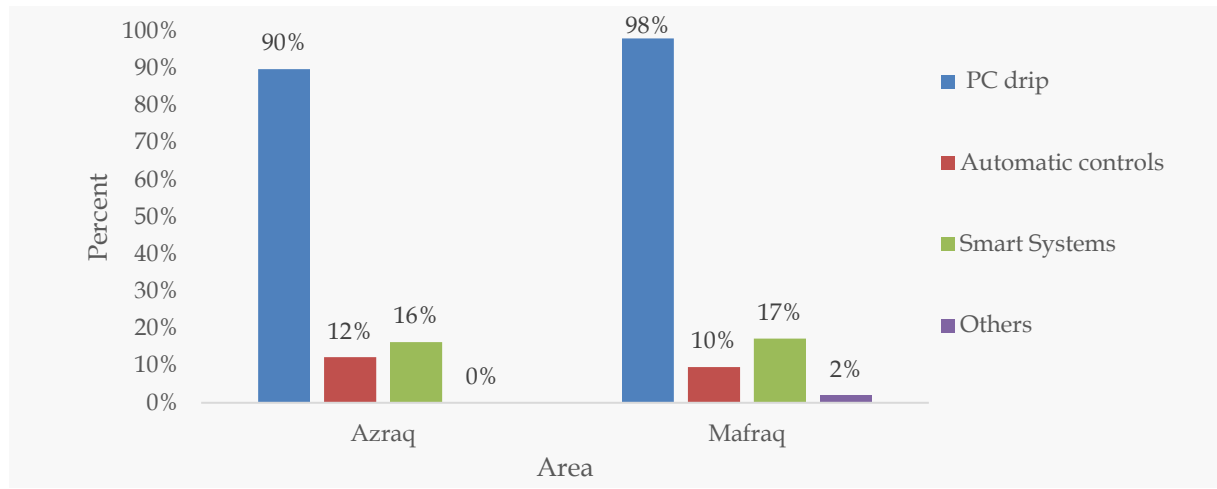


While several farmers refrained from answering this question, many farmers have expressed their concerns with the high costs of water saving technologies. Other farmers also expressed their lack of knowledge in these technologies. Therefore, any intervention that targets farmers who are familiar with the benefits of WSDs must include financial and technical support.

Type of irrigation system (drip/open hose/low flow/bubblers/mini sprinklers(Farm audit)

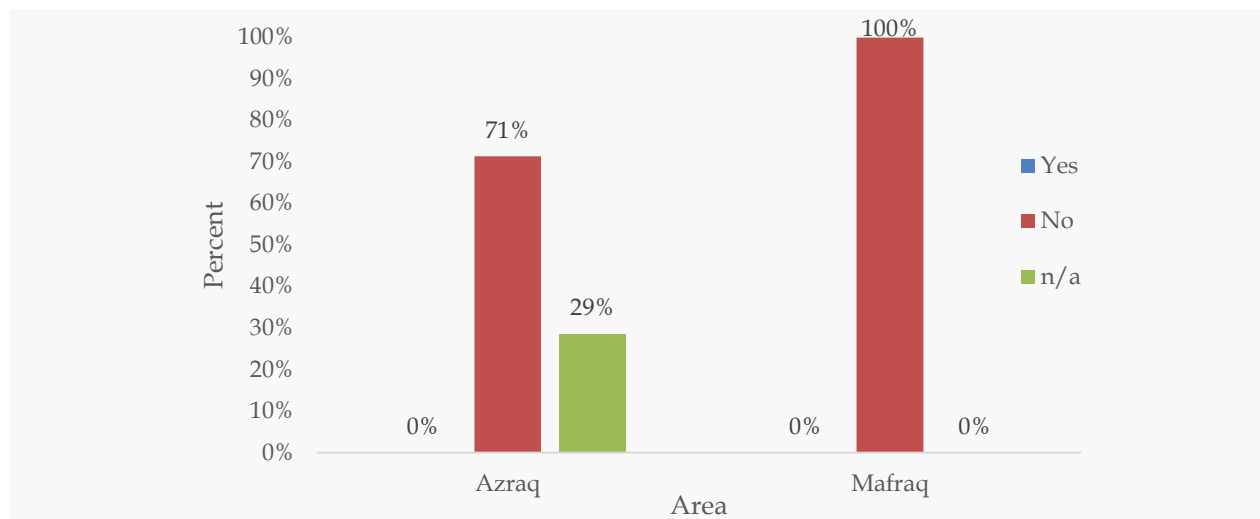
It is a point of interest that farmers in Azraq and Mafrq are majorly dependent on relatively primitive irrigation processes. Around one fifth of respondents (22% in Azraq, 17% in Mafrq) are still using open hose irrigation. This technique is usually considered low in irrigation efficiency, as it is purely dependent on how it is used, and leads to major losses in water. Drip GR is not the latest technology. The high dependency (71%) on Drip GR can be replaced with more efficient techniques such as micro drip irrigation, and PC Drip which appears to be used by very few farmers in both areas.

**What irrigation improvements would you like to implement? (More than one answer is allowed)
(Farm Audit/KAP)**

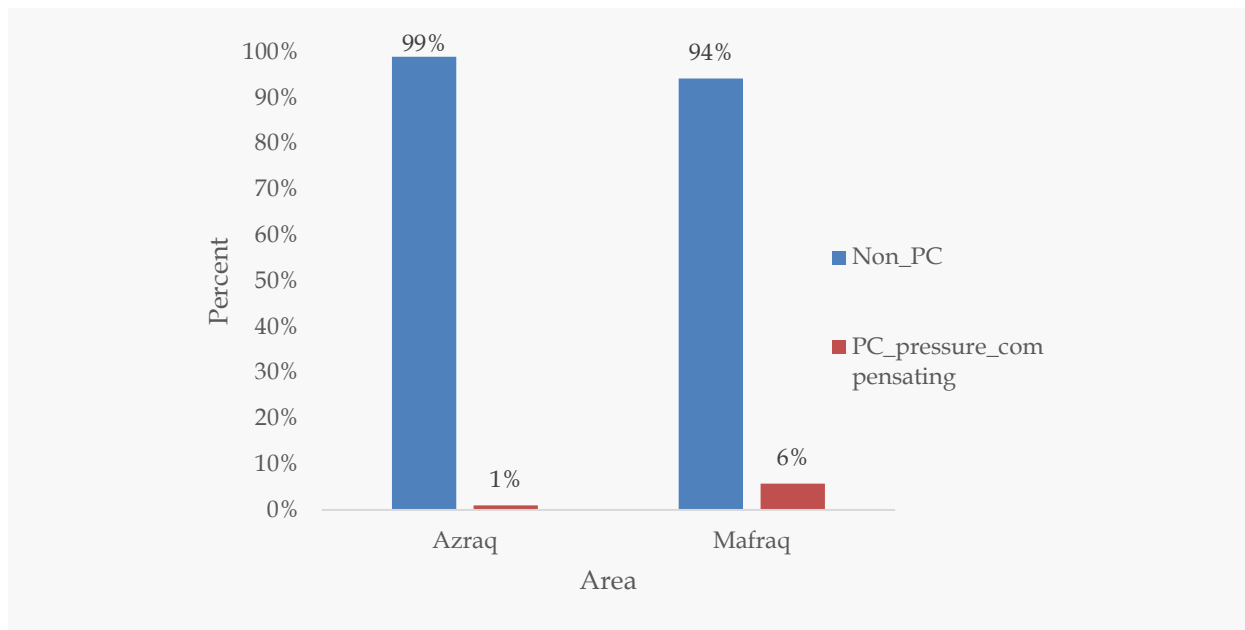


The majority of farmers in Mafraq and Azraq wish to install PC drip irrigation equipment. However, further investigation is necessary to understand whether and why farmers do not wish to install automatic controls or smart systems as an upgrade to their original network or other water saving techniques.

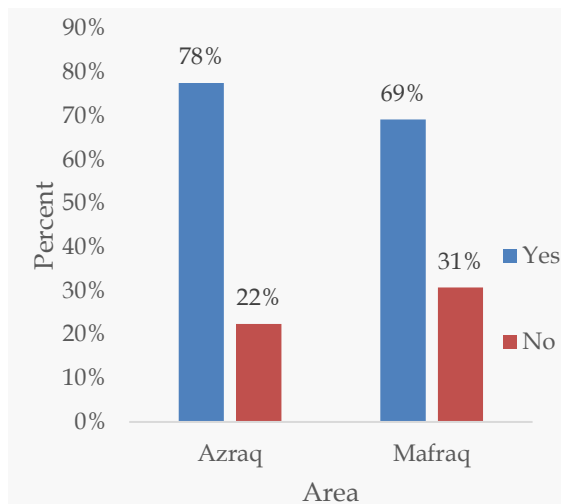
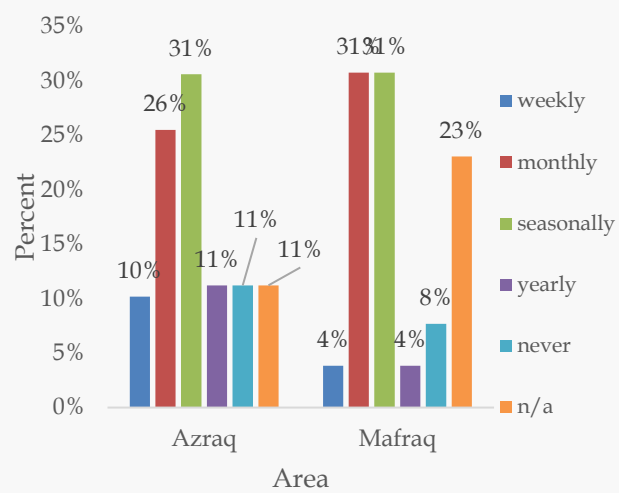
Are the pipes of the irrigation system made from recycled plastic? (Farm Audit)



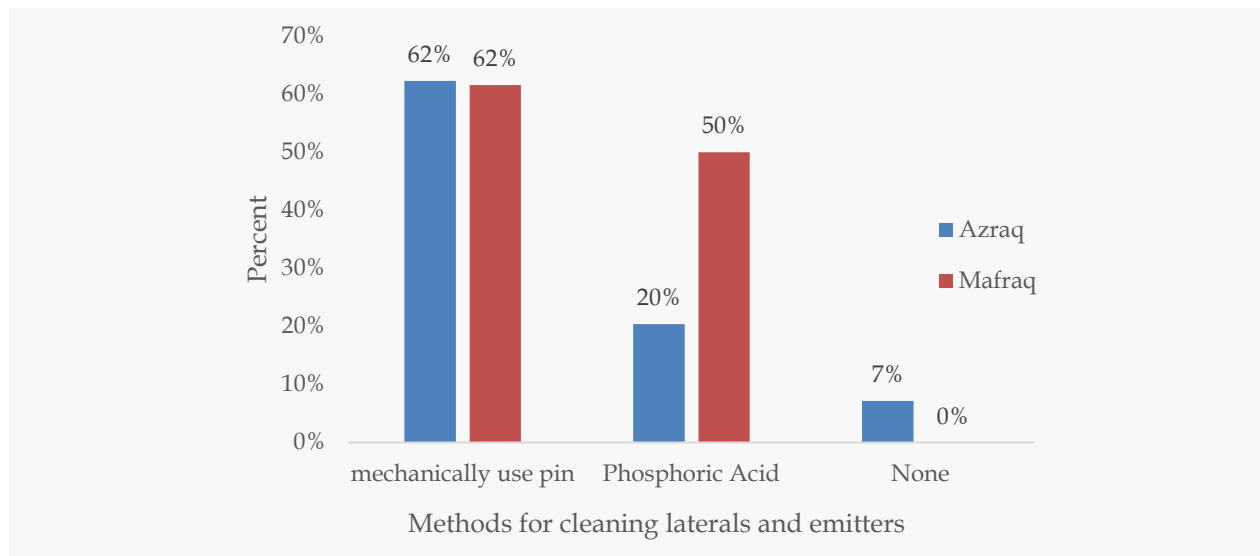
The cost of recycled plastic tends to be cheaper than non-recycled plastic. However, the lifetime of recycled plastic tends to be shorter due to previous stresses applied on the material that compromise its hardness. Nevertheless, future investigations should address the farmers' preference on pipe materials, and whether environmental benefits gained from using recycled plastic outweigh the water savings provided by non-recycled materials.

What type of drip irrigation you use in management of the block? (Farm Audit)

Less than 10% of both areas depend on PC Drip irrigation. Hence, any intervention that tackles block management shall address the transition of current drip network into PC Drips that are characterized by much higher efficiencies.

**(1)
Do you clean laterals and emitters? (Farm Audit)****(2)
(If YES) How often do you clean laterals and emitters? (Farm Audit)**

(3)

How do you clean the laterals and emitters? (More than one answer is allowed) (Farm Audit)

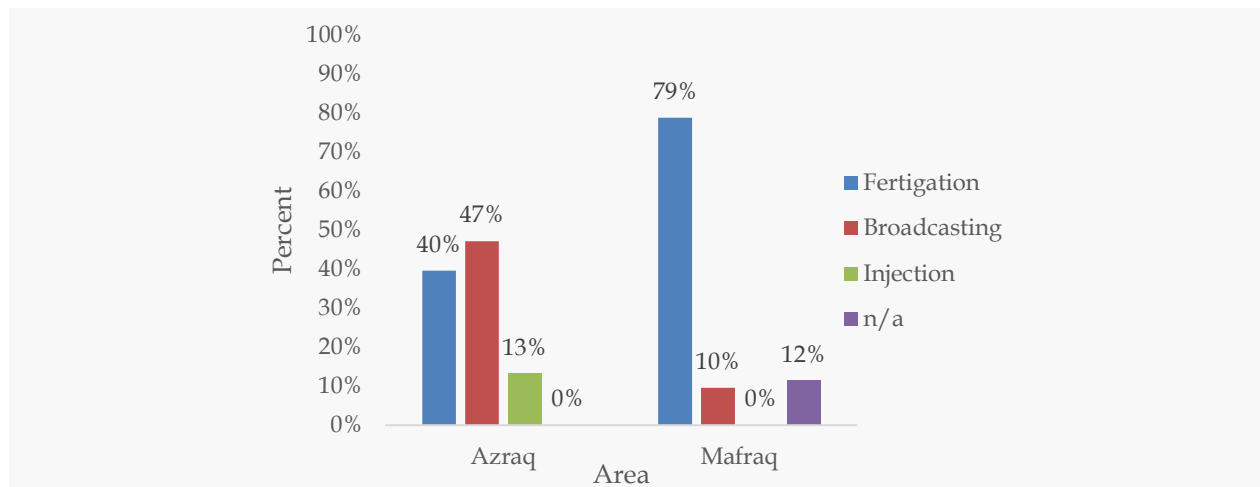
The simplest drip irrigation system includes Pump, pressure regulator, valves, filtration system, mainline, sub-main, laterals, drippers. It provides a controlled and uniform distribution of water and nutrients between plants located along the irrigation line. However, emitters are prone to clogging from deposits of calcium carbonate, algae or bacteria, so irrigation lines require maintenance for better and longer service.

As presented in chart (1), more than two-thirds of respondents in each area clean their laterals, indicating a certain level of awareness regards cleaning of laterals and emitters. However, in chart (2) more than half of respondents in each area clean laterals and emitters on a monthly or seasonally basis.

In chart (3), two-thirds of respondents in each area are using pin mechanically to clean the emitters and laterals. Moreover, half of respondents in Mafraq and 20% in Azraq are rinsing the laterals and emitters with phosphoric acid.

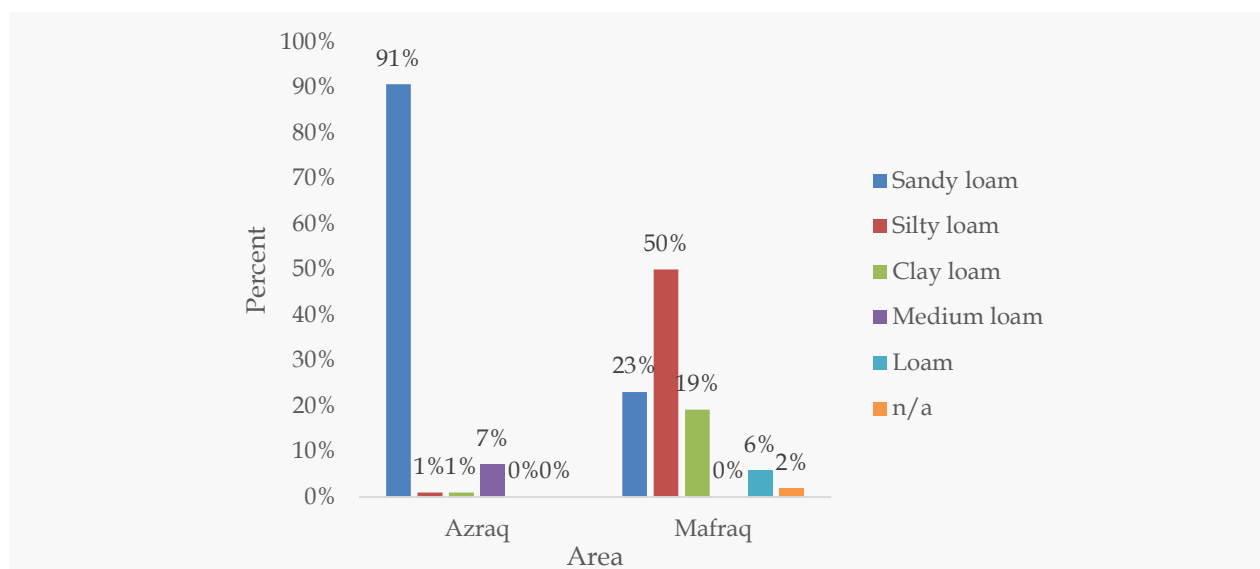
Nevertheless, it is recommended that the drip system should be checked every day and must be mechanically cleaned if necessary. Also, the emitters and laterals lines should be flushed with acid at the end of each season to remove build-up of precipitates.

Type of Fertilizer Application Methods (Farm Audit)



In Mafraa, 79% of farmers use fertigation, the most efficient technique for applying fertilizers, followed by injection. Nevertheless, future interventions must address broadcasting in both areas, with higher concentration on Azraq where the majority of interviewed farmers (47%) depend on this wasteful technique.

Estimate of soil type [based on sand-silt-clay content] (Farm Audit)



While some techniques, like drip irrigation, can be used for different types of soils, each soil might require completely different irrigation schedules due to the different properties of each soil.

The following tables presents the properties of each soil type that are related to water, according to Michigan State University (MSU, 2012):

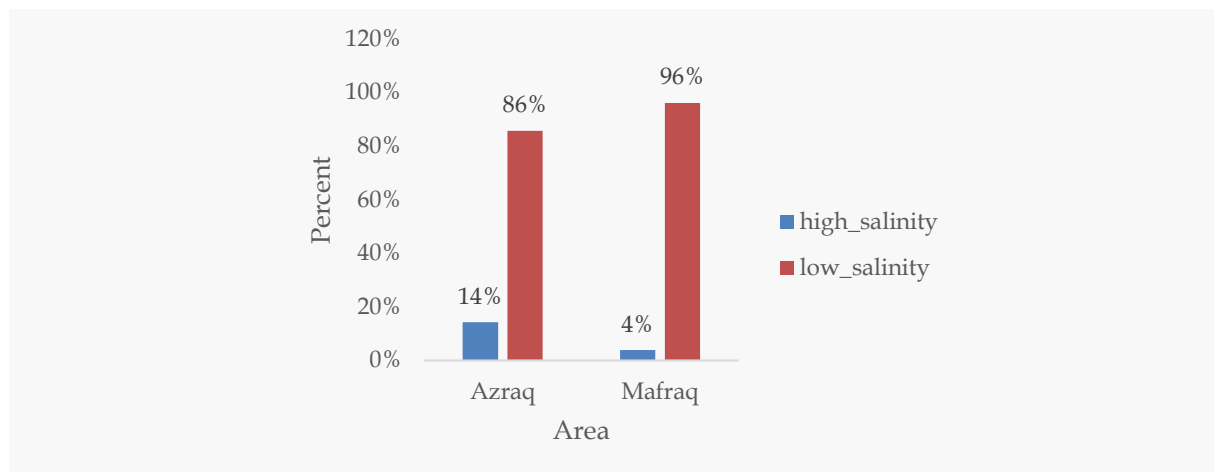
Soil Properties			
Property/Behavior	Sand	Silt	Clay
Water-holding capacity	Low	Medium to high	High

Internal Drainage	High	Slow to medium	Very slow
Susceptibility to water erosion	Low	High	Low if aggregated, high if not
Pollutant leaching	Poor	Medium	Good

Minimum and Maximum Emitter Flow Rate (liter per hour)		
	Average of Minimum emitters flow rate (l/hr)	Average of Maximum emitter flow rate (l/hr)
Azraq	106.9	274.3
Mafraq	28.9	76.0
	Max of Minimum emitters flow rate (l/hr)	Max of Maximum emitter flow rate (l/hr)
Azraq	1140.0	3240.0
Mafraq	122.0	240.0
	Min of Minimum emitters flow rate (l/hr)	Min of Maximum emitter flow rate (l/hr)
Azraq	0.6	2.1
Mafraq	0.6	2.7

All these values seem to be alarming. According to California Polytechnic State University, the minimum emitter flow rates should be closer to 2 L/hr, while maximum emitter flow rates should be closer to 4 L/hr. The study team further investigated the case and verified with several farmers and the WIT team. Average and maximum flow rates portrayed in the table must be investigated in future interventions, where solutions must be proposed for farmers to either replace their emitters or their entire irrigation system. Similarly, minimum flow rates portrayed in the table are lower than the recommended, which raises a speculation revolving around whether crops are being under irrigated or not.

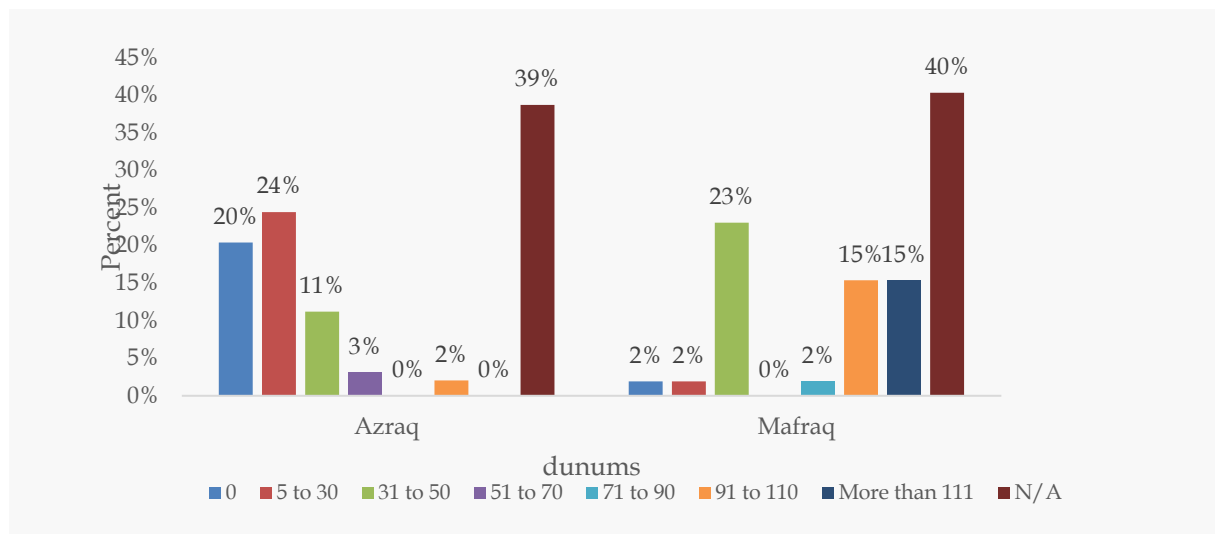
Salinity level (Farm Audit)



According to respondents the salinity levels seems to be low in both areas, where 86% of Azraq farmers and 96% of Mafraq farmers do not complain from salinity problems. Although the salinity level in Azraq is higher than in Mafraq in reference to Al Naber, (2018) study³. This might indicate an ignorance or lack of awareness about the salinity level issue. As time passes by, the over exploiting of groundwater resource will result in the increasing of salinity.

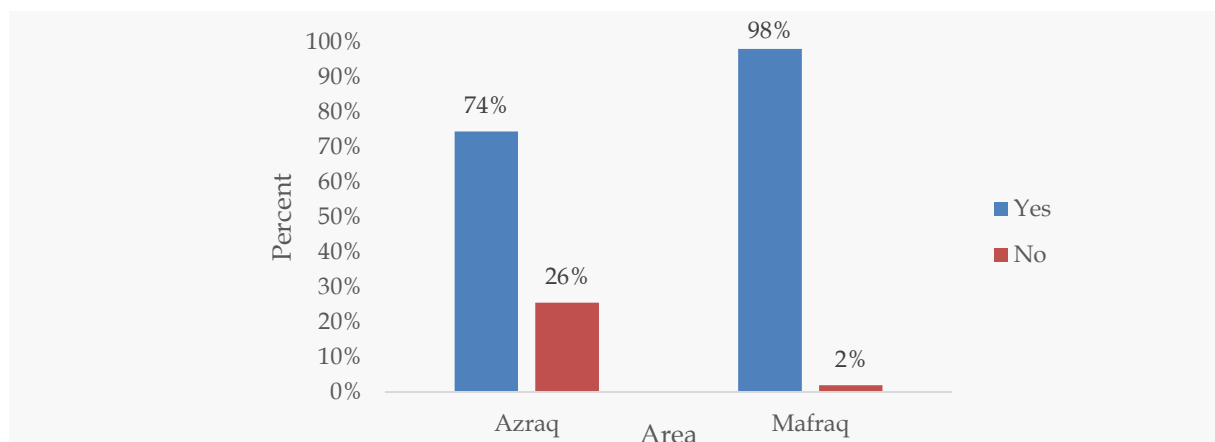
³ Majd Al Naber, 2018 Groundwater-Based Agriculture in Arid Land: The Case of Azraq Basin, Jordan

For annual maintenance, how many dunums you are planning to change for this season? (Farm Audit)



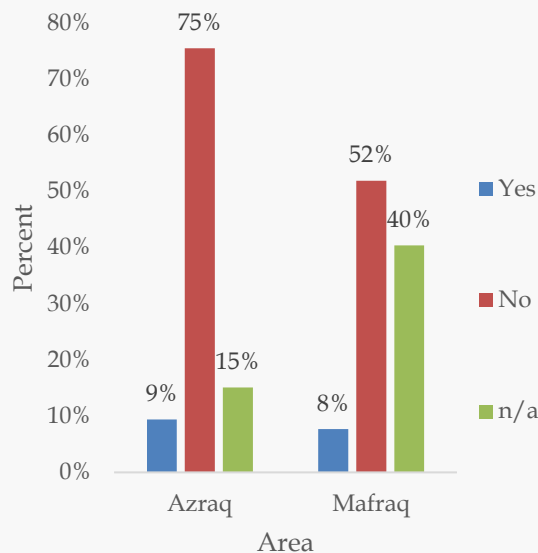
A good percentage of respondents are planning for annual maintenance for multiple dunums this season; mostly clustered between 5-50 dunums. This piece of information is essential for future interventions since prudence in maintenance could entail high responsiveness to future productive interventions. However, while some results appear alarming (such as the 20% of Azraq farmers who are not planning to conduct any annual maintenance), and others appear to be promising (like the 23% of Mafraq farmers who plan to maintain 32-50 dunums), further investigation needs to be done to understand what criteria did the farmers use when deciding how many dunums will undergo maintenance.

Are you interested in installing for free a water meter for one of the management blocks to improve your schedule? (Farm Audit)



It is quite evident that farmers in Mafraq are appalled at the high costs of irrigation. As a result, 98% are interested in installing meters that monitor and manage irrigation schedules; if the farmers are able to calculate the cost of 1m³ of water, the effect of water meter will serve as monitoring and scheduling tool. Also, a good percentage of respondents in Azraq (74%) indicated the same interest.

(1)
Have you ever conducted any feasibility studies for your farm? (KAP)



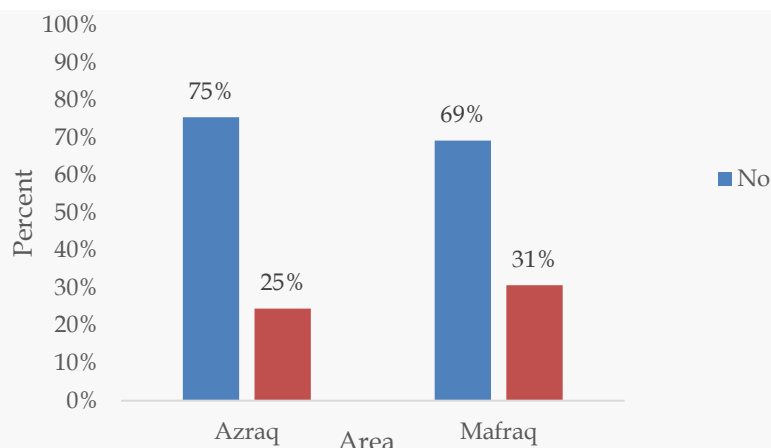
(2)
If yes, why?

	Azraq	Mafrq	Grand Total
Find out if a project is successful	1		1
To test if a project is beneficial		1	1
To test whether an investment is successful (i.e.)	1		1
To [check for change in] species	1		1
To have a successful project	1		1
To try fertilizer injection machine		1	1
n/a	49	50	99
Grand Total	53	52	105

When asking farmers in Azraq and Mafrq if they ever conducted a feasibility study in chart (1), less than 10% of the respondents in both areas indicated that they did, in fact, conduct feasibility studies. Usually, a feasibility study focuses on helping farmers to determine whether they should proceed with the proposed project idea. Farmers should conduct a feasibility study to determine the viability of their idea before proceeding with it.

3.3 FINANCIAL/ECONOMIC ASSISTANCE

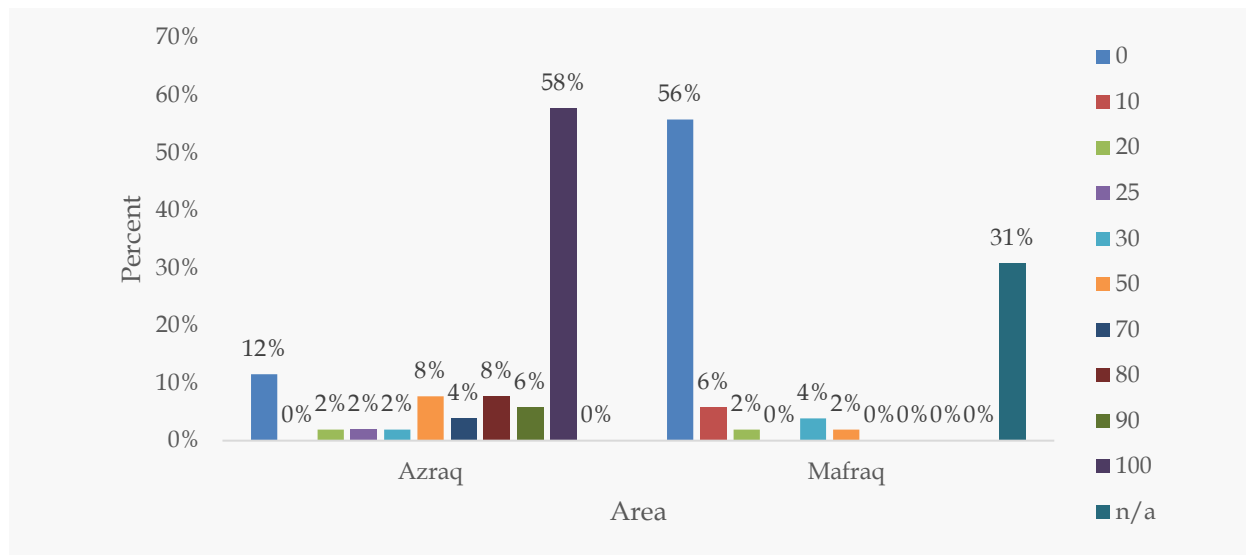
Do you keep written financial records of revenues and expenses? (KAP)



Ideally, everyone in the agricultural business must keep **financial records** of revenues and expenses. Unfortunately, 75% of interviewed farmers in Azraq, and 69% in Mafrq do not keep written financial records of revenues and expenses. However, keeping good records is very important to the business. Good records will help monitor the progress of the business. Records can show whether the business is

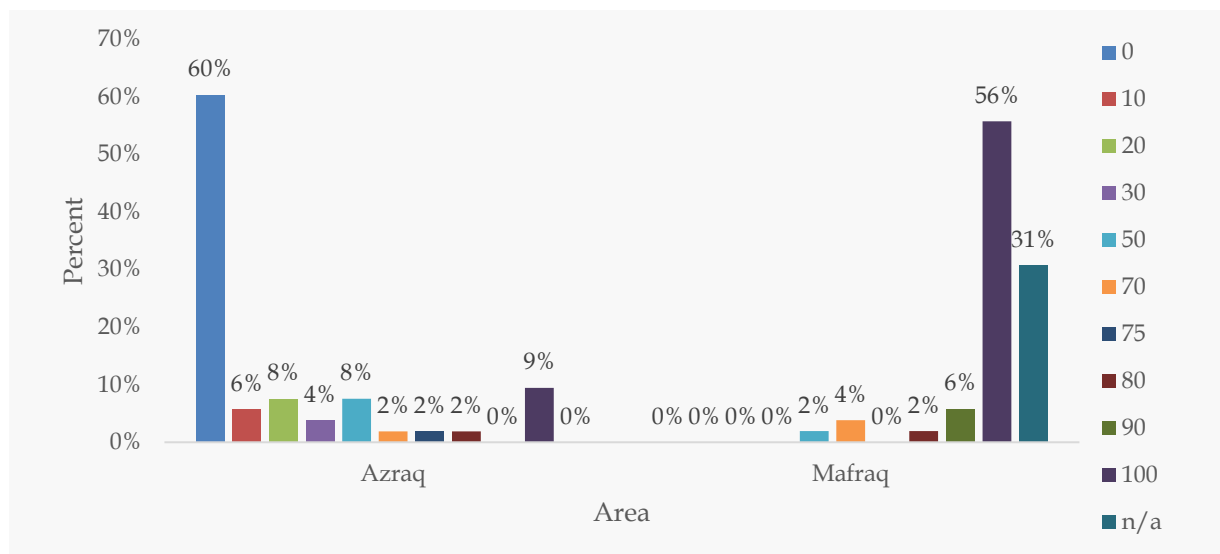
improving, which products are being sold, or what changes are needed to be made. Good records can also increase the likelihood of business success.

In the last 12 months, what proportion of your farm's working capital and new fixed investment has been financed from External funding sources? (KAP)



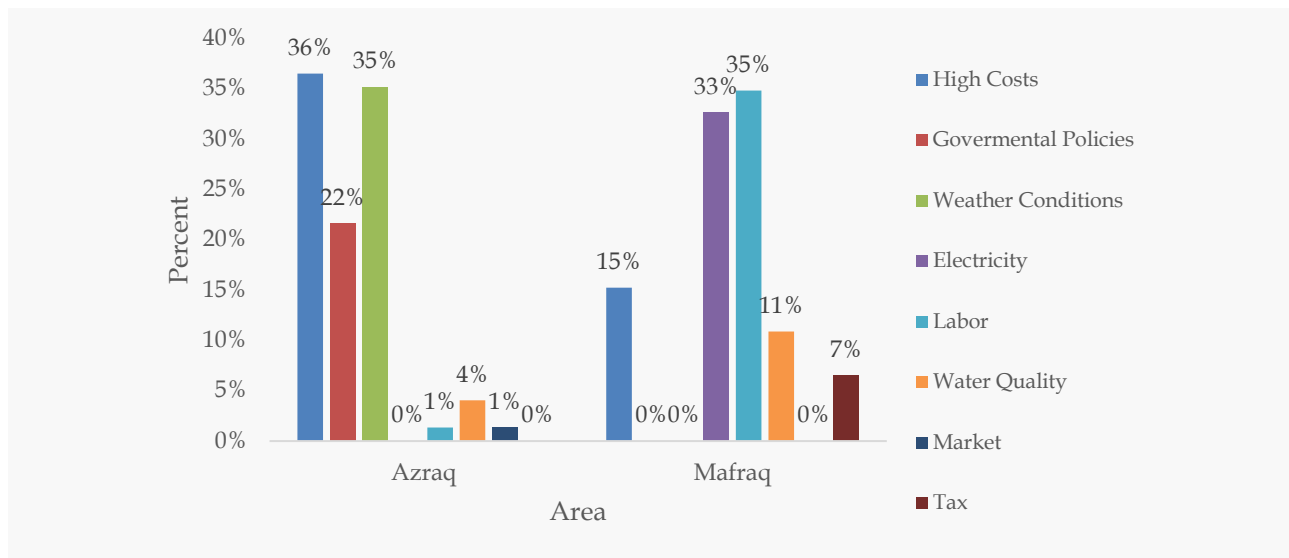
A percentage of 58% of respondents in Azraq indicated that their farm capital and new fixed investment have been a 100% financed from external funding sources. On the other hand, none of respondents in Mafraq depend on any external funding source. Further investigation about funding sources in both areas is required.

In the last 12 months, what proportion of your farm's working capital and new fixed investment has been financed from Retained Earning? (KAP)



In Mafraq, 56% of respondents depend fully on retained earnings to finance the working capital and new fixed investment. On the other hand, only 9% of respondents in Azraq stated the same.

What is the primary barrier to saving money? (KAP)



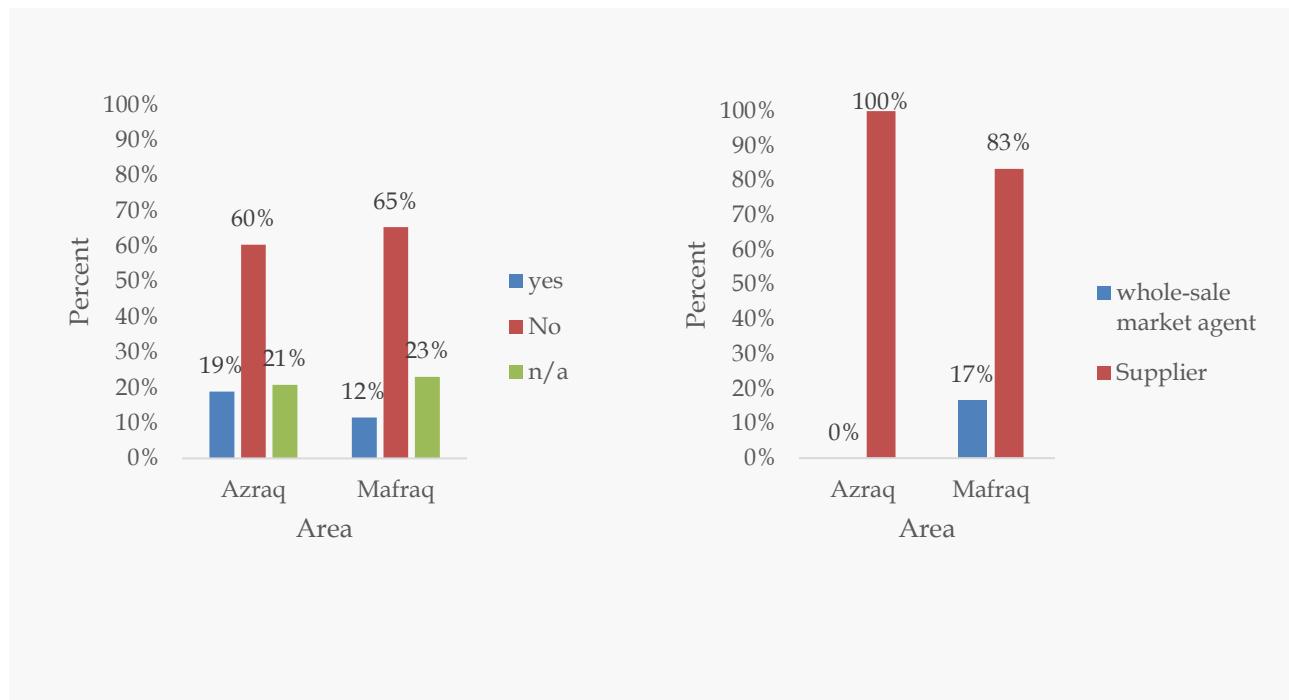
According to the respondents, the main three barriers to saving money in Azraq are high costs (36%), weather conditions (35%), and governmental policies (22%). On another hand, the main barriers for saving money in Mafraq are; labor costs (35%), high costs (15%), and According to the above table of (Al Naber, 2018), electricity is a key source of energy in Mafraq, therefore 33% of respondents in Mafraq indicated that the cost of electricity is one of the primary barriers to save money.

(1)

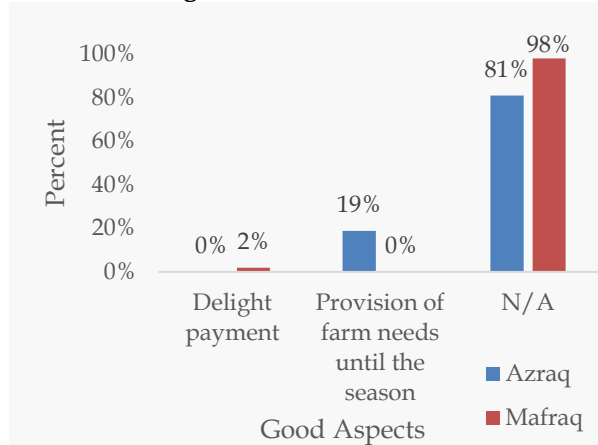
Do you usually buy on credit, or take loans when buying new irrigation equipment?

(2)

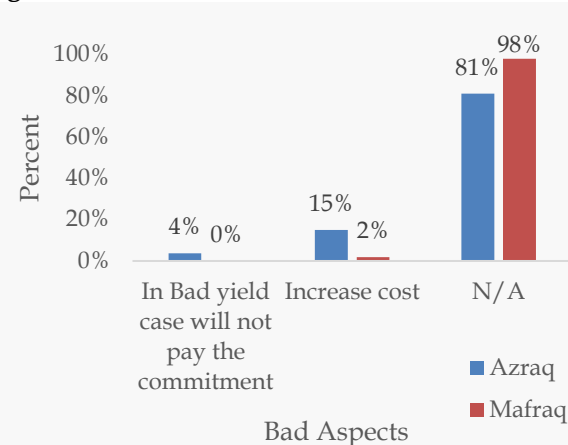
If you buy on credit, who gives you that credit?



(3)
If [you do buy on credit], what are the good aspects of borrowing from suppliers or whole-sale market agent?



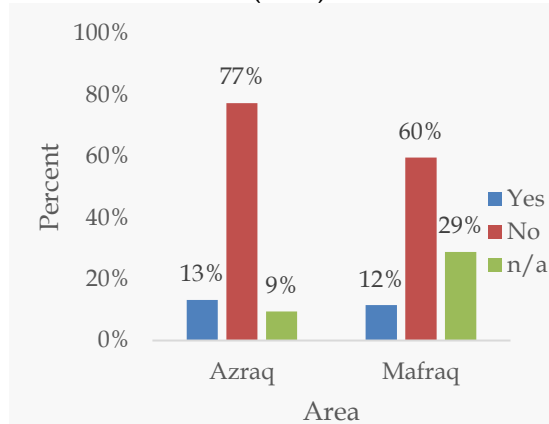
(4)
If [you do buy on credit], what are the bad aspects borrowing from suppliers or whole-sale market agent?



According to the respondents in chart (1), they do not usually buy credits or take loans when buying new irrigation equipment. Only 19% in Azraq and 12% Mafrq declared that they took credits or loans. In chart (2), all interviewed farmers in Azraq usually buy credits from whole-sale market agent. While 17% of respondents in Mafrq buy credit from whole-sale market agent, 83% buy from suppliers.

As presented in chart (3), those who buy on credit indicated that the main good aspects are allowing farmers to supply their needs until the end of the season, and delight payments. On the other hand, in chart (4) the bad aspects for buying credits according to the respondents that costs will be increased in this way, also in the case of bad weather and weak seasons, they will not be able to pay the due installments.

(1)
Have you ever borrowed from ACC or a commercial bank? (KAP)



(2)
If yes, how often do you access loans? (KAP)

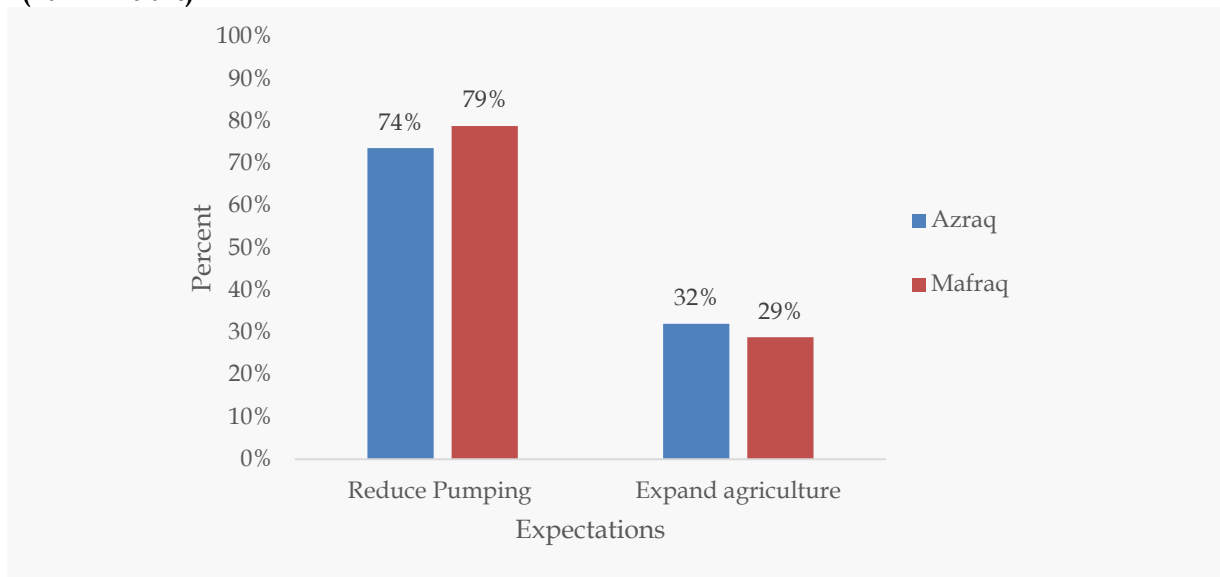


As shown in chart (1), a very small percent (Less than 15%) of the respondents in Azraq and Mafrq stated that they borrowed from ACC or a commercial bank. Reasons may include religious limitations on interests imposed by commercial banks. In chart (2), Most of those who indicated that they borrowed from ACC or a commercial bank had access to loans 4 to 5 years ago. Therefore, it is recommended to reach a number of banks and lenders, and work with them to reduce the provisions and restrictions on financing the agricultural sector.

Establishment and Operational cost of Azraq/Mafraq farm :

Average hardware purchase cost of irrigation system at the time of farm establishment (JD)	
Azraq	Mafraq
25,203.19	54,344.44
Cost of hardware purchase is calculated as an average for all farms per area. Mafraq farms average costs was about 54,344.44 JD. On the other hand, hardware purchase costs in Azraq is much cheaper (almost half of the number) than in Mafraq with 25,203.19 JD.	
Average cost of the laterals (JD/dunum)	
Azraq	Mafraq
37.16	107.73
The Average cost of the laterals in Mafraq according to the interviewed farmers is 107.73 (JD/ dunam) which is more expensive than in Azraq with 37.16 (JD/ dunam) average cost of the laterals.	
Average percent of electricity bill cost from the total farm operational costs (%)	
Azraq	Mafraq
26%	36%
The percentage of electricity bill cost from the total farm operational costs is averaged for the interviewed farmers in Mafraq and was around 36%, which -in comparison to the percentage in Azraq (26%) -is considerably higher.	
Average Cost of Fertilizer (JD/year/dunum)	
Azraq	Mafraq
30.2	63.8
The cost of fertilizer according to the interviewed farmers in Mafraq is 63.8 (JD/year/ dunam) which is almost the double of the results in Azraq (30.2 (JD/year/ dunam))- (Cost is calculated by averaging responses of all farmers)	
Average Cost of Pests and Weed Treatments (JD/year/dunam)	
Azraq	Mafraq
9.3	45.9
The cost of Pests and Weed Treatments according to the interviewed farmers in Mafraq is 45.9 (JD/year/ dunam), while in Azraq the cost is 9.3 (JD/year/ dunam)- (Cost is calculated by averaging responses of all farmers)	

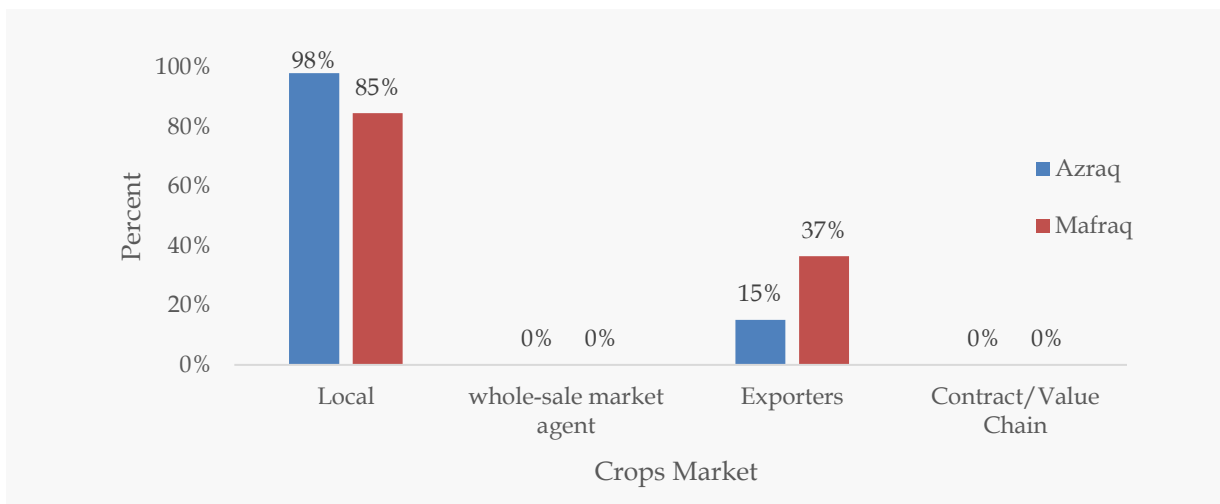
**What is your expectations from saving water and related costs? (More than one answer is allowed)
(Farm Audit)**



As seen in previous questions in the survey, farmers suffer from extremely high costs of irrigation. This triggers an urgency in prioritizing expenditure cuts rather than expanding their business. This might not be the only reason but, also, the political situation and external factors that prevent farms from importing their productions to neighbor areas.

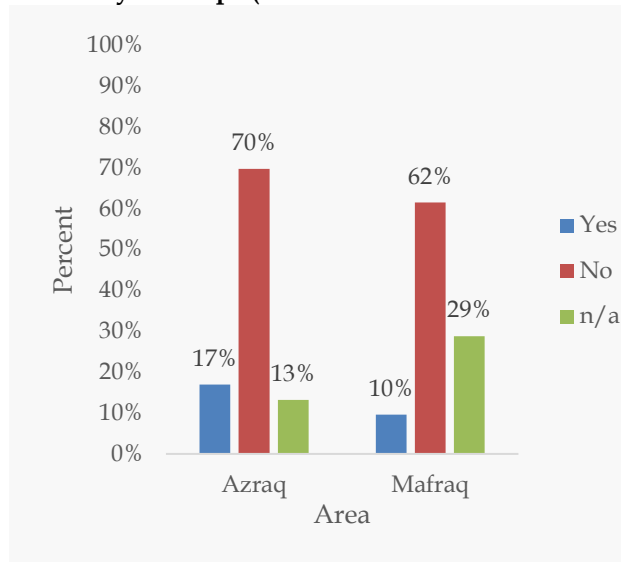
3.4 COMMUNICATION AND OUTREACH

To whom do you market your products? (More than one answer is allowed) (KAP)

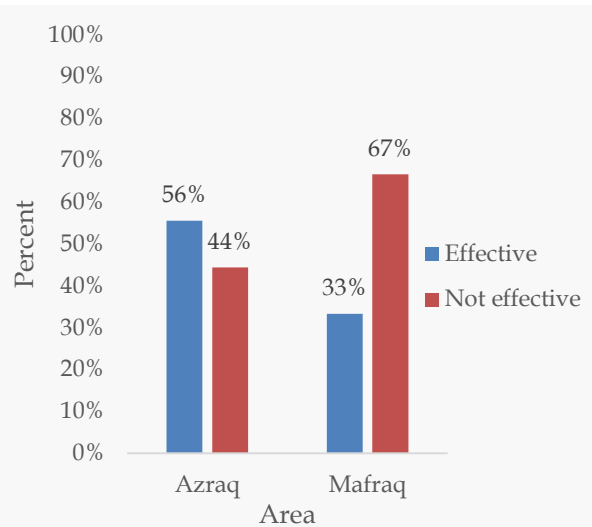


Due to political conditions in the region, specifically after closure of border crossings with Syria and Iraq, Jordanian farmers are heavily dependent on selling their products to the local market. The majority of respondents in Azraq (98%) and Mafrq (85%) indicated that they locally market their product, as illustrated in the figure above.

(1)
Do you belong to an organization that helps you market your crop? (KAP)



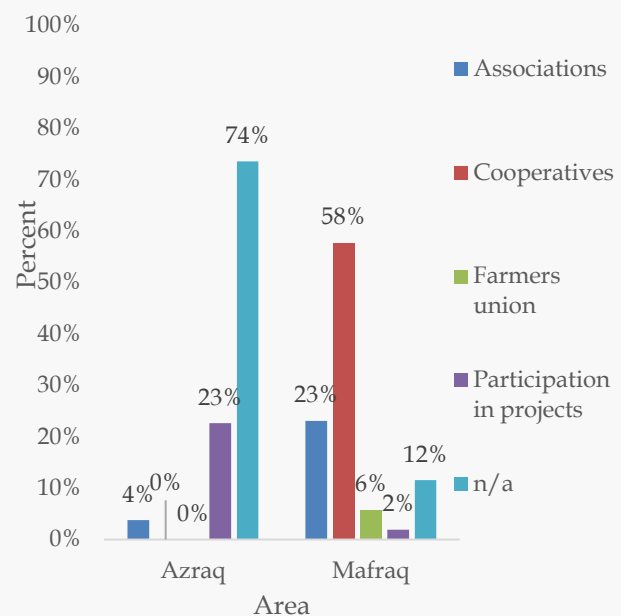
(2)
If yes, is it effective and useful or not?



(3)
If Yes, what is the organization name? (KAP)

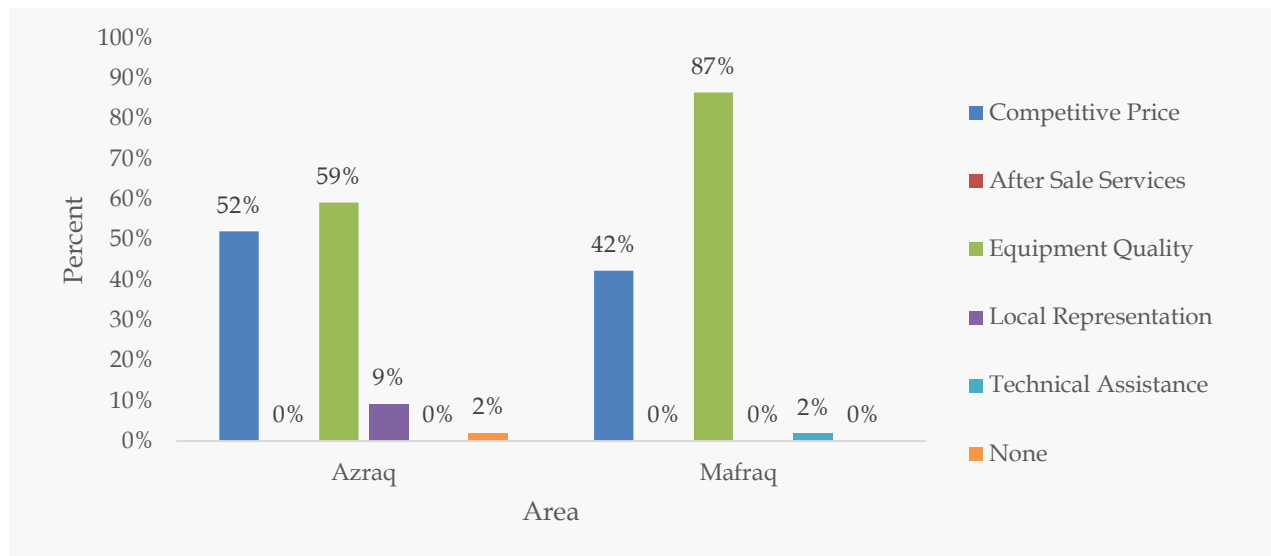
	Number of Responses		
	Azraq	Mafraq	Grand Total
Azraq reservoir association	1		1
JEPA		4	4
JOPEA	1		1
Olive producer society	1		1
Reservoir savers	1		1
Sarah farmer to save an oasis	1		1
Azraq Association to saving oasis water	1		1
Azraq Association for produce and marketing olives	3		3
Grand Total	9	4	13

(4)
What is your preferred professional network?



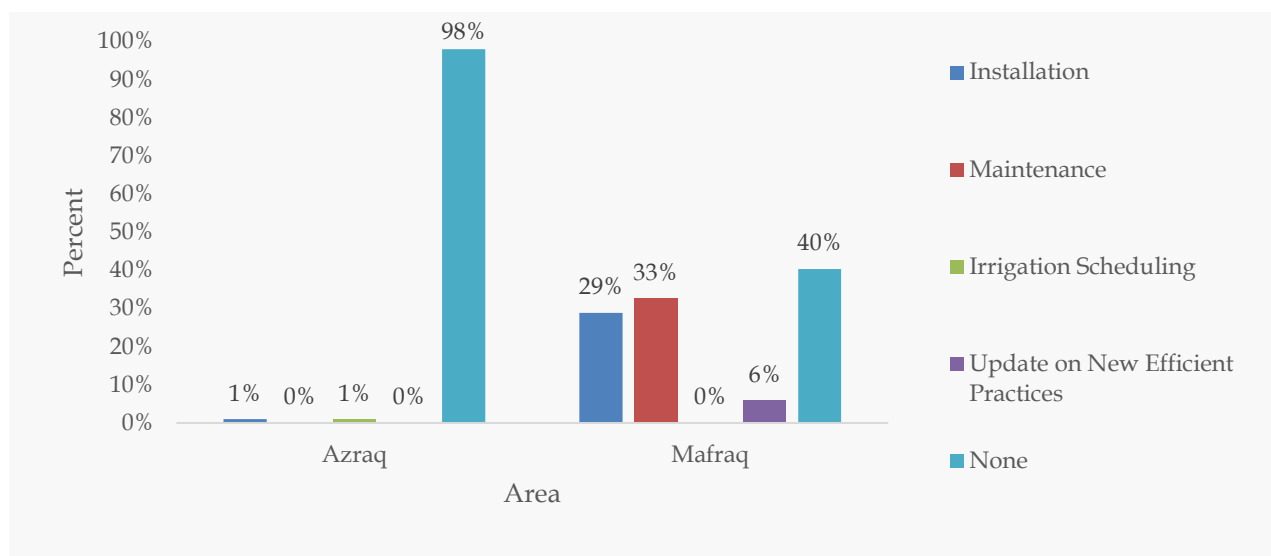
A high percentage of farmers do not take advantage of the services provided by organizations who work on marketing products as shown in chart (1). Future interventions must investigate the effectiveness of such organizations. As presented in chart (2), 44% of Azraq farmers, and 67% of Mafraq farmers, who belong to these organizations believe that organizations are less effective than their expectations.

Reasons Behind Selection of Supplier/Company (More than one answer is allowed) (Farm Audit)



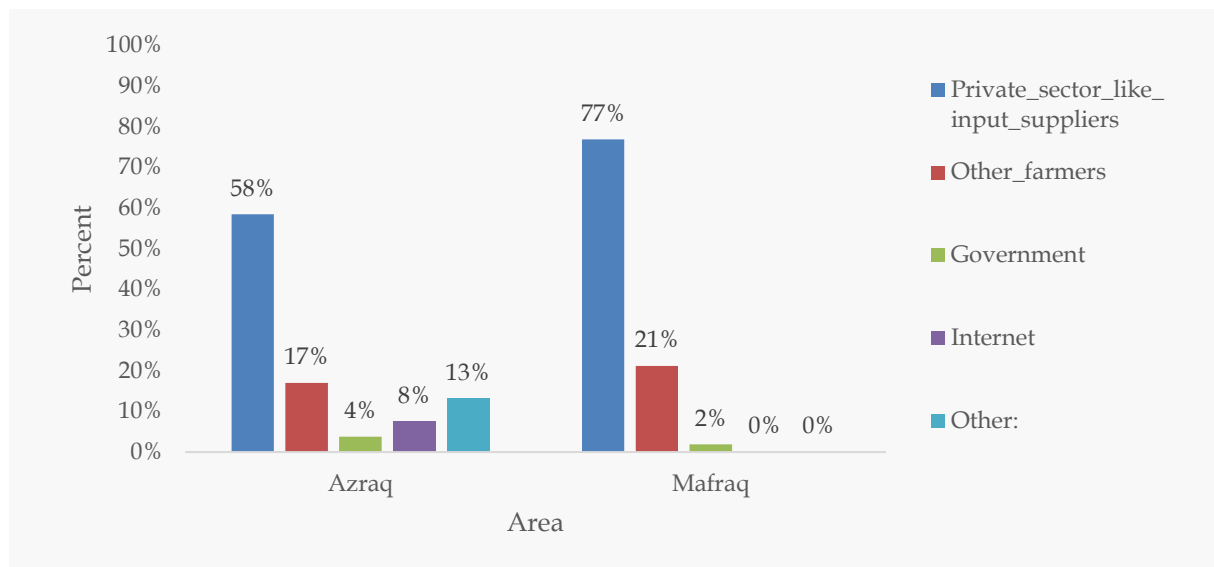
The majority of the interviewed farmers in Mafraq (87%) said that the reason for choosing the supplier company is the quality of the equipment. The other reason was the competitive price, as shown in the figure above. For Azraq, almost 60% of the respondents indicated that the reason for choosing the Supply Company is the quality of the equipment. For approximately half of the respondents in Azraq, the competitive price is the reason for choosing the supply company.

Services Provided by Suppliers (More than one answer is allowed) (Farm Audit)



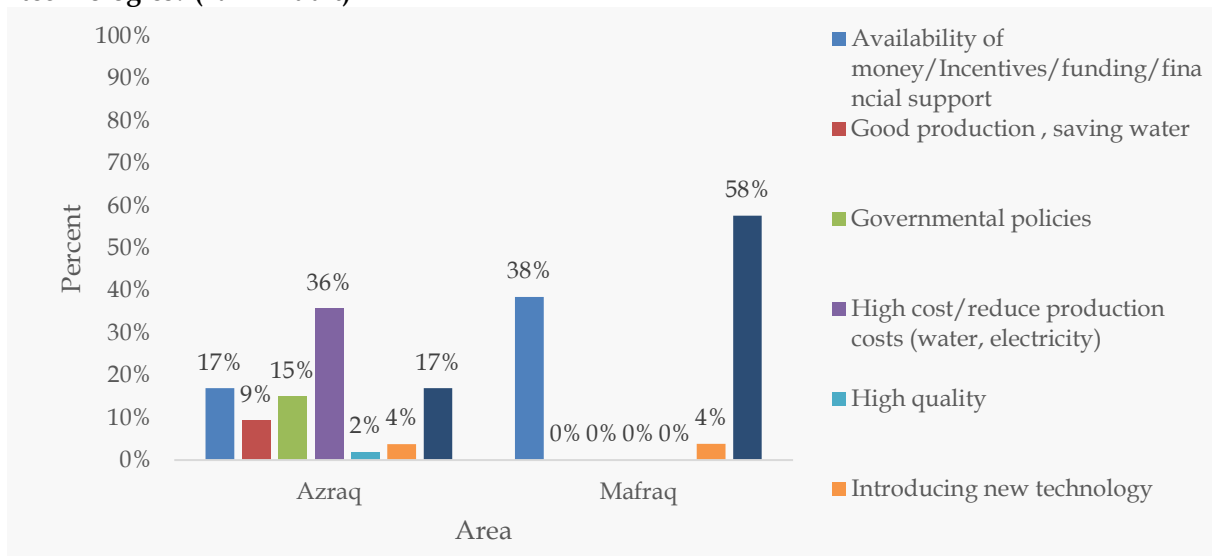
While 98% of the farmers in Azraq indicated that the suppliers do not provide any services, only 40% of respondents in Mafraq indicated that the suppliers do not provide any services. On the other hand, around one-third of the farmers in Mafraq said that the supplier provides maintenance services, and 29% indicated that they get an installation refers services from the supplier. After sales services to various processes make sure that customers are satisfied with the products and services of the company. Customers are the assets of every business. Hence, sales professionals must try their best to satisfy customers for them to come back again to their company.

From which source do you prefer to get technical information? (Farm Audit)



Farmers of both areas, as portrayed in the graph, prefer technical information from the private sector. Reasons for such preference may be due to the fact that competition among suppliers is always present, making some suppliers more competent and trustworthy than any other stakeholders. Such ability and transparency increase the suppliers' credibility, were others said that they take the technical information from exhibitions and agricultural magazines.

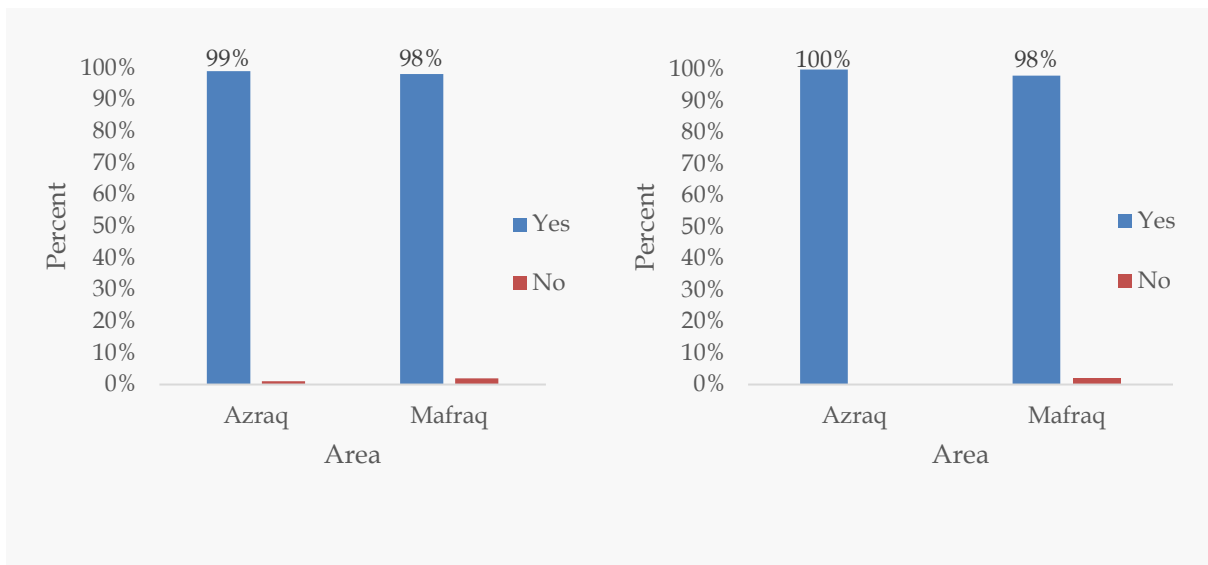
What could industry, government or other actors do to motivate you to switch to new practices or technologies? (Farm Audit)



As can be seen in the graph, respondents have been consistent with their concerns that relate to the financial burden of irrigation. Therefore, additional costs of WSDs can also become a new short-term burden that could affect their expenditure. While some realize the benefits of such technologies, 38% of respondents in Mafrq believe that they would be willing to use new technologies when financial incentives such as funding and loans are available to farmers. The majority of farmers in Azraq share similar financial concerns, hence they are willing to pay for WSDs when there is an incentive or a solid proof that contribute to decreasing costs of electricity and water.

(1)
Are you interested in the project advice for connecting you to a supplier that could provide quality equipment?

(2)
Are you interested in the project technical advice through suppliers?



It is quite evident that farmers in both areas are willing and interested in taking project advice for more supplier connection, that could provide equipment with a good quality. On the other hand, the vast majority have expressed their interest in being linked to suppliers that possess technical expertise. Providing a robust starting point to design an intervention that can greatly benefit farmers on so many levels.

4.0 RECOMMENDATIONS

Technical Recommendations:

- Since recording water use and agricultural inputs use were not a practice adopted by most farmers, it is recommended to:
 - Conducting awareness-raising training program on the importance of keeping a water/agricultural inputs records to ensure successful outcomes. **(Training Needs)**
 - Encouraging suppliers to consult farmers about farm report cards, tools and instruments. Moreover, improving farmers' technical (know-how) competencies that encourage them to use records in predicting expenditure revenues.
- It is recommended to increase farmers' knowledge in pre and post procedures used to deal with weather conditions' consequences. **(Training Needs)**
- It is critically important to search for decent and innovative irrigation systems in order to enhance water efficiency and economic advantage growth. Apparently, farmers are facing some barriers in investing in decent irrigation systems. Therefore, there is a need to increase farmers' knowledge of the importance of looking for/adapt new irrigation systems for their notable return on investment in the long term. This can be achieved through conducting several trainings and awareness sessions. **(Training Needs)**
- Farmers need to be exposed to new estimation methods of Crop Water Requirements (CWR) in their area. This can be achieved through piloting CWR practices. After that, disseminating these practices through the qualified farmer who has the right scientific knowledge (farmer-to-farmer and peer learning). This is considered as an effective way to exchange CWR knowledge based on trust, relying on social networks, with learning and social multiplier effects. Together with collective action, it can lead to effective adoption of CWR practices.
- Suppliers can act as a key player in the capacity building and technical assistance provided to farmers about the best practices and technology used in irrigation and equipment maintenance. They are by far the most preferred channel of technical information. It is recommended to design interventions that incorporate supplier's presence and expertise in capacity building and advisory to farmers. Local AGR institutions and entities can serve as a hub for bringing expertise together and provide advisory services. Another intervention can be conducting an event that is similar in nature to an exhibition of the different WSDs, where suppliers and experts can demonstrate the benefits of the adopting WSD. Financial support must not be overlooked when planning such interventions.
- Suppliers must pay more attention on after sale services This can be achieved through raising awareness of the importance and the need to provide aftersales services and how this positively affects their business and provide greater market penetration.
- It is very important for suppliers to promote for additional effective filtration systems, especially in Azraq. It is recommended for farmers in both areas to increase their awareness about the benefits of filtration systems on the long term, focusing more on their pay off in the future. **(Awareness raising)**
- Additional studies must take place to investigate in the current salinity level in both Azraq and Mafraq and how farmers are dealing with this issue (best practices along with preventive actions).
- Water saving technologies will pay off in the future. Therefore, it is recommended for suppliers to strengthen their capacity with the most updated water saving technologies, for example,

tensiometer, P.C, and drip irrigation system. By default, this will be reflected on raising farmers' awareness level about the effectiveness of WSDs. **(Training Needs)**

- Future investigations should address the farmers' preference on pipe materials, and whether environmental benefits gained from using recycled plastic outweigh the water savings provided by non-recycled materials.
- Farmers need to receive trainings on the following topics:
 - Recommended minimum and maximum emitters' flow rates
 - Importance of cleaning laterals and emitters network, and its impact on irrigation efficiency **(Training Needs)**
 - Importance of conducting feasibility studies and how to conduct them **(Training Needs)**. Workshops must emphasize that the feasibility study does not have to be difficult nor expensive, but the most important aspects should all be considered to ensure that potential problems are addressed. When teaching farmers how to conduct a feasibility study, farmers should learn how to answer the following questions:
 - Is there a demand for the product? (Find out the characteristics required of the product and the size and value of the market)
 - Who else is producing similar products? (Determine the number and type of competitors)
 - What is needed for production? (Find the availability and cost of staff, equipment, services, raw materials, ingredients and packaging)
 - What is the cost of producing a product? (Calculate the capital costs of getting started and the operating costs of production)
 - What is the likely profit? (Calculate the difference between the expected income from sales to an estimated share of the market and the costs of production)
 - For farmers, it is recommended to conduct more trainings specified in expanding their market outreach and improving their marketing competencies. **(Training Needs)**

Financial / Economic Recommendations:

- Conduct more trainings about the importance and the method of keeping written financial records of farmers revenues and expenses. **(Training Needs)**
- Attention should be given to exploring why farmers are avoiding loans in order to come up with several types of incentives along with soft loans that encourage them to adopt new technologies.
- Reaching several banks and lenders and working with them to reduce the provisions and restrictions on financing the agricultural sector is also recommended.
- Develop a financial tool to promote the adoption of water saving technologies. What is the payback period of investing on these systems? What is the estimation reduction on energy bill?

Communication and outreach Recommendations:

- Further interventions must address local organizations capacities (e.g. CBOs, NGOs, etc), in order to support them in maximizing the outreach and impact of any future interventions. As well as the providing advice and technical support when appropriate.
- Further opportunities and procedures are suggested to improve the communication channels between the government and farmers in both areas, for instance creating a new platform for farmers to know more/ access to policies, regulations and instructions.
- It is recommended to intensively increase the communication channels between farmers and (suppliers, funding agencies, ACCs and commercial banks), through regular meetings and discussions to figure out the best ways for cooperation and funding services.
- Farmers are essentially affected by and learn from other farmers. They are on the look for new updates and info by similar sector peers. It is recommended that capacity building interventions and promotion of WSDs are achieved through experienced farmers. Ambassadors among famers who have success stories can be recruited and trained support other farmers. Observatory visits by farmers to other farms that adopt new technologies and best practices is equally recommended

ANNEX 1 (FARM BASELINE SURVEY FORM):**Purpose of the survey**

- Assess the demand side market.
- Identify top opportunities to link pioneer farmers to suppliers for using water saving technologies and inputs.
- Identify technology early adopters willing to host demonstration sites and / or receiving technical advice.

	Audit team info	
1	Names of Audit Team member 1:	
2	Names of Audit Team member 2:	
3	Date of Audit [use format: YYYY-MM-DD]:	
4	Our location group (Azraq / Mafraq):	
5	Farm name	
6	Farm gate coordinates (UTM)	North: East:
7	GPS-lat (y-value) [range 31.700000 - 32.400000]:	
8	GPS-lon (x-value) [range 36.000000 - 37.200000]:	

Farm info

9	Respondent name:	
10	Telephone No.	Email P.O. Box
11	Interviewee Nationality	1. Jordanian 2. Egyptian 3. Pakistani 4. Other
12	Interviewee Age:	Age:
13	Interviewee Sex:	1. Male 2. Female
14	Relationship to the Farm	1. Land owner 2. Land Leased 3. Sharecropper 4. Manger 5. Other
15	Land User Name:	1. Age: 2. Sex: M / F
16	Farm Manager Name:	1. Age: 2. Sex: M / F
17	Farm Manager education	1. Primary, 2. Secondary 3. Short-cycle tertiary 4. Bachelor 5. Above (Master, Doctoral)
18	Year of farm establishment (if known):	

19	Date of appointment of farm manager:	
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	Farming system	
20	Farm area (dunam, du):	
21	Open field crops on the farm:	1. crop / variety / area: 2. crop / variety / area: 3. crop / variety / area: 4. crop / variety / area: 5. crop / variety / area: 6. crop / variety / area: 7. crop / variety / area:
22	Total area of open field crops (dunam):	
23	Area of greenhouses (m ²):	
24	Number of greenhouses:	
25	Type of greenhouse systems:	1. In-Soil 2. Soil-less hydroponic:
26	What is the range of yield for olives (min-max kg/du)?	
27	What is the range oil yield (min-max liters per 100 kg)?	
28	What is the range of yield for stone fruits (min-max kg/du)?	
29	Livestock (specie, number)	1. specie 1 / number: 2. specie 2 / number: 3. specie 3 / number:
30	What are the other agricultural products of the farm?	
31	Do you have a warehouse for post-harvest processing	1. Yes 2. No
32	Number of tractors	
33	Total Horse power	
34	Number of machinery for pesticide application	

	Farm economics	
35	What is the range of prices for olive for the last 2 years? (min-max JD/kg)	
36	What is the range of prices for stone fruits for the last 2 years? (min-max JD/kg)	
37	What kind of processed farm produce you get revenue from?	
38	What the farm produces that constitutes the source the primary income?	
39	Is your business profitable during the whole year?	1. Yes 2. No
40	If no, How many months does your agribusiness have positive cash flow?	
41	Do you keep records of water use and agricultural inputs use?	1. Yes 2. No
42	(If No) Why not? (Rank Top Two)	1. Can't write 2. Not enough time 3. Would not use the information 4. Other_
43	Do you keep written financial records of revenues and expenses?	1. Yes 2. No
44	Evaluate the development of your farm business over the last 24 months.	1. Declined significantly 2. Improve significantly
45	In the last 12 months, what proportion of your farm's working capital and new fixed investment has been financed from each of the following sources?	1. Retained earnings (%) 2. External funding sources (%)
46	How do you think your business could become more profitable, sustainable, resilient to price shocks and changing market access conditions?	

	Financing	
47	What is the primary barrier to saving money?	
48	What is the primary barrier to improving crop production levels?	
49	What is the primary barrier to investing in descent irrigation system?	
50	Do you usually buy on credit, or take loans when buying new irrigation equipment?	1. Yes 2. No
51	If you buy on credit, who gives you that credit	1. Supplier 2. Commissioner
52	What are the good/bad aspects borrowing from suppliers or commissioners?	1. Good aspects: 2. Bad aspects:
53	If you take out loans, who with and on what terms.	1. Bank: 2. Duration 3. Repayment rate 4. Security 5. Insurance
54	In an ideal case, how much are you can afford to pay per month as loan repayment?	a) <300 b) 300-500 c) >501
55	Have you ever borrowed from ACC or a commercial bank?	
56	If yes, how often do they access loans?	
57	Have you ever conducted any feasibility studies for your farm? if yes, why?	1. Yes 2. No Study reason:
58	Would you do so again?	1. Yes 2. No
59	What were the good/bad aspects of borrowing from them?	3. Good aspects: 4. Bad aspects:
60	In how many years you were able to compensate the initial investment cost? (yrs.)	

	Business Profile	
61	Is this farm the main or secondary source of income?	1. Main source 2. Secondary source
62	What is your main market?	1. Local, 2. Export 3. Contract/value chain
63	How do you find new customers?	
64	Do you belong to an organization that helps you market your crop?	1. Yes (Give name) 2. No
65	If yes is it effective and useful, and for which reason?	1. Effective 2. Not Effective Reason:
66	What is your preferred professional network?	1. Associations 2. Cooperatives 3. Participation in projects and events
67	Are you organized within a community to get services?	1. Extension 2. Group Procurement 3. Sharing production factors
68	How you are going to hand over your profession to the next generation	1. Continue agricultural business, 2. Support another

Farm level water audit (Irrigation System)

	Wells, pumps hardware and basin	
69	Number of Wells	
70	Average wells depth (m)	
71	What year was the groundwater pump installed?	
72	Which company supplied the pump?	
73	Well pump brand / Nominal consumption KW/hr	
74	Well pump horse power	
75	Well pump capacity [m ³ /hr]	
76	What is the lower limit of acceptable pumping capacity to irrigate your farm?	
77	Dimensions of the pumping basin (m)	Length = Width = Dept =
78	Number of booster pumps	
79	Booster pump brand	
80	Booster pump horse power	
81	Booster pump capacity [m ³ /hr]	
82	Main water line diameter [m]	
83	Number of months per year that basin contains water	
84	Select Months	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sept, Oct, Nov, Dec.

	Water requirements and demand	
85	What is your estimate of olive average water requirement (m ³ /dunum/yr)	
86	What is your estimate of stone fruits average water requirement (m ³ /dunum/yr)	
87	What are the methods you use to estimate crop water requirement?	1. Visual 2. Meters 3. Weather/soil sensors. 4. Scheduling based on crop growth stage 5. Others
88	Do you keep records of water use?	1. Yes 2. No
89	(IF NO) Why not? (Rank Top Two)	<u>1.</u> Can't write <u>2.</u> Not enough time <u>3.</u> Would not use the information <u>4.</u> Not finding a consultant to do it <u>5.</u> Other
90	What is your estimation of total water demand? (m ³ /yr)	
91	What is your estimation of the total water use? (m ³ /yr)	
92	What is the time of highest water demand? (months)	
	Irrigation System Suppliers	
93	Which company supplied the full irrigation system for full farm establishment?	
94	Why have you chosen this supply company?	1. Competitive price 2. After sale services 3. Equipment quality 4. Local representation 5. Technical assistance
95	What services are provided from the supplier?	1. Installation, 2. Maintenance 3. Irrigation scheduling 4. Update on new efficient practices
96	Do you upgrade the laterals on annual basis?	1. Yes 2. No
97	If Yes, on average for how many dunams per year you upgrade your laterals (hoses)?	
98	Why do you upgrade the laterals (hoses)?	
99	What is your estimation of laterals (hoses) duration life (in years)?	
100	When was the last time you upgraded laterals (hoses)? And for how many dunams?	Date: Dunams:

101	Which company supplied the laterals?	
102	Why have you chosen this laterals supply company?	1. Competitive price 2. After sale services 3. Equipment quality 4. Local representation Technical assistance
103	What services are provided from the laterals supplier?	1. Installation, 2. Maintenance 3. Irrigation scheduling 4. Update on new efficient practices
104	Apart from laterals, what are the other equipment components that were so far upgrades? And when?	1. Equipment 1 / year 2. Equipment 2/year 3. Equipment 3/year
	Irrigation cost	
105	What are the total hardware purchase costs for your irrigation system at the farm establishment? (JD)	
106	What is the average cost of the laterals (JD/dunam)?	
107	Electricity Bill - min value (JD/month)	
108	Electricity Bill - max value (JD/month)	
109	What is the electricity bill cost percentage of the total farm operational costs (%)?	
110	What is the total cost of fertilizers (JD/year)? If this information is not available, what is the percentage of cost of fertilizers from the total farm operational costs?	
111	What is the total cost of pests and weed treatments (JD/year)? If this information is not available, what is the percentage of cost of pesticides from the total farm operational costs?	
112	What is the total cost of permanent labors (JD/year)?	
113	What is the total cost of occasional labors (JD/year)?	
114	Are the labors operating irrigation; occasional or permanent?	1. Occasional 2. Permanent
115	What is the total cost of labors operating the irrigation system (JD/year)?	
	Water Saving Awareness	
116	What has been the decline/change in groundwater level over the past 10 years? [m]	
117	What, if any, water quality issues are experienced?	1. Salinity 2. Turbidity 3. Smell 4. pH 5. Gypsomate

		6. Others
118	Does the water quality have an effect irrigation system?	1. Yes 2. No 3. don't know
119	What type of filtration is used?	1. None 2. Sand 3. Disks 4. Others
120	What are the soil quality issues are experienced	1. Salinity 2. Gypsomate 3. Alkaline 4. Others
121	Have you experienced soil salinization in the last 5 years?	
122	Do you think that long-term over watering led to salinization?	
123	Are you using any water saving technologies/methods on your farm? What types of technologies/methods were used (a, b, c)?	1. No 2. Yes a. b. c.
124	Would you be interested in implementing water saving technologies in your farm?	1. not likely 2. likely 3. very likely
125	If you save water and related costs, what is your expectations	1. Reduce pumping 2. Expand agriculture 3. Others
126	What are the past farm expansion phases by year and area?	1. Phase 1: year / area 2. Phase 2: year / area 3. Phase 3: year / area 4. Phase 4: year / area
127	From which source do you prefer to get technical information? (Read)	1. Government 2. Private sector, like input suppliers 3. Internet 4. Other farmers 5. Other:
128	What could industry, government or other actors do to motivate you to switch to new practices or technologies?	
129	In case the farmer is aware of water saving technologies: "You said earlier that you know about technologies that could help you reduce costs" Why are you not switching to water saving technologies?	

130	What irrigation improvements would you like to implement?	1. PC drip 2. Automatic controls 3. Smart Systems 4. Others
131	Which supplier would you approach?	
132	What are the reasons to work with this supplier?	

Management block level water audit (Irrigation System): for each major crop (olives, stone fruits, grapes)**Location of specific management block**

133	GPS-lat (y-value) [range 31.700000 - 32.400000]:	
134	GPS-lon (x-value) [range 36.000000 - 37.200000]:	

Management unit info and Dimensions

135	Field block name / Management unit ID / Block Nr:	
136	Crop in this block (Olives/Stone Fruit/Grapes) Specify the variety	
137	Year of trees/vines plantation	
138	Width of the block (in meter)	
139	Length of the block (in meter)	
140	Tree or vine spacing along the planting row (m)	
141	Tree or vine spacing between the planting rows (m)	
142	Number of trees/vines per block	
	Management block irrigation system	
143	Type of irrigation system (drip/ open hose/ low flow/ bubblers/ mini sprinklers)	
144	Date of Installation [use format: YYYY-MM-DD]:	
145	Brand of irrigation line/emitters	
146	Pipe diameter of the main line (in inch)	
147	Pipe diameter of the sub-main line (in inch)	
148	Lateral pipe diameter (in inch)	
149	Thickness of the lateral pipe (mm)	
150	Is the pipe being made from recycled plastic?	
151	Number of lines per tree/ vine row (1, 2 or #)	
152	Distance between irrigation lines (m) [if more than 1 line on a tree row]	
153	Distance between 'emitters' or other delivery devices on the same irrigation line/lateral/hose(cm)	
154	Number of 'bubblers' per tree (in case of non-equal distance)	
155	If known, design flow rate (sometimes indicated on the line) (Liter/ hour)	
	Irrigation (If drip irrigation)	

156	What type of drip irrigation you use in this management block?	1. Non PC 2. PC (pressure compensating)
157	Do you clean laterals and emitters?	1. Yes 2. No
158	(If YES) How often?	1. Weekly 2. Monthly 3. Seasonally 4. Yearly 5. Never 6. Other:
159	(Also if YES) How do you clean them?	1. Phosphoric Acid 2. Citric Acid 3. Nitric Acid 4. Sulfuric Acid 5. mechanically (e.g., use pin)

Current irrigation scheduling practices of the management block			
	Period	Number of irrigations per week	Number of hours per irrigation
160	Oct - Mar (Autumn/Winter)		
161	Apr-Jun (Spring)		
162	July-Sept (Summer)		
164	What is your estimated irrigation dose per sector (in m3 per dunam)?		

Current fertilization/fertigation scheduling practices of the management block

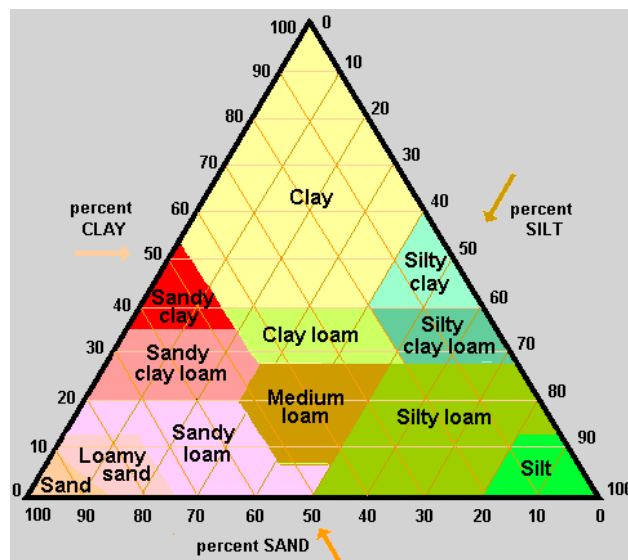
	#	Fertilizer/ composition	Month of application	Dose (kg per dunam)
165	1			
166	2			
167	3			
168	4			
169	5			
170	Type of fertilizer application methods		1. Broadcasting 2. Fertigation 3. Foliar 4. Injection 5. Aerial	

Current pesticides scheduling practices of the management block

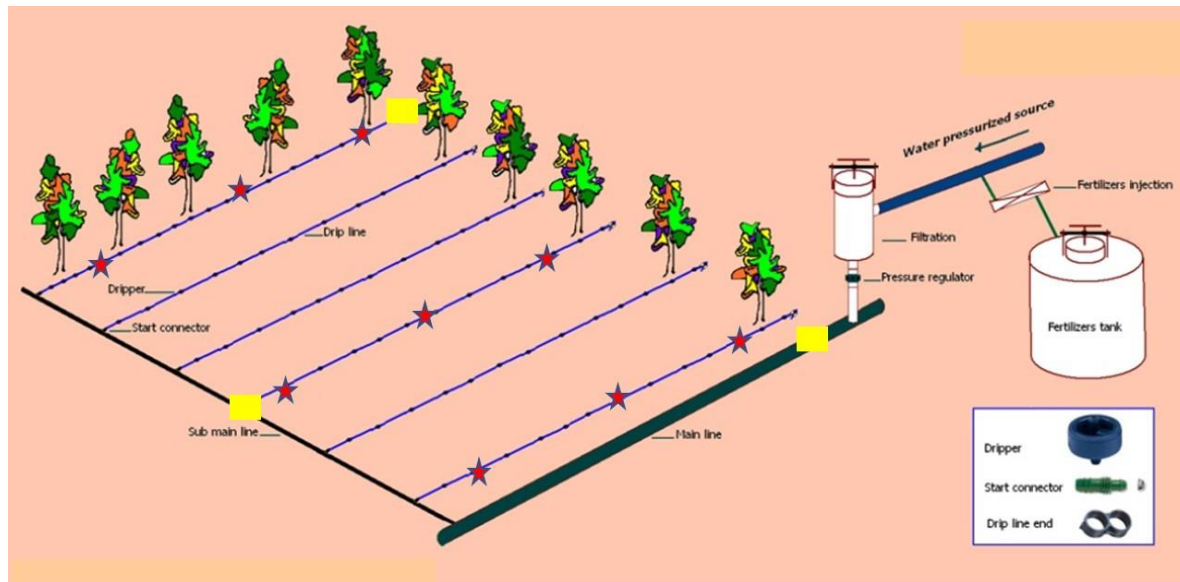
	#	Pesticide/ active ingredient	Month of application	Dose (liter or gram per dunam)
171	1			
172	2			
173	3			
174	4			
175	5			

	Soil type	
176	Estimate of maximum root depth equal (if farmer observed)	
177	Estimate of gravel content of the soil [% by volume]	
178	Estimate of soil type [based on sand-silt-clay content - use triangle below]	

Soil class - identification aid:
Click on image for large version



- For flow rate measurements
 - Select 3 irrigation lines (two in the borders and one in the middle of the bloc)
 - Select in each irrigation line 3 emitters (one at the beginning, one in the middle and one in the end of line, see stars in the Figure below)
 - Water salinity is measured in the water collected from the emitters at the same locations of flowrate measurements.
- Pressure measurements are done at the beginning of the main line, at the middle of the sub-main and at the last emitter of the management plot (see squares in the Figure below).



★ Point of flow rate and water salinity measurements (9 reps)

■ Point of pressure measurement (3 reps)

Flow rate measurements

	Emitter measurement #	GPS lat	GPS lon	Flow rate measured (L/min)
179	#1			
180	#2			
181	#3			
182	#4			
183	#5			
184	#6			
185	#7			
186	#8			
187	#9			

Pressure measurements

	Pressure measurement #	GPS lat	GPS lon	Pressure measured (hPa)
188	#1 (main)			
189	#2 (sub-main)			
190	#3 (lateral)			

Water salinity measurement

	Water salinity measurement #	GPS lat	GPS lon	Unit (ECw in dS/m)
191	#1			
192	#2			
193	#3			

Feedback to farmer

194	Minimum emitter flow rate (liter per minute)	
195	Maximum emitter flow rate (liter per minute)	
196	Flow rate variability (variation coefficient)	
197	Select in the following (X)	
198	Salinity level (low when if lower 2 dS/m)	
199	High salinity (if higher than 7 dS/m)	

Recommendations:

200	Use of acid to clean emitters	
201	Use low rate emitters	
202	Use pressure compensating systems	
203	Improve irrigation scheduling/ practices	

204	For annual maintenance, how many dunams you are planning to change for this season?	
205	Are you interested in the project advice for connecting you to a supplier that could provide quality equipment?	1. Yes 2. No
206	Are you interested in the project technical advice through suppliers?	1. Yes 2. No
207	Are you interested in installing for free a water meter for one of the management blocks to improve your schedule?	1. Yes 2. No

	Post-Interview Observations and Assessments	
208	General condition of irrigation system	1. Excellent, 2. Average 3. Poor
209	Assessment of irrigation management	1. Excellent, 2. Average 3. Poor

Interview notes/stories:

Suggestions to improve this questionnaire

Upload photos

Finalize form

Save data once the form is complete: [Save data](#)

ANNEX 2 (SUPPLIER LISTS):

Full Irrigation System Supplier			
Row Labels	Mafrq	Azraq	Average
Mais	38%	12%	21%
Al Karama	4%	27%	19%
WATANYAH	21%	5%	11%
Mada	13%	7%	9%
Al Jabali	4%	11%	9%
ARABYAH	4%	7%	6%
Al Almia	0%	8%	5%
Kuwait pipe manufacturing company	4%	0%	1%
Al asraa	0%	3%	2%
Al Kurdi	0%	2%	1%
Alshraa	0%	2%	1%
Abd alhafed	0%	1%	1%
Al shahbaa	0%	1%	1%
Al wsal	0%	1%	1%
Albaraka	0%	1%	1%
Alhoda	0%	1%	1%
Alwaref	0%	1%	1%
Don't know	0%	1%	1%
Hisham	0%	1%	1%
KORDI	0%	1%	1%
Local market	0%	1%	1%
Nandezy	0%	1%	1%
Sobeah almasri company	2%	0%	1%
n/a	10%	4%	6%
Grand Total	100%	100%	100%

Which company supplied the laterals?			
Row Labels	Azraq	Mafrq	Average
Mais	14%	44%	25%
Al Karama	26%	4%	18%
Mada	7%	13%	9%
ALAMIA	10%	0%	7%
WATANYAH	5%	13%	8%
WATANYAH	0%	8%	3%
Al Jabali	6%	4%	5%
Al Alaf	1%	0%	1%
Al Huda	1%	0%	1%
Al Israa	3%	0%	2%
Al Shahbaa	1%	0%	1%
Al Shraa	2%	0%	1%
Al Waref	1%	0%	1%
Al Wassael	1%	0%	1%
Alsheraa	1%	0%	1%
ARABYAH	3%	8%	5%
Barada	1%	0%	1%
Hisham	1%	0%	1%
KORDI	2%	0%	1%
Sobeah almasri	0%	2%	1%
n/a	13%	4%	10%
Grand Total	100%	100%	100%