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Farmers' Perceptions of Water Policies: A Case Study from the Jordanian Badia

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Water and Livelihood Initiative (WLI)

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Executive Summary

This report reviews a case study of farmers' perceptions of policies and regulations to improve water security in the Jordanian Badia. The aim is to improve water management and conservation by engaging all stakeholders, in particular farmers and rural communities, in this common goal. The research forms part of the Water Livelihood Initiative and will be of interest to policymakers, development agencies, NGOs, and water-management agencies operating in similarly water-stressed regions.

As one of the most water-poor countries in the world, Jordan must address increasing demand for and decreasing supply of good quality water resources. This study considers the need to apply water-harvesting technologies to the region and identifies barriers to implementing this effectively. The subject is introduced with a general overview of regulatory bodies, coordinated by the Ministry of Water and Irrigation, followed by a discussion of relevant policies and regulations. A case study directly investigates farmers' awareness and acceptance of current water policies to assess the likely success of such policies in two areas of the Jordanian Badia.

The study areas of Majidyya and Muharib are small rural villages. The livelihoods of the villagers are based on livestock and government-subsidized arable farming; however, land is degraded through overgrazing and water shortages, and there is a serious problem with out-migration as young people leave to seek work elsewhere.

Focus group discussions covering agricultural policies, groundwater and irrigation management, and cooperatives and water-user associations were held with five community leaders. The study revealed a disjunction between knowledge of policies and their implementation. Communities were generally well informed on the purposes of water-management projects and responded positively to the improved infrastructure and development associated with them. However, the talks highlighted several problems.

Water scarcity, both in terms of day-to-day personal use and irrigation, is the main issue in the area and cost presents a major barrier to addressing this. Lack of financial support has prevented the effective implementation of new water-collecting technologies, such as semicircular bunds, small dams, wells, and marabs being trialed in the villages. Insufficient extension service support was also cited as a reason for the failure of some projects. Other issues raised were high feed and seed prices and poor soil fertility.

To address these problems and improve access to water in the region there is a need for both financial and technological support to build pipelines, build soil check dams, and establish collecting wells near each household. To complement this, support in developing better water-use plans is essential. Better targeting of financial and extension service support could achieve this.

1. Introduction

Jordan is considered to be the fourth-poorest country for water resources in the world. In 1946 available renewable water was 3600 m3/capita, while in 2009 it had dramatically reduced to 140 m3/capita (Al-Salaymeh, 2009). The demand for water has sharply been increasing. While the gap between supply and demand has been widening, the deficit has been handled through rationing and underground water depletion. Prompted by the increasing water scarcity, Jordan has searched technical resources and financial assistance from the international community to implement urgent water development measures to deal with forthcoming further water scarcity.

The continuous decline in the quantity of fresh water available for agriculture and the continued deterioration of its quality due to the increased mixing with saline treated-wastewater, especially in the middle Ghors (Jordan Valley), have led to increasing soil salinity and land degradation (World Water Council, 2013). Since the early 1960s the country has issued decrees, laws and regulations, including many international and domestic projects to induce a more rational and sustainable use of water resources. However, water availability has diminished dramatically, including groundwater levels that have declined at a long-term average of about one meter per year (USAID, 2012).

This report presents results from a study on farmers' perceptions water polices and their application in the Jordanian Badia. It was jointly undertaken by the National Center for Agricultural Research and Extension (NCARE) and the International Center for Agricultural Research in the Dry Areas (ICARDA). This research was conducted in the Majidyya and Muharib areas, Muwaqer District, Jordan under the framework of the Water Livelihood Initiative (WLI)[1] . This study analyzes some of the underlying reasons that prevent laws, regulations, and strategies being effectively implemented on the ground. What are the barriers from farmers' perspectives that prevent effective implementation? Are the policies unsuitable or unrealistic? Or are the institutions failing in their implementation? Shedding light on these issues can help the Government of Jordan to introduce mechanisms to improve water management and conservation.

This report is organized as follows: The first part presents the institutional setting for the water sector, which describes the institutions that have historically been in charge of designing and implementing water policies in the country. The second part refers to the most important policy documents in the form of strategies, regulations, and laws issued to administrate the use of water in Jordan. In the third part, we discuss farmers' perception in regards to the implementation of the bulk of regulations in their communities (Majidyya and Muharib). The last section presents some findings and conclusions emerging from this study.

[1] Funded by USAID, the WLI's objective is to improve the livelihoods of rural households and communities in areas where water scarcity, land degradation, water quality deterioration, food security and health problems are prevalent.

2. Institutional setup for the Water Sector in Jordan

Two main institutions have historically driven the water sector in Jordan: the Jordan Valley Authority (JVA) and the Water Authority of Jordan (WAJ). The JVA, created in 1977, has been the main institution responsible for water management in the Jordan Valley. The JVA has been in charge of designing, implementation, operation, and maintenance of all major dams and irrigation projects in the country. It has been and still is responsible for delivering and distributing irrigation water to farmers and collecting irrigation water charges, encouraging farmers to save water and improving farm irrigation efficiency through modern irrigation methods, land management, and distribution outside the municipal boundaries. The JVA is also responsible for providing water to the WAJ, to assist in improved farming irrigation practices and scheduling, to implement emergency plans to face water shortages in dry years and seasons, to undertake public awareness and water conservation programs in irrigation, to develop an integrated plan for the Jordan Rift Valley (JRV)[2], and to coordinate programs with international donors.

The WAJ, created in 1988, was established to regulate municipal and industrial water supply and wastewater collection and treatment. Currently the WAJ is responsible for providing licenses to farmers to utilize groundwater for irrigated agriculture, to control tube well drilling, to test yields of wells, to measure abstraction by tube wells from groundwater basins, and to reduce overexploitation of renewable groundwater resources practiced by farmers (as per Law No 83, 2003). The WAJ monitors retail supply contracts, and has a major role in the operational monitoring of a number of management contracts with private sector utilities and providers. The WAJ manages the resources as well as the bulk of supplies that have not been privatized, and provides support to smaller retail distribution units, which are not operated by the private sector[3].

In 1992 the Ministry of Water and Irrigation (MWI) was established to bring together the JVA and the WAJ under a single ministry, which would create better coordination for more efficient water use. Before establishment of the MWI, the JVA and the WAJ were two autonomous authorities directly under the responsibility of the Prime Minister of Jordan. The MWI is currently in charge of development and protection of water resources for agricultural, industrial, and domestic use throughout the country. Its main responsibilities are proposing legislation, strategies, and regulations relevant to the water sector; developing strategies and programs pertaining to the implementation of water policies; securing funding necessary for water projects; following-up implementation of projects; maintaining the rights of Jordan's shared water resources; updating plans and projects; and promoting institutional development, training, and public awareness. The Minister of Water and Irrigation is the Chair of the Board of Directors of the JVA and the WAJ.

The above paragraphs show some expected overlapping functions between the MWI, the JVA, and the WAJ. For the agricultural sector, the MWI, together with the JVA and the WAJ, have as a main objective to optimize water use in irrigation by adopting modern irrigation and agricultural techniques, so increasing the yield of irrigated crops (intensification and higher productivity) and the livelihoods of farmers. Since inception, the MWI has been in charge of preparing water master plans and annual water balance budgets, establishment of a water data center, improving human

[2] The JRV is an elongated depression that includes the Jordan River, Jordan Valley, Hula Valley, Lake Tiberias, and the Dead Sea. The valley continues to the Red Sea, incorporating Arabah and the shorelines of the Gulf of Aqaba.

[3] The private sector operates through agricultural companies that specialize in manufacturing for irrigation (such as drip irrigation equipment). When selling irrigation-related equipment (such as sprinkler irrigation, greenhouses, and modern agricultural supplies), private companies tend to provide technical support to farmers. Agricultural credit is not widely available, but there are agricultural credit corporations and a few private banks and agro-irrigation companies that provide some credit to private farms.

resources, and implementing training programs for the water sector. Other government institutions with responsibilities in the water sector in Jordan follow:

a) The Ministry of Agriculture (MOA) is responsible for maintaining an active agricultural sector by enhancing food security, achieving comprehensive development and wellbeing of farmers, and ensuring sustainability of resource use. The MOA works on the organization and development of the agricultural sector in order to secure agricultural production in an efficient, diversified, and integrated manner. The MOA is also responsible for conserving the environment, natural resources, and promoting self-reliance in food production in line with requirements of the local market.
b) The Ministry of Environment (MOE) seeks to improve the conditions of the environment of Jordan by preserving natural resources and contributing to the achievement of sustainable development through the preparation and development of policies, strategies, and legislation. The MOE ensures that programs are implemented under environmental precepts and within the umbrella of national development plans.
c) The Ministry of Health (MOH) is responsible for ensuring the safety of drinking water, and contributes to water and agricultural related policies and legislation from the perspective of maintaining food safety and quality standards. The MOH works in partnership with authorities from the other ministries in organizing food safety monitoring services, which is embedded in the national health policy.
d) The National Water Advisory Council (NWAC), created in late 2011 by Government Law No 54 of 2011, is chaired by the Minister of Water and Irrigation and has 10 member ministers and secretary generals of various government organizations. The NWAC membership includes five representatives from the private sector and civil society organizations. The latter members are nominated by the Minister of Water and Irrigation and approved by the Cabinet. The NWAC main functions are to: discuss water sector policy, including financial implications, and provide strategic advice and follow up on its implementation; review the water sector strategy, plans, and programs needed to implement it; coordinate the efforts of institutions and commissions from the public and private sectors to enhance partnership and integration between them; and suggest procedures related to raising the level of service provided by the water sector. The NWAC holds meetings at least twice a year or more frequently if needed.
e) The Royal Water Committee (RWC), established in 2008 by Royal Decree, was requested to develop the National Water Strategy. The RWC is chaired by Prince Feisal and has the Ministers of Water, Agriculture, Environment, and Energy as members. The RWC also has members from universities, farmers' union, and the private sector. The RWC prepared the Water Strategy in 2009 and submitted it to the government, which in turn approved it and adopted it as the baseline national strategy.

3. Policies and Regulations

Institutions with responsibilities over the water sector, including civil society, have contributed in different capacities and extents in the formulation of policies and strategies for the sector. Since the creation of the MWI, it has led the process of drafting policies and requesting inputs from other ministries and civil society. These policies – covering national, regional, and local levels – address water-scarcity issues of cities, municipalities, industries, and agriculture. The main policy documents formulated to set a framework strategy to rationally and sustainably manage the use of water in Jordan are mentioned below. Some of the policies formulated in the 1980s and 1990s still provide a framework for more current water policies, with the most important being:

- **National Water Master Plan of 1988:** The MWI, in cooperation with the United Nations Development Programme (UNDP) and the Arab Fund for Economic and Social Development, formulated the National Water Master Plan to strengthen central water administration, to develop guidelines for water policy, and to establish a computerized water sector databank and an integrated water sector management model;
- **Water Strategy for Jordan and Water Utility Policy of 1997:** These policy documents address aspects of the water sector related to water resource development, resource management, legislation and institutional implementation issues, shared water resources, public awareness, performance, health standards, private sector participation, financing, and research development;
- **Groundwater Management Policy and Wastewater Management Policy of 1998:** This policy sets out the Government's policy and intentions concerning groundwater management aiming at development of the resource, its protection, management, and measures needed to bring annual abstractions (from the various renewable aquifers) to sustainable rates;
- **Irrigation Water Policy of 1998:** The policy addresses water related issues of resource development: agricultural use, resource management, and the imperative of technology transfer, water quality, efficiency, cost recovery, management, and other issues. The policy is compatible with the Water Strategy and conforms with its long-term objectives;
- **2002 Jordan Water Policy and Strategy**: Based on previous policies, namely the Water Strategy for Jordan (2002), the Groundwater Management Policy (1998), the Water Utility Policy (1998), the Irrigation Water Policy (1998), and the Wastewater Management Policy (1998), the MWI released the 2002 Jordan Water Policy and Strategy. This document covers issues related to sustainability of irrigation water resources, research and technology transfer, farm water management, irrigation water quality, management and administration, water pricing, regulation and control, and irrigation efficiency;
- **Jordan Valley Development Law No 30 of 2001**: As stated in the JVA Strategic Plan for 2003–2008, this law allows the participation of the private sector in the operation and management of the irrigation system in the Jordan Valley. Law No 30 of 2001 is an amended law of the Jordan Valley Development Law of 1988 according to which the JVA was established to conduct, inter alia, social and economic development of the Valley (Saidam and Ibrahim, 2006);
- **Water Sector Planning & Associated Investment Program of 2002–2011**: Published In 2002 by the MWI, the goals of this program are to unify water sector projects, create uniform project baselines, schedule projects based on multiple scenarios, identify the role for private sector participation, and identify least cost solutions for development projects;

- **Underground Water Control By-Law No 85, 2002 and its amendments of 2003, 2004, and 2007:** This by-law describes and entails the different procedures needed for controlling groundwater resources in Jordan. It regulates the utilization and extraction of allowed groundwater abstractions. Moreover, conditions concerning licenses and their cost for borehole drilling and water extraction fees are included in this regulation (MWI, 2007);
- **Irrigation Water Allocation and Use Policy of 2008**: This policy consolidates and elaborates elements of the irrigation water policy relating to on-farm water management, management and administration, water tariffing, and irrigation efficiency. The policy addresses the following themes: defining and updating crop water requirements, water allocation and billing practices, building farmers' water management skills, using reclaimed water, measuring deliveries, and delivering water to groups;
- **Water for Life: Jordan Water Strategy for 2008–2022:** Formulated by the MWI, this strategy introduces policies for balancing water demand and supply related to groundwater management, irrigation water, water utilities, and wastewater management (MWI, 2009). This is the most recent strategy that specifies drinking water as the main priority in water allocation, followed by industry and agriculture. The 2008–2022 Strategy is supplemented with policies related to groundwater management, irrigation water, water utilities, and wastewater management aiming to achieve a balance between water demand and supply, and emphasizing a major role for the private sector.

All these policies, laws, and strategies barely mention how the technical information and laws should be disseminated to farmers. The JVA officials believe that they should play a more important role in providing extension services to farmers related to water management, which is now under the responsibility of the MOA.

4. Study Site and Assessment

4.1 Majidyya and Muharib communities

The Badia of Jordan was selected as the benchmark site for the water harvesting project 'Community-Based Optimization of the Management of Scarce Water Resources in Agriculture', funded by IFAD (International Fund for Agricultural Development) and AFESD (Arab Fund for Economic and Social Development). The purpose of the project was to develop and test, with the full participation of rural communities, water management options that increase water productivity, optimize water use, and that are economically viable, socially acceptable, and environmentally sound (Akroush et al., 2008). In two phases the project has worked in the Majidyya and Muharib communities in the Jordan Badia.

Majidyya is a rural village 70 km south of Jordan's capital city of Amman. With a small population of 40 household heads and approximately 250 inhabitants, the Majidyya community members traditionally use their land for grazing. However, continuous overgrazing has degraded the natural rangeland vegetation. In response, some residents switched to barley cultivation. Barley is a government-subsidized crop, which typically yields little grain as a result of water scarcity, and is used as livestock fodder. Muharib is also a small agricultural village with 30 household heads and about 190 inhabitants. Similarly to Majidyya, Muharib has been suffering from water shortages and degradation of arable land. Unable to earn sufficient agricultural livelihoods, some families have left Muharib for other neighboring villages or cities such as Amman where private and public services provide more prospects for a better life.

4.2 Methodology

We used focus group discussion (FGD) methodology (Krueger, 2002) to collect detailed information on farmers' knowledge concerning agricultural and water polices, rules, and regulations relevant to their communities, and their enforcement. We held a FGD with five community leaders representing Majidyya and Muharib villages. All of them were male, which was unsurprising. In these relatively conservative societies women's work and social involvement outside home is not favored. Community leadership or representation is usually a task reserved for men.

We streamlined 57 discussion questions around four areas, namely water resources, use, and management; agricultural projects in both villages; agricultural policies in relation to groundwater and irrigation management; and cooperatives and water-user associations. The format of the discussion group consisted of both analytical questions (i.e. questions that help verifying information or encourage a more in-depth discussion of the topic) and clarifying questions (i.e. questions that help clearing up confusion). We also used the pair-wise ranking tool, to identify and rank, in a participatory way, the main problems both communities face. This methodology allowed comparison of different farmers' priorities that represented a good mixture of interests. Farmers were asked to think about their problems and to list six problems (in any order) that were most challenging for them.

4.3 Familiarity with agricultural and water polices, rules, and regulations

The 2002 Jordan Water Policy and Strategy, the Jordan Valley Development Law No 30 of 2001, the Irrigation Water Allocation and Use Policy of 2008, and the Jordan Water Strategy for 2008–2022, among others, shape policies that the MOA, the MWI, and associated partners implement through development and research projects. Here we present results in terms of farmers' participation in projects located in Majidyya and Muharib communities including the projects implemented through ICARDA and NCARE, such as the WLI and the Badia Benchmark Project.

Discussions with farmers revealed that they are fairly aware of water policies and regulations. Farmers were well aware that the MWI is the responsible authority for developing regulations, policies, and legislation related to water and water use. For example, they mentioned the government's policy to ban the construction of new wells, other than those having an explicit license. They explained that the regulation aims at preventing from further depletion of groundwater resources. They also showed that they knew the steps involved in requesting a government license to dig a new well, to request development project support, or to be eligible for government subsidy of barley production.

Community leaders showed that they were aware of the mechanisms (development and research projects) the government uses to implement policies and regulations. For example, they reported that in their communities there are different development-related projects being implemented by the government in collaboration with international organizations. They mentioned that the 'Canadian project', implemented since early 2000 through the MOA, has focused on establishing water-collecting wells. The communities have also benefited from infrastructure and agricultural development projects. They claimed to benefit from projects that focused on distributing collecting wells (i.e. cement tanks) used for drinking, household uses, and livestock watering. They also mentioned the Badia Benchmark Project and the WLI, implemented by NCARE and ICARDA, which have been working towards improving water harvesting, rangeland management, and barley productivity.

In general community leaders claimed that development projects were relatively satisfactory, but extension services were generally insufficient. Such services, provided through government agencies, tend to be limited in marginalized rural areas, and consequently farmers face high costs for agricultural/livestock advice, which otherwise would be covered by extension services. For example, community leaders declared that for veterinary services they usually use private clinics at significant financial cost. They also challenged the efficacy of subsidies provided to farmers producing barley used as fodder for small ruminants (mainly sheep). They reported that frequently farmers that no longer own sheep are still getting the subsidy to produce feed, which they sell in local markets pushing up fodder prices. In addition, farmers claim that the quality of subsidized animal feed in recent years has decreased as no quality control is enforced.

In terms of macro issues currently affecting Majidyya and Muharib communities, community leaders mentioned that the MWI has decided not to build a piped water network in these communities. The reason for this decision is basically cost. Meyahona, a private company contracted by the MWI, estimated that the construction cost of the pipe was around 1.2 million Jordanian Dinars (JD). This pipe would connect the network to the closest water pipe line in the Muwagar area (19 km away).

While the decision to not provide a pipeline was due to the high cost involved, a human right issue related to access to water and sanitation remains. In 2010 the UN Human Rights Council adopted a binding resolution recognizing the human right to water and sanitation as part of the right to an adequate standard of living. Hence, a lesson from these communities is that decisions entirely based on cost/benefit indicators have to be revised in order to build equity for small and remote communities. Lack of a water pipeline in these two communities has negatively affected community inhabitants, prompting male emigration to other places such as Sahab and Muwagar, while and leaving behind fragmented families.

Community leaders mentioned that they had several times expressed their concern about lack of water to the MWI, but no response had been obtained. They also reported that they suggested that the MWI incorporate their communities in the Disi project, which is a large project designed to improve drinking water provision to Amman from the Disi Aquifer located in southern Jordan. No positive answer was obtained. Another concern they raised is that the MOE has allowed and licensed the establishment of stone quarries in areas that are basically rangelands. Community leaders claim that these establishments have led to destruction and deterioration of pastures by turning them into stone quarries.

Community leaders are also aware that the Department of Land and Survey (depending on the Ministry of Finance) is the authority responsible for preserving land property rights and resolving any conflicts concerning rights in land or water at community level. This department has defined that the minimum land size in the community area is 1 ha, implying that land transactions smaller than this size are not allowed. Farmers are aware that they must have a minimum area of 5 ha to apply for a license to dig a groundwater well. In cases where a license is approved, the WAJ is in charge of regulating and monitoring groundwater pumping. Yet, in practice we verified that many wells are not monitored, have out-of-service groundwater meters, or even have no meter at all.
Farmers are fully aware that there is no law or regulation that obliges them to cultivate a particular crop. They know that cultivation is not allowed on public land (owned by the government) and that government laws ban planting barley in rangelands because this practice has led to land deterioration with no chance for natural rehabilitation. Farmers consider that they need a specific regulation to consider community lands as agricultural lands, and not just as pasture lands because of the lower land value.

4.4 Water harvesting practices, and water use at household level

Water policies have also been implemented in areas related to conservation of water resources and harvesting. Water harvesting technologies are widely used in Majidyya and Muharib communities. Farmers in these two communities have been using different technologies such as contour ridges, semicircular bunds (vallerani), small dams, collecting wells and pools, small check dams, and Marabs[4]. Barley and rangeland shrubs, such as Atriplex and Salsola, benefit from these water harvesting technologies. Yet, community leaders expressed that water harvesting also brings challenges in terms of high investment costs and risk of low returns exacerbated by high input prices (such as barley seed prices).

[4] Marabs are natural formations found in the Badia where water spreads naturally over a relatively wide stream bed, and thus allow the use of this area for agricultural production (barley cultivation).

The group discussions showed that water sources at community level come from collective wells that are available at each household level. Households generally have water storage tanks on their roofs, which are filled with water bought from nearby artesian wells at an average cost of 2.5 JD/m^3, which is extremely high compared with the price of water in Amman city (less than 0.1 JD/m^3). In some cases, where a collective well is drying out, households buy truck-delivered water from Muwaqer located 20 km away at a price of 4 JD/m^3. Community leaders mentioned that while water prices water fluctuate during the year, use does not vary according to the season.

4.5 Problems and constraints: pair-wise results

The pair-wise ranking showed that water scarcity was the problem with the highest score. In general, community leaders agreed that to improve wellbeing in their communities, implementation of pragmatic steps is needed to make water available, which includes allocation of resources and funding to connect their communities with the water pipeline network, to construct small dams, and to establish collecting wells near each household. Community leaders consider that only through specific and concrete steps their communities improve in the relatively short term. Households in the community constantly prioritize water use in their households and plan their activities based on the amount of water available in their tanks. Households postpone heavy cleaning (laundry, washing carpets, and cleaning), which requires substantial amounts of water, until the day that water is supplied (usually once a week). After that day, the households reduce water consumption, and prioritize it for cooking and drinking. Continuous planning of water use in every household is a result of water shortage, and is the foremost problem in the community.

Table.1 Pair-wise ranking matrix

Problems	Water scarcity	High seed prices	High cost of plowing	High cost of establishing water harvesting techniques	Poor soil	High feed prices	Score	Rank
Water scarcity		Water scarcity	Water scarcity	Water scarcity	Water scarcity	Water scarcity	**5**	**1**
High seed prices			High seed prices	High cost of establishing water harvesting techniques	Poor soil	High feed prices	**1**	**4**
High cost of plowing				High cost of plowing	Poor soil	High feed prices	**1**	**4**
High cost of establishing water harvesting techniques					Small dams etc.	High cost of establishing water harvesting techniques	**3**	**2**
Poor soil						High feed prices	**2**	**3**
High feed prices							**3**	**2**

Source: Own elaboration based on pair-wise ranking in Majidyya and Muharib communities.

Following water scarcity, community leaders identified high feed prices and high cost of establishing water harvesting techniques as the second most critical constraint. However, they expressed interest and willingness in applying water harvesting technologies as a mechanism to face water scarcity. They mentioned that support and technical advice are needed to improve development of the communities. They ranked poor soil fertility as the third-most severe constraint, and high seed prices and high cost of plowing shared the fourth-most constraining problem at farm level.

5. Summary and Conclusion

Generally we found the Majidya and Muharib community leaders to be fairly aware of water policies and regulations. They understand main purposes of water and land polices, as well as the institutions that are in charge of implementing laws and regulations. Community leaders are keen to work on research and agricultural development projects that bring much-needed solutions to the main issue of their communities – lack of water. Water shortage, as evidenced by the pair-wise ranking methodology, was the top problem. However, these two communities are also challenged by other constraints such as high feed prices and high cost of establishing water harvesting techniques. Lack of financial support and extension services, which are generally needed to acquire improved technologies for water harvesting, were also identified as important issues.

These constraints also show farmers' interest in applying water harvesting technologies. Community leaders are particularly interested in participating in projects that bring comprehensive development programs to their communities, and in particular solving the issue of lack of water. Community leaders consider that to improve living conditions in their communities, the following steps are needed: (1) connecting the community with the water pipeline network; (2) constructing soil check dams; (3) establishing collecting wells near each household; and (4) helping farms in land reclamation.

We conclude that the government was able to make farmers aware of water policies, regulations, and laws. However, the mechanisms to implement them, i.e. development and research projects, need to be reinforced to bring much-needed solutions to the huge problem of water scarcity that these communities face. We acknowledge that fulfilling water requirements can bring about a delicate balance and trade-off in terms of water availability and environment. On the one hand, households struggle to get water, and on the other hand aquifers have already been over-pumped and so stress the environment. Currently the MOA is conducting a review of the existing agriculture strategy, and preparing for a medium- and long-term agricultural development strategy. This review will have to evaluate trade-offs emerging from households' rights to get access to water and sanitation (that in turns allows farmers to make a decent living), while preserving and promoting conservation of water resources.

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Science for Better Livelihoods in Dry Areas

Established in 1977, ICARDA is one of the 15 centers supported by the CGIAR. ICARDA's mission is to improve the livelihoods of the resource- poor in dry areas through research and partnerships dedicated to achieving sustainable increases in agricultural productivity and income, while ensuring efficient and more equitable use and conservation of natural resources.

ICARDA has a global mandate for the improvement of barley, lentil and faba bean, and serves the non-tropical dry areas for the improvement of on- farm water use efficiency, rangeland and small ruminant production. In Central Asia, West Asia, South Asia, and North Africa regions, ICARDA contributes to the improvement of bread and durum wheats, kabuli chickpea, pasture and forage legumes, and associated farming systems. It also works on improved land management, diversification of production systems, and value-added crop and livestock products. Social, economic and policy research is an integral component of ICARDA's research to better target poverty and to enhance the uptake and maximize impact of research outputs.

CGIAR

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