Agricultural Water Demand Management in the Palestinian Territories

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1. Introduction

Meeting the water needs of a growing population and growing economies in the Middle East is a huge challenge for a region struggling already with water scarcity and climate change (Shetty 2006). It is even more so in the occupied Palestinian Territories facing severe constraints due to the long-term conflict with Israel and heavily restricted access to available water resources. Unsustainable use of ground and surface water resources has also led to dramatic effects for the environment and a 98% reduction of the natural flow of the Lower Jordan River. Friends of the Earth Middle East (FoEME), a trinational NGO promoting cooperation over transboundary water resources in Israel, Palestine and Jordan, have therefore commissioned several studies with the aim of identifying policy options for redirecting fresh water resources to rehabilitating the river ecosystem. Like many other scholars, they argue for a shift from the current policy focused on increasing water supply (eg. through technical solutions such as desalination) to a more integrated approach of reducing water demand (FoEME 2010, 2009, 2008). Water demand management (WDM) helps us in "doing better with what we have" (Bergstein 2010: 4) as opposed to increasing water supply. The paradigm shift towards demand management will be a crucial step towards a more sustainable use of natural resources in the region, but it has not yet become fully acknowledged as such by the Palestinian authorities and society, and even less in the agricultural sector (Brooks and Trottier 2010; Glover and Hunter 2010). As a follow-up to a policy paper focusing on best practices of Agricultural Water Demand Management in Israel (Bergstein 2010), this research paper will look into policy options for the Palestinian Territories. It will discuss Agricultural WDM tools such as irrigation water pricing, removal of trade barriers and agricultural planning, as well as on-farm efficiency and their applicability to the Palestinian context.

2. Methodology

In a first step, the existing scientific literature on water demand management in Palestinian agriculture will be reviewed, discussing the advantages and disadvantages of each policy option. In addition to that, 14 expert interviews have been carried out in January 2011 in order to fill gaps and verify insights from the literature, complement up-to-date developments, as well as explore the feasibility of suggested policy options in the Palestinian context. Interview partners (complete list in Annex I) have been selected based on their expertise in the water and agricultural sector. A balance of views from governmental bodies, research institutes and environmental NGOs was intended and was partly verified by random interviews with farmers in two agro-ecological regions (Jordan Valley, Central Highlands). The chosen qualitative research methodology intends to explore the subject area, rather than providing empirical evidence. Due to technical failures in the recording and repetition of information, not all interviews have been analyzed in depth for the results section of this paper (Khateb, Srouji and Sbeih have been excluded).

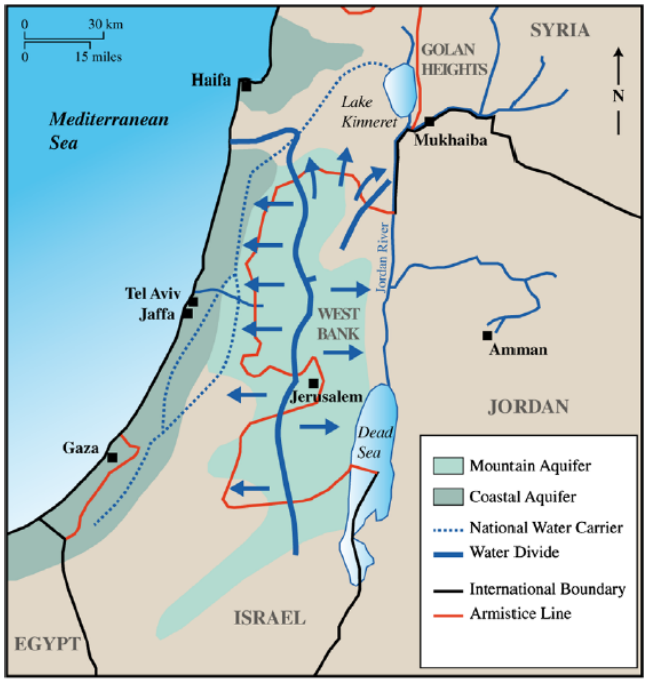
Limitations

The study aims to provide a compact overview and discussion of policy options for agricultural water demand management in the Palestinian Territories. It includes unpublished up-to-date knowledge from experts and policymakers, which slightly makes up for gaps in existing scientific publications. However, at the same time this must also be considered as a weakness since the collected data are subject to personal opinions, spontaneous statements and a high probability of changes in actual policy making. Outcomes must therefore be treated

carefully and need further quantitative and qualitative research in order to achieve any validity. Feasibility of the proposed policies has to be checked against different local socio-cultural, agro-ecological and hydrological realities.

3. Water availability and expansion of irrigated agriculture in the Palestinian Territories

Water resources in the region are already used to the limits of natural recharge capacities and exceeding these in several places, eg. the Gaza Strip. The climate is predominantly semi-arid, with a semi-humid north and arid south (Gaza Strip). Total natural water resources in the region consist of groundwater (more than 50 %) Jordan River (more than 30 %) and other surface waters, eg. coastal rivers and wadis (USGS 1998). They are recharged by rainfall with high precipitation levels on the western slope and low precipitation levels on the eastern slope of the Central Mountain Range (see Water Divide in the picture). In addition to natural water sources, Israel increasingly uses brackish, treated waste-water and desalination to cover national water demand. These options, however, require high capital investments and operational costs, which are currently unaffordable for Palestinians on a necessary scale (Brooks and Trottier 2010).



Source: Brooks and Trottier 2010

Groundwater

The two main aquifers are the Coastal Aquifer and the Mountain Aquifer. While the shallow coastal aquifer, supplying the Gaza Strip, already is overpumped and affected by increased seawater infiltration and agricultural pollution, the Mountain Aquifer carries largely high-quality water (USGS 1998, Brooks and Trottier 2010). According to the Oslo Agreement of 1995, only 20% (118 mcm/year) are allocated to the Palestinian Territories, while the rest is used by Israel (Brooks and Trottier 2010, FoEME 2010). The fact that Palestinians today extract less than before the Oslo Agreement and in some areas even have to buy water from the Israeli water company Mekorot, has lead to a strong focus in Palestinian society on increasing water supply and possibly reduced motivation for protection of the available resources (World Bank 2009).

Jordan River

Due to Israeli occupation, Palestinians have no access to the Jordan River, to which they would have a historically equal share, also considering other riparian states (Brooks and Trottier). The river water instead is dammed and diverted by Israel, Jordan and Syria leaving only 2% of the original volume downstream (FoEME 2010). There is not only a need to recognize historical Palestinian water rights but also a re-allocation of approximately 400-600

mcm of mostly freshwater would be needed for the rehabilitation of the severely damaged river ecosystem (idem).

Other Surface water

The wadis flowing from the highlands through both Israel and the Palestinian Territories have been exploited to their limits and only recently have started to recover from wastewater pollution (Brooks and Trottier 2010).

Agricultural Sector in the Palestinian Territories

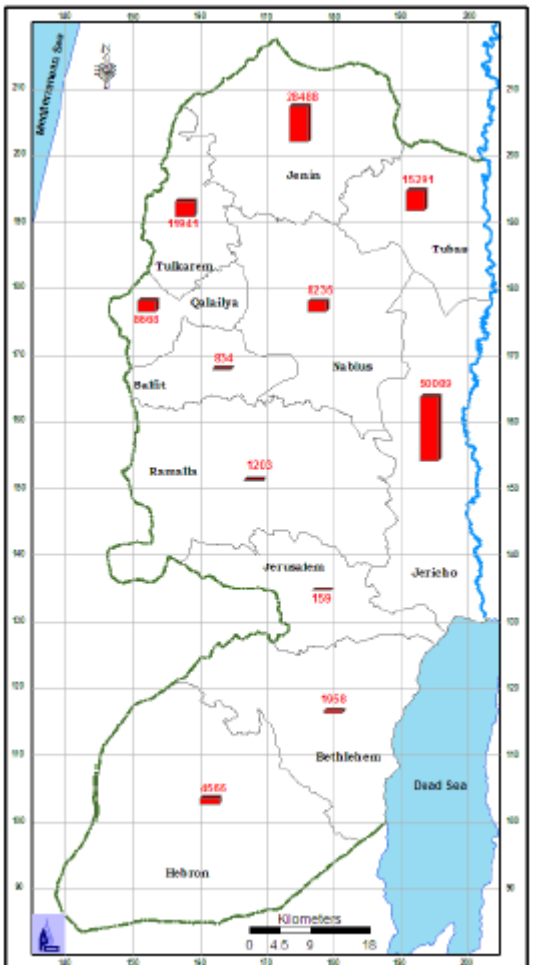


Figure: Irrigated land per governorate in 2003 (PHG 2006)

Agriculture plays a key role in the Palestinian economy, society and politics, by providing jobs (12% GDP), national self-sufficiency, cultural identity and by securing land from Israeli occupation (WB 2009). Average land-holdings are small and fragmented due to inheritance within families, suggesting a pattern of subsistence agriculture. Most of the land area is used for rainfed agriculture (western and northern slope of the Mountain range), but provide only 23.2% of overall production volume. Irrigated agriculture (from wells and springs) is used only for 13.2% of the land area (both greenhouses and open-field), but provides for 76.9% of production volume (all figures taken from ARIJ 2007). The geographical distribution of irrigated agriculture in the West Bank is shown in the map, clearly indicating the lack of rainfall and consequent need for irrigation in the hot and dry Lower Jordan Valley. Also in arid Gaza, agriculture is almost entirely irrigated. Due to the warm climate and high efficiency in greenhouse cultivation, both regions could be potentially very profitable, but are increasingly constrained by deteriorating water quality (WB 2009).

In general, Palestinian agriculture is struggling with the following constraints:

- restricted access to water and markets (eg. frequent border closures, roadblocks; competition with subsidized Israeli products)
- high costs for water and agricultural inputs
- land closures and isolation of irrigation infrastructure by the Separation Barrier
- water losses due to inefficient irrigation practices, poorly maintained infrastructure

(ARIJ 2007, 2008, 2010, WB 2009)

Irrigated agriculture is already by far the largest consumer of Palestinian fresh water (60-70%, aprox. 160 mcm according to WB 2009 and ARIJ 2007), and would consume 552 mcm/year in 2020, if all suitable land was put under irrigation (Jayoussi / Srouji 2009). In fact, only a small part of the irrigable land is used, supposing a substantial forgone profit of roughly 10% GDP, which naturally leads to a high interest in expanding irrigated agriculture (idem; Glover

and Hunter 2010; WB 2009). Any plans to expand irrigated agriculture however would definitely exceed the amount of fresh water currently allocated to the Palestinian Territories and even the more equitable share still to be defined in a future final settlement with Israel. Since alternative water sources such as treated wastewater or desalination plants, dams or large scale rainwater collection infrastructure, require high investments which are unlikely to be raised by the PA itself, water demand management is of vital importance to secure the short to medium term future of Palestinian agriculture.

4. Policy options for improved Agricultural Water Demand Management in the Palestinian Territories

Brooks and Trottier (2010:110) depart from the assumption that water shared by Israelis and Palestinians is enough "to satisfy all of their needs and to provide a high quality of life, but far less than enough to satisfy all their desires", justifying the urgent need for a shift from supply to demand management. Assuming that society's "desire" would be the all-year-round limitless supply of freshwater to everybody, closing the gap between actual needs and desires could be called demand management, which then encompasses "dimensions of both quantity and quality, as well as timing of use […] to off-peak periods" (idem). Applied to the agricultural sector, Bergstein (2010) divide WDM tools into

- pricing tools,
- removal of trade barriers,
- on-farm efficiency and
- environmental policies.

While this paper follows the same structure, the aspect of environmental policies has not been dealt with in depth, due to restrictions in time and interview opportunities[1]. However, it can be assumed that Palestinian environmental policies provide even less for concrete policies to allocate freshwater to nature (eg. by irrigated land retirement programs) than Israeli environmental policies, which are also lagging behind international best practices (Bergstein 2010). Furthermore, the use of alternative water sources, such as brackish or treated waste-water, by some authors is considered part of the broad concept of Water Demand Management, but for the purpose of this paper I have considered the technical feasibility of waste-water treatment for irrigation in the Palestinian Territories as belonging to the realm of supply management, and will focus exclusively on policies for promoting the adequate use of these alternative water sources for irrigation. Last but not least, the section "Removal of trade barriers" has been extended to include also national agricultural planning, an option that was not addressed by Bergstein for the case of Israel.

The following sections are going to discuss insights from relevant scientific literature on each of the above mentioned policy options, which are then complemented by findings of the expert interviews conducted in January 2011.

[1] The only relevant information was a reference to the reforestation program "Green Palestine", which provides farmers with tree seedlings. While contributing to increased water infiltration and soil water conservation in the long-term, the planting of trees also requires water in the initial years. The program is considered to be highly successful and hardly able to satisfy farmers' demands. Both farmers interviewed had already applied to the program (Abdo 2011, Mukarke 2011, Fatalkab 2011).

4.1 Pricing Tools

Literature review

As opposed to the extensive and widely accepted use of pricing tools in Israel (Bergstein 2010), irrigation water pricing is a highly contentious policy in the Palestinian context. Regardless of the fact that price increases would have to be substantial in order to achieve real water savings (Glover and Hunter 2009), even a slight increase in prices would put the viability of Palestinian agriculture immediately at risk, since farmers are already struggling to make a living (Abu-Madi 2009). The majority of countries in the Middle East have been reluctant to reform irrigation water pricing (Shetty 2006) and this holds true for the Palestinian Water Authority (PWA) until today. There is no unified tariff system for the Palestinian Territories. Instead water prices, including irrigation water prices, are set at the local level and vary significantly according to water or infrastructure availability, population size and institutional capacities (Cushman 2009). In many areas, and especially in regions with water shortage, eg. Jenin, municipal water prices are much higher than the subsidized Israeli irrigation water prices (WB 2009)[2]. In other regions, eg. Jordan Valley, wells are private property and their owners use the water for themselves free of charge and sell it at differing prices to neighbours (Glover and Hunter 2009).

This practice of decentralized water management by local institutions, such as municipalities, private or communally owned wells and springs, and the still prevailing perception of water as a private good is in sharp contrast to the proposed centralized management as a public good stated by the Palestinian Water Law and PWA, both products of the Oslo Agreement, which tried to adopt Israel's nationalized water management system for the Palestinians (Brooks and Trottier 2010). In reality, the PWA does not have the administrative capacity of a national regulating body that would be able to enforce water prices. Given the lack of real sovereignty over Palestinian water resources, the PWA considers a national pricing reform as extremely unpopular and undermining its own legitimacy, since the population strongly believes it should first "win back Palestinian water rights before imposing any limitations on the already struggling public" (Cushman 2009:1). Even in cases where irrigation water prices are paid and achieve cost recovery, they are far from reflecting the real economic, social and environmental value of water in the region, just as in Israel (Bergstein 2010). In addition to these institutional restrictions, many Palestinians still consider water pricing as unacceptable, since people believe water is a gift from God and should therefore be free (Institute Veolia Environment 2008).

Education and public awareness are needed to overcome cultural barriers to pricing policies or reforming historical use rights of private wells and are a necessary first step to advocate for more efficient water use. Volumetric metering in combination with escalated block tariffs as opposed to the prevailing time-based water allocation system would also provide a clear incentive for more efficient water use (Glover and Hunter 2010).

Instead of a national unified tariff system, local irrigation management by water user associations (WUA), including locally adapted pricing schemes, is considered a promising option, since WUA are more likely to address concerns of justice, acceptability and legitimacy, eg. of reinvestments into local infrastructure (Sbeih 2008; Glover and Hunter 2010). These local forms of water management have proved their efficiency and effectiveness

[2] This is a sign for the economic inefficiency of current prices in Israel, which "do not reflect the unsatisfied demand for irrigation water from Palestinian farmers in the West Bank" (Brooks and Trottier 2010:108).

in the Palestinian Territories and elsewhere in the world, but their replacement by top-down centralized management seems to be a political project promoted by both Israeli and at least some Palestinian officials (Brooks and Trottier 2010).

Interview results

The PWA (Abdel-Ghafour 2011) reassures that it does not intend to harmonize water prizes at the national level and that it agrees with the need to subsidize irrigation water prices due to the importance of agriculture for Palestinian society. However, it sees a need to reform Water Law in order to change the historical water rights and well licensing system towards use rights instead of water ownership. The current situation has led to the use of seasonal peak-prices by some private well-owners in the Jordan Valley, which causes social imbalances[3]. The PWA plans to address the issue by making lower water prices a condition for public investment into the rehabilitation of old wells. The new irrigation water framework is currently being discussed in a Joint Committee with the Ministry of Agriculture (MoA) and finds significant orientation in the Jordanian Water Law. One important aspect of the new framework also is the establishment of price incentives for unconventional water resources such as treated waste-water or a mix of waste and flood water.

Also, part of the common strategy of PWA and MoA (Abdo 2011) is the promotion of volumetric metering systems, as opposed to the time-based water allocation prevailing in many areas. With international support, they currently pilot the installation of water reservoirs which allow for continuous water supply, to be managed by Water User Associations and paid per volume (eg. Rasatiya in Qalqilya[4], total eight projects). According to their experience, WUA are much more successful in regions with historical collective well ownership, while in the Jordan Valley they are more difficult to implement. Social conflicts within spring committees (eg. Ain AsSultan in Jericho) or with private well owners hinder effective local management. Other cooperatives may not be troubled by social conflict but still require a lot of managerial capacity building. Nevertheless, the WUA approach is considered to be highly efficient, not only in decentralized pricing but also improved maintenance & operation (Nofal 2011).

Dr. Tamimi, director of the non-governmental organization and research institute *Palestinian Hydrology Group* supports the WUA approach but warns against imposing any blue-print on the communities. According to him, WUA should be initiated by and accountable to the farmers and should be a coherent part of the whole institutional and legal framework for irrigation water, just as any national pricing policy. First of all, there is a need for a discussion at the level of the whole Palestinian society about whether water should be a public or a private good.

> "Pricing is not only to put how many Shekel for m³, this is not pricing, this is costing. But pricing is policy. That's why I think for any pricing policy we first need to define the ownership of water, we need to know what is the objective of the pricing policy. Also what is the agriculture we need, export-agriculture or self-sufficient agriculture, cash-crops, whatever, I don't know. This important question is not answered in the Palestinian society. Also is the objective of pricing to control the demand? Or to improve the situation of agriculture in Palestine? Is it in favour of small scale or large-scale farmers? Is

[3] This information was confirmed by Khaled Mukarke, farmer in Jericho, who reported that some of his neighbour pay between 20-50 NIS/hour, while pure pumping costs for electrical wells are only 7 NIS/hour (Mukarke 2011).

[4] The Rasatiya WUA consists of 150 farmers, who elect a 20 person steering committee responsible for irrigation water management and pricing, under the oversight of the Agricultural Directorate of Qalqilya. The establishment of the local self-management has reduced irrigation water prices from 2,5 to 1 NIS in 2010 (Eid, Marabi 2011)

it increasing intensive agriculture or not? The final destination after all these questions is the pricing." (Tamimi 2011)

In the same sense he warns against a too early privatization of water resources (which is what he perceives to be a motivation behind ongoing reform plans) as long as there is no solution to the dispute with Israelis. While welcoming the recent efforts of the Palestinian Authority to consult their strategy with all stakeholders, such as the Environmental Quality Authority, the Ministry of Governorates, Municipalities, agricultural associations and farmer unions, he thinks that there is still a long way to go and that it is very early to have a pricing policy for Palestinian agriculture.

4.2 Removal of trade barriers and agricultural planning

Literature review

Just as Israel (Bergstein 2010), the Palestinian Territories are dependent on trade in virtual water, eg. by exporting water-intensive crops (eg. citrus, flowers, vegetables) to Israel and third countries, contributing to a virtual water loss of 56 mcm in 2002 (Nassar 2004). At the same time large water savings are achieved by water-intensive imports, eg. wheat and meat products (2200 mcm in 2002, idem). According to market analysts, Palestinian exports of virtual water could certainly achieve higher economic returns than currently achieved for citrus, eg. by exporting dates and high value vegetables such as cherry tomato (idem, ARIJ 2007, 2010). Trade reform is supposed to reduce incentives for growing water-intensive crops, such as banana and citrus, by removing trade barriers that protect local markets from international competition (Bergstein 2010). If trade barriers were lowered, more produce from water-abundant tropical countries would be imported and Palestinian or Israeli farmers would no longer be able to compete and finally have to "accept that bananas, citrus and flowers are not suitable crops to grow in a desert" (Partridge 2008: 17). Beyond international trade in virtual water, the concept can also help to achieve a more suitable domestic production according to local water availability. Diao and Roe (2003) therefore advocate, based on the Moroccan experience, for the establishment of national water rights markets immediately after trade reform, in order to smooth out social imbalances caused by agricultural liberalization.

However, the removal of trade barriers, apart from being inseparably linked to Israeli trade policy, is a contentious issue, especially due to concerns for national food security and the vital role agriculture still plays for the Palestinian economy and society (Nassar 2004; WB 2009). Arguing from a more state-directed perspective, FoEME (2010) and Partridge (2008) call for improved agricultural planning at the national level and more stringent regulation on water-efficient crops (financial incentives or penalties). Although recent years have witnessed a gradual reduction in banana (31%) and citrus (37.5%) in the Jordan Valley according to ARIJ (2007), further promotion of water-efficient crops and diversification towards high value crops is necessary, especially when deciding over the much desired expansion of irrigated agriculture. Such agricultural planning and research would focus on crops that are economically attractive, water-efficient and at least partly suitable for the use of brackish or treated wastewater. Valuable experience exists eg. for the case of almonds, jojoba, rain-fed olives and thyme, as well as some insights into why they are not yet used to their full economic potential, eg. lack of necessary infrastructure investments due to security situation or high regulatory requirements of export markets (Assaf 2004).

The following table (adapted from Assaf 2004) is meant to show how much water requirements can vary per crop and irrigation method. For more detailed publications, see ARIJ.

Crop	**Total water need m³/dunum/year****	
	Open field, mainly irrigated * mainly rainfed	Greenhouse
Banana	2000	
Avocado	1700	
Mango	1600	
Date Palm	1500	
Citrus	1200	
Cucumbers	1200	850
Tomatoes	1000	600
Green Beans	900	750
Peppers	800	600
Corn	600*	
Figs	480*	
Melons	450*	
Olives	400*	
Apricots	400*	
Chickpeas	385*	
Plums	380*	
Soft Shell Almonds	380*	
Hard Shell Almonds	350*	
Thyme	350*	300
Lentils	325*	
Jojoba	300*	
Cumin, Anis, Blackseed	225*	
Cactus-prickly pears	150*	
***Average crop water requirements (i.e. under moderately favourable conditions)*		

However, many influencing conditions need to be taken into account for determining real water needs of crops, eg. “type of soil, the variety type, the climate in the area, time of planting, time and distribution of rain, type of irrigation method, type and amount of fertilizers used, method of cultivation, time of harvest, and evapotranspiration rates in the area” (Assaf:6). This is why ARIJ (2007) also stress the need for improved extension services to farmers on crop water requirements, planting schedules, and the promotion of sustainable agricultural practices such as agroforestry, crop rotation and intercropping, integrated pest management, soil water conservation practices etc (see 4.3 On-farm efficiency).

Interview results

While recognizing the need for the removal of trade barriers and the usefulness of the concept of virtual water, the Ministry of Agriculture (MoA) sees only limited leverage with the Palestinian Authority, which currently does not even have control over internal trade within the Palestinian Territories, eg. between Gaza and the West Bank or even within the West Bank, due to Israeli occupation and frequent border closures. A study on the comparative advantage of all crops and agroecological zones of the Palestinian Territories was carried out in 1999 and will be up-dated in 2011. According to this study, there is still comparative advantage for the cultivation of eg. cut flowers in Gaza, while the comparative advantage is going down for banana and citrus. In terms of agricultural planning, the MoA sees its role as a mainly advisory one. “We cannot force the farmer. We show him the way, and he has all the free choice to adopt our advice or not.” (Abdo 2011). Such advice would recommend eg. the cultivation of salt-tolerant crops in the Jordan Valley, such as date palm or cherry tomato, or the introduction of water-efficient and high-value-added cash crops, such as colored pepper, almond or asparagus. Aiming to take a more proactive approach towards drought management, the MoA is trying to set up an early warning system with information on droughts, soil moisture and recommended restrictions in fertilizer application. Such a system

should inform farmers beforehand and minimise compensation payments in the case of lost harvests, and ideally should be complemented by an agricultural insurance system. Furthermore, the MoA would like to see a shift from individual farming systems towards a more aggregated agriculture, in which a group of farmers would cultivate the same products with the same practices, adopting one common irrigation approach (eg. through WUA). This clearly shows a strategic shift away from subsistence agriculture to more export-oriented agrobusiness, which so far has been hindered by the inheritance-fragmented system of landholdings in the West Bank (ARIJ 2007; Assaf 2004). For its strategic focus, the MoA refers to the "Shared Vision for Palestinian Agriculture" (MoA 2010), a product of stakeholder consultations in 2010.

ARIJ (Hrimat 2011) highlights the interconnectedness of Palestinian and Israeli trade policy, with its mutual virtual water trade (eg. vegetable exports to Israel represent virtual water loss, while fruit imports from Israel actually imports water). In order to reduce virtual water losses and increase the value-added on the water used by accessing attractive European markets, ARIJ suggests the establishment of a national marketing information system, including a production and consumption calendar with information on local and export markets, which would provide vital information to farmers, who are now reluctant to diversify or change their crops because of the uncertainty of marketing opportunities. Instead of surplus production in water-intensive vegetables which are then sold cheaply to Israel, Palestinian farmers should produce garlic, onion, carrots or sweetcorn, which in recent years had to be imported and guarantee a stable price. While supporting the Ministry of Agriculture's strategy, ARIJ strongly criticizes their reluctance towards national agricultural planning. For the sake of food security, the protection of the Palestinian agricultural sector and fragile ecosystems, ARIJ believes the government should provide more than just advice to the farmers and actually share the risk they take, by giving out clear marketing and climate information, guaranteeing seed stocks, as well as creating an agricultural insurance system.

The Palestinian Hydrology Group (Tamimi 2011) recognizes the importance of efficient water use, but warns against underestimating the political interests of the Palestinians.

> "Regardless of economic revenue of m^3 or land, in some areas we have to do agriculture because this is our political interest. You cannot ask people in Jayous to give up agriculture because it is not profitable, because to keep land cultivated is part of their struggle. Also some crops cannot be changed. Most of the land confiscated by Israelis is planted with olive trees, and this is the most efficient way they use for agriculture." (Tamimi 2011)

4.3 On-farm efficiency

Literature review

Palestinian agriculture struggles with poor on-farm water storage, irrigation infrastructure and technologies (PHG 2004; WB 2009). Although traditionally, Palestinian farmers are masters in water-conserving agricultural practices, competition with international markets requires even larger water-productivity. While progress has been made, and only 23 % of irrigation systems still use evaporation-prone surface irrigation, modern micro-irrigation systems or greenhouses are capital intensive technologies which are either not affordable to small farmers, or don't receive the necessary maintenance and up-grade due to the lack of low-cost loans (Glover and Hunter 2009). In general, Palestinian farmers receive much less support from their government than their Israeli competitors (Nassar 2004). This holds true for input subsidies but also with respect to agricultural extension services (ARIJ 2008). Knowledge transfer and capacity building is needed not only for the adequate use of irrigation

technologies (eg. water pressure requirements), treated waste-water (eg. incompatibility with certain crops, soil types or drip irrigation systems), rainwater-harvesting, but also for the impact of integrated pest management, fertilizers, planting schedules, irrigation timing, crop rotation, intercropping or agroforestry on water productivity (PHG 2004; ARIJ 2007, 2008). In the absence of sufficient governmental extension services, farmers often rely on information from agricultural input providers or experience gained while working on Israeli farms (Tamimi 2008). The need for improved capacity building for farmers seems to be widely recognized among Palestinian authorities and researchers. However, it remains to be confirmed whether due attention is given to water demand management in existing governmental and non-governmental agricultural extension services.

Interview results

The MoA admits that there are signigicant weaknesses in the governmental extension services, which consist of 400 extension agents, frequently colaborating with agricultural companies in the task of advising farmers, but having severe problems of accessing many farmers due to the fact that most agricultural lands are in area C under Israeli military control. Since governmental extension agents are perceived as "our eye to know exactly what is going on in that area", the MoA believes "that this should be done by the private sector. And at the end, the private sector should take all the responsibility for the extension services." Another weakness, the lack of institutionalized micro-loans for Palestinian farmers, is also pointed out be the MoA who are trying to increase cooperation with international donors and NGOs on that issue, rejecting to work with banks due to the reservations Islamic culture has with regards to commercial loans. However, big efforts are made on pilot projects for demonstrating the benefits of irrigation with brackish or treated waste-water, which according to the MoA is the only option for irrigated agriculture in some regions. They are very optimistic to be able to overcome problems of social acceptability, also because of the fact that in severe droughts in the past, some farmers even fell back on using raw sewage for irrigation.

Adding to the logistical constraints of the governmental extension service, Ekrima Addas of the *Palestinian Agricultural Relief Committee* also points to communicational gaps between farmers and agronomists due to differences in political opinion. He therefore recommends the government to closer coordinate their extension services with the work of national and local NGOs, and the incorporation of experience on the role of women in the successful adoption of water-efficient practices.

While supporting the promotion of sustainable agricultural practices, the *Palestinian Hydrology Group* (Tamimi 2011) calls for a deeper understanding of the socio-cultural and economic forces that motivate farmers, which are on the one hand the deep appreciation of traditional farming practices and on the other hand the pressure to compete with Israeli products on the domestic and international markets, which is what forces Palestinian farmers to apply industrial fertilizers and chemicals or to invest into expensive efficiency technologies.

From a farmer's perspective (Mukarke 2011, Jericho), improved extension services, information on marketing, more stringent regulation on crops to be planted and chemicals to be used, the provision of seed banks would be more than welcome. Very positive experience has been made with the use of tentionmeters for measuring soil moisture (introduced by JICA project in Jordan Valley) and accordingly increase or reduce irrigaiton, as well as night irrigation, diversification, intercropping, crop rotation, the use of nethouses instead of hermetic greenhouses, covered water-pools, low-pressure drip-irrigation systems (2.5 instead

of 8 l), the use of local drought-resistant seeds and organic fertilizer. For small-scale subsistence farming in Tulkarem, best practices in rainwater harvesting can be found for eg. with Yousef Adel Fatalkab, who stores rainwater in the ground floor of his own house.

5. Conclusions and recommendations

According to popular views, Palestinian agriculture historically has been one of the most water-efficient and sustainable worldwide. However, competition with the Israeli and international market, occupation and population growth have led to more and more unsustainable practices in terms of water use and management. Although water demand management receives increasing attention within governmental strategies for the water and agricultural sector, the paradigm of increasing water supply still dominates the political agenda and public awareness. Allocating freshwater to nature remains an inconceivable option for decision-makers and most of the public, and any savings made from successful water demand management would very likely be allocated first and foremost to the much desired expansion of irrigated agriculture, due to economic and political reasons.

The Oslo Agreement has left the Palestinian Territories with an unsatisfying share of available water and with an inappropriate institutional set-up for its management. Palestinian Water Law and agricultural sector policies are currently under redefinition and the policy options presented in this paper should be part of an inclusive societal debate. The conclusions from this research are the following:

Pricing tools:

- Do not separate the discussion about irrigation water pricing from the overall societal debate about the future of Palestinian's agriculture and development strategy.
- Demand meaningful and effective stakeholder participation in the design of the national irrigation policy, legislative and institutional framework.
- Do not copy other country's water policy without consideration for existing local water management institutions.
- Allow for the decentralized definition of irrigation water prices, by piloting and monitoring Water User Associations, as one form of local irrigation water management. Offer capacity building for improving their participatory, transparent and accountable management.
- Negotiate with private well owners about the appropriate design of licensing schemes and fair water prices for neighbouring farmers, possibly by providing infrastructure investment incentives.

Removing trade barriers and agricultural planning:

- Instead of relying on market liberalization, establish and maintain an open-access marketing information system and production calendar, in order to avoid surplus production in water-intensive crops and deficit production in water-efficient or high-value crops.
- Advocate for a societal sharing of farmers risk, eg. through the establishment of an agricultural insurance system and the institutionalization of micro-loans for water-efficiency investments.

On-farm efficiency:

- Increase the government budget for extension services and agricultural research as well as increased coordination with non-governmental and private sector extension activities.
- Improve extension services and promote farmer-to-farmer exchange on the adequate use of irrigation technologies and treated waste-water, best practices in rainwater harvesting and water-efficient agricultural practices, such as night irrigation, integrated pest management, intercropping etc.

Environmental policies:

- Carry out research on existing environmental policies for the reallocation of freshwater to natural ecosystems and the socio-economic potential and risks of ecotourism as an alternative use for water currently allocated to only marginally profitable agricultural areas.
- Monitor and research the environmental impact of unconventional water resources for irrigation (treated waste water, desalination plants, flood water storage).

Even more than in the Israeli context and due to the political situation, Agricultural Water Demand Management is less popular in the Palestinian society and hence less prominent in government policy than water supply. However, if it takes into account farmers' needs, it bears great potential to improve their situation and the sustainability of available water resources. It can be beneficial both in the short term, since in most cases it does not require large investments but rather a change of behaviour, and in the long term, because it builds on a knowledge-intensive agriculture and farmers' adaptive capacity, thereby contributing to food security and climate change adaptation.

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Annex

Complete list of interview partners:

Abdel-Ghafour, Deeb: Director of Water Resources Development Department, Palestinian Water Authority, 9th January 2011 in Ramallah.

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Addas, Ekrima: Palestinian Agricultural Relief Committee – Jericho Office, 19th January 2011 in Jericho.

Eid, Ahmad: Agricultural Directorate of Qalqilya, 12th January 2011 in Qalqilya

Fatalkab, Yousef Abdel (wife): Farmer, 12th January 2011 in Der Lahsun, Tulkarem

Hrimat, Nader: Deputy Director General of ARIJ, The Applied Research Institute Jerusalem, Bethlehem Office, 20th January 2011 in Bethlehem

Khateb, Nader: Friends of the Earth Middle East, 10th January 2011 in Jericho

Mahmoud, Nidal: Birzeit University, 11th January 2011 in Ramallah.

Marabi, Masus: Vice-president of Water User Association of Rasatiyya, 12th January 2011 in Qalqilya

Mukarke, Khaled: Farmer, 10th January 2011 in Auja, Jericho

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Tamimi, Abdel Rahman: Palestinian Hydrology Group, 11th January 2011 in Ramallah.

Sbeih, Mohammed Yousef: Palestinian Olive Council, 11th January 2011 in Ramallah.

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