Implementing water markets in the Jordan Valley to insure environmental flows in drought periods

Water markets are among the tools implemented to help sustain environmental flows in basins facing water scarcity issues worldwide. We explore here the possibility of such a market for the Jordan River Basin, with a buy-back mechanism limited to drought periods. The mechanism, inspired by Australian experiences, could contribute to the rehabilitation of the Lower Jordan River, by recovering water for the River from the agricultural sector, based on farmers' voluntary participation.

Amélie Joseph
Intern - EcoPeace / Friends of the Earth Middle East

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The context: Agricultural water uses in the Jordan River Basin, within Israel

The Jordan River basin, stretching from the Syrian heights to the Dead Sea Shore, is a major water source for Israel, as well as its neighboring countries. Overexploitation of the water in the basin has resulted in a severe depletion of the river flows: in its lower section, south of the Sea of Galilee, the Jordan River flow is less than 5 % of its historical level [1].Israel is responsible for a large part of the water consumption, with the Sea of Galilee serving as the largest surface water reservoir of the country. Fresh water is pumped from the Sea of Galilee for domestic, industrial and agricultural uses. Water extracted from the Jordan River Basin in the Israeli side is used both for local domestic consumption and farming in the basin (70-150 million cubic meters (MCM)/year in the Upper Jordan river basin, 39 MCM/year around the Sea of Galilee and196 MCM/year in Lower Jordan Valley) and diverted to the south by the National Water Carrier (290 MCM/year) [2, 3].

The agricultural sector is the major water consumer in Israel; it accounts for about 42 % of the fresh water uses, approximately 500 MCM per year [4].Local consumption for agriculture is estimated to be about 200-250 MCM /year[1].

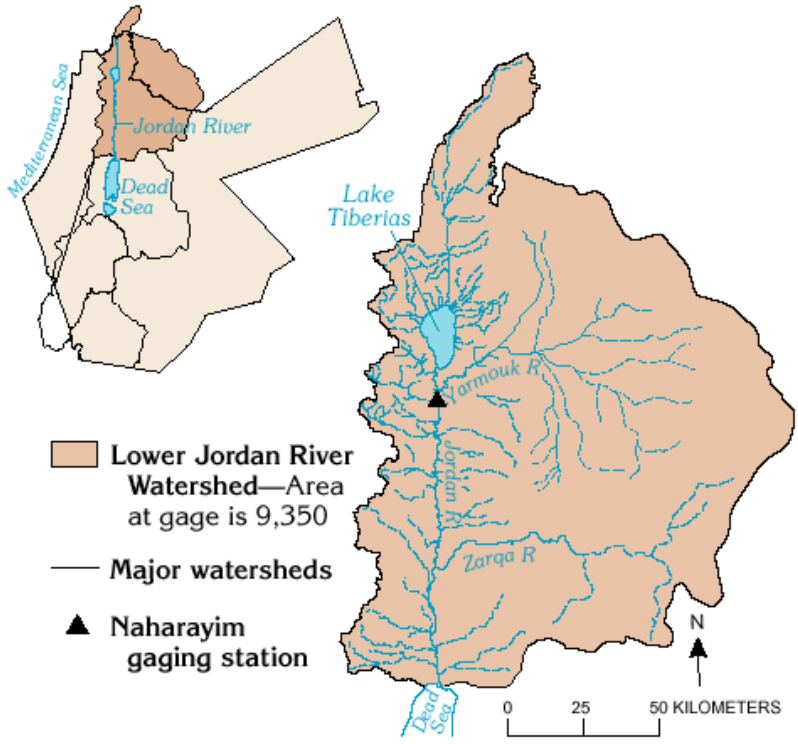

Figure 1: The Jordan River basin. Map from the Water Data Banks Project, Overview of Middle East Water Resource, 1998

[1] Other local major consumers are domestic use (about 23 MCM, for a population around 237,000) and fish ponds in the Lower Jordan River area (100-120 MCM).

Friends of the Earth Middle East (FoEME)'s Environmental Flows report[1] identifies 400 MCM/Year (less than a third of the historical flow) as the minimum quantity of water required for a healthy Lower Jordan River. Quality considerations require most of the incoming flow to be fresh water, in order to restore lower salinity levels. Return flows efforts would be shared between Israel, Jordan and Syria; from historical diversions and socio-economic considerations, the study concludes that Israel should be responsible for returning 220 MCM annually. The agricultural sector, as others, will have to contribute to the efforts to meet environmental flow requirements. FoEME's Roadmap for the rehabilitation of the Lower Jordan River [2] focuses on local measures and plans an average of 30% decrease of the fresh water allocated to agriculture in the valley (about 60-75 MCM redirected to environmental flows).

Challenge

Different measures can be combined to reduce the amount of water consumed by the agricultural sector in the Jordan Valley. Changes of practices are likely to bring some improvement: covering banana plantations with nets reduce the need for irrigation, the development of local waste water treatment plants allow for swapping some fresh water for treated waste water, with a potential of about 16 MCM. However, these measures are not sufficient to reach the target of 30% decrease of fresh water allocations in the Jordan Valley.

A direct cut of agricultural fresh water allocations, imposed by the government, would face strong social resistance from farmers. In similar situations of water scarcity and competition between agricultural and environmental water uses, Australia and western US stakeholders have developed water markets oriented towards the recovering of environmental flows. Such water markets offer some flexibility for the management of water consumption and environmental flows and are likely to be more acceptable for farmers.

We focus here on the idea of a temporary water market for environmental flows restricted to the Jordan Valley area, with a particular emphasis on drought periods, in which the government can buy water allocations from the agricultural sector, to contribute to maintaining a minimum flow in the Lower Jordan River.

A water market to achieve environmental flow goals

Water markets have been developed in the last decades to answer the growing issue of water scarcity and introduce flexibility into the systems of water allocation in order to meet farmers' needs. They usually coexist with other tools that regulate water use, such as pricing regulations and volumetric limitations. Economists advocate that water markets increase economic efficiency, through reallocation of water from low-value to high-value users. Australia and Western US have been the first to develop water markets oriented towards an environmental target: recovering environmental flows. Thus, such a

market supposes that rights and limits over freshwater extraction are clearly established, that water for the environment is recognized as a legitimate use, and that some transfer mechanisms allow for reallocating water from agriculture to the environment [5].

Allocations of environmental flows are not conditioned by the existence of a water market. In Israel, since farmers do not have private rights over the water they use, the government could implement direct large cuts on the agricultural water allocations. While this solution would be at first sight costless and easy to carry out, it would actually face very strong opposition from the farmers and no social acceptance of environmental flow targets [6]. Water markets do not provide an ideal solution, but they offer some flexibility, since farmers are given a choice, and are likely to choose the most economically profitable option they have.

A water market is based on voluntary participation of the water users: thus, its successes are deeply dependant on farmers' will to enter the market. It is necessary that they find a relative advantage in trading water, primarily an economic benefit, and that they feel secure about not endangering their future production. In this respect, farmers tend to prefer temporary trade mechanisms (selling their water rights only for a season) over permanent trade (definitive selling of their water rights): that offers them some welcome additional flexibility and does not dispossess them from their allocation for future years [6, 7].Volumes of water traded reflect this preference; permanent trade usually accounts for 1 to 5% of the total volume of allocations, while temporary trade reaches higher levels, often around 10-15%.Therefore, a water market involving permanent environmental buy-back of water only can allow a limited volume of water to be recovered for environmental flows. Australian and Western US experiences show that a combination of different forms of water acquisitions (permanent, temporary, option contracts…) and strong institutional support proves to be more efficient, allowing for adaptation to many local situations, with high flexibility [8].

Murray-Darling Basin, Australia [6]

The Water for the future program started in 2008, managed by the Murray-Darling Basin Authority (MDBA), an independent authority with federal powers. It consists in direct intervention in the water market; with buy-back of permanent entitlements (the farmer who sells partial, or his entire quota, definitely loses his rights for this quota).The initial target was to buy-back 1500 MCM of water entitlements from willing sellers over 10 years, total target now is 2750 MCM. In January 2012, the MDBA had obtained 1204 MCM of entitlements. The program, initially quite successful, suffers from two main constraints: a cost higher than expected (initial budget $3.1 billion, another $5 billion needed), and less farmers than expected who are willing to sell, fearing for the future local economic situation.

Such an example shows how important it is to take into account farmers' interests in participating in the market. Studies from Australia and USA both conclude that farmers usually tend to prefer temporary trade of water that allows them to sell only on certain years and to keep their water rights that they see as a security.

Columbia basin, USA [5]

The Columbia basin, featuring a wetter and colder climate, has a long history of dealing with environmental flows; Oregon for example already set up administrative regulations of flows for fish and wildlife in 1955. In the 70's and 80's the states have progressively built the legal framework to allow water transfer for the environment. Water acquisition programs use diverse contract types and transfer mechanisms, including permanent acquisitions, temporary leases, and there-allocation of water conserved through irrigation efficiency projects. They are managed both by public and private bodies, dealing with a complex patchwork of legislative and regulatory jurisdictions. Initially, transfers for the environment targeted restoration of tributary streams, where small-scale water acquisitions were effective. Efforts now are being developed at a wider scale, using reverse-auction market and water banking, as well as contractual arrangements with farmers to temporarily or permanently reduce water use.

The success of these combined measures to save water for the environment relies on several drivers. The local culture being based on salmon has been a strong incentive for stakeholders to facilitate environmental flows protection. The strong institutional support and a combination of many different forms of water acquisitions have allowed adaptation to many local situations, with high flexibility. Water markets have also been driven by a growing urban demand and land use change. However, it is highlighted that one of the main barriers was and remains gaining trust with farmers, for them to participate, even temporarily, in these water transfer mechanisms.

A water market provides some flexibility under water scarcity

When examining water transactions in the Murray-Darling basin in Australia [6, 9]over the last decades, it appears that overall sales of water increase in drought periods. In times of water scarcity, the market mechanisms ease farmers' adaptation. Farmers whose priority is to maintain their production, typically perennial and high added value crops, are likely to keep their allocations as long as their production is not endangered in the long-term. Others can arbitrate between producing what is possible with their allocation, and selling their water for an income instead of producing, which actually become more profitable. Sales of water can allow critical financial injection for farmers: either to restructure debts or to make a new start out of agriculture. Accordingly, a temporary water market mechanism limited to drought periods benefits both farmers and river ecosystems, providing an alternative income source to the farmers, and minimum flows to the ecosystems.

Farm size, type of crops, financial capacity of the farm business and the level of existing irrigation investment are the main production factors impacting farmers' choice to sell water or not, while uncertainty about future water resources and risk aversion strategies also play a critical role in the water market dynamics, often limiting its extent. Water sellers are primarily small farmers, with constraint resources, limited access to credit and technology, and are mostly annual crops producers. Analyzing the behavior of these annual crops producers during droughts in Australia, Loch and al.[9] identify a range of

strategies and motivations[2]. Most of water sellers report an economic opportunity, getting a higher income for trading water than for producing. Others only look for selling their water so cash flow allows them to offset their fixed charges, while some farmers who would benefit from a sale prefer maintaining a history of water use to secure their future years allocations.

Thus, implementing an environmental water market requires considering trade-offs between efficiency (getting water for environment at the lowest cost), effectiveness (insuring farmers' participation into the market, secure the level of environmental flows needed) and equity (minimize market distortions and negative social impacts).

Implementation in the Jordan Valley

While there is no established water market in agriculture, implementing a mechanism allowing for water transfer between users is not new in Israel. A small scale water exchange mechanism was set up in 2008, to ease a cut in water allocations consecutive to drought years. It was observed that at a macro level water allocations were not fully used, when some farmers were in desperate need of water. Hence, transfers were allowed up to 30% of a farmer's allocation. In addition, local unofficial transfers have taken place for years, within different consumers of the same water association. Facts in the ground acknowledged today that the current system of water allocations lacks flexibility, and research is conducted on the potential economic benefit of a water market between farmers[10]. Such a market may help for a better resource allocation inside the agricultural sector. However, with a long-lasting over exploitation of the fresh water resources, the call today is for a better repartition of water between sectors, fully taking into account the need for a healthy environment and maintained river systems. A transfer of water from agriculture to the Jordan River is necessary, and an environmental water market can ease it.

In periods of drought, maintaining a minimum level of environmental flows in the Lower Jordan River is crucial for the ecological system. Thus, the aim of the proposed water market is initially to recover up to 25 MCM of water[3] from agricultural allocations in the Jordan Valley in drought years. Farmers will have the possibility, through the water market, to sell all or part of their allocation for the year to an official body representing environmental flow interests. The price of sale can either be arbitrarily fixed or determined by an auction mechanism. It must offer an economic incentive for the farmers.

Estimation of the potential buy-back costs goes beyond the frame of this study and will need further consideration. As a first draft, we can consider that the price set up in the water market would have to exceed the current water prices. As a reference, farmers in the Jordan Valley Regional Council pay between 0.7 and 1.6 NIS/m^3 for the water they consume, while prices in the rest of the Jordan River

[2] Although it is not studied in details here, the timing of the water sales also potentially impacts the market: risk factors for farmers vary depending on whether the rain season is passed or not.
[3] Most temporary water markets allow for the recovery of about 10% of the total volume of water allocations.

basin area lay between 1.65and 2.41 NIS/m^3, following a tier price system [4]. Accordingly, buying back 25 MCM for one drought season would cost at a minimum 52 million NIS[4]. A deeper economic study should take into account the loss of agricultural production that would result from farmers selling water, risk factors, and the expected higher willingness to sell water instead of cultivating in drought periods. In addition, is it necessary to balance the measure cost with other economic benefits of the rehabilitation of the Jordan River, which may offset some of the losses the agricultural sector may face.

Gaining trust with farmers: a key element of success

Farmers' acceptance has been stressed as a key element for successful implementation of a water market [8, 6]. Hence, a trust-building process is necessary, involving a high level of transparency and efforts to support the process. A concern of importance for farmers is their water security over the long term, which may prevent them from entering the water market to sell. Thus, any expected changes in the volume of water allocations should be clearly stated, as well as the water market objectives, to avoid the threat of uncertainty. Transparency in the water market mechanisms is crucial, especially regarding price building, but also the final use of water: farmers should be informed of environmental flow targets. In the Murray-Darling basin, transactions data are largely public, allowing farmers to access all the information they might need to make a decision. Accompanying processes widely help to establish trust among farmers. Meetings and other forms of public information allow for a better dialogue between farmers and institutions. In addition, when looking for potential water sellers, targeted efforts towards identified key farmers are likely to give good results [8].

Prior to implementing a water market, a survey with farmers in the Jordan Valley would provide a better understanding of farms' dynamics regarding water, their perceptions on environmental flows, and the conditions and prices in which they would be willing to enter a water market. Such a consultation could serve as a base for adapting the water market mechanisms and for further cooperation with farmers on different projects.

[4]Calculation made for 10MCM bought back at 1.6NIS/m3 and 15MCM at 2.41NIS. Volume repartition between the different prices is a rough estimation.

Conclusion

A temporary water market involving the government buying water allocations back from farmers could help recover a minimum level of environmental flow in the Lower Jordan River, in periods of severe water scarcity.

- The potential for water recovery through this measure is about 10% of the volume of allocation to agriculture, namely 25MCM for the Jordan River basin area
- Costs, to be further determined, would excess 50 million NIS for a year. However, previous direct cuts in allocations in period of scarcity in Israel have been compensated by expensive measures as well, with state's participation in irrigation investments.
- Environmental benefits for the Jordan River may offset costs.
- The water market mechanism brings flexibility, allows for farmers' choices and for annual adaptations.
- Farmers' acceptance and willingness to enter the market, as a key element of the process, call for particular attention.

The proposed water market mechanism is one of a range of measures that, all together, will contribute to the recovery of environmental flows for a healthy Jordan River, and thus could be integrated into the Jordan River regional master plan. Over the long term, if successfully implemented along the Jordan River, environmental water markets could be extended to all Israel, contributing to a more sustainable repartition of water between agricultural and environmental uses.

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