BUSINESS MODEL 20

Inter-sectoral water exchange

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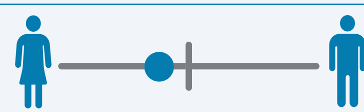
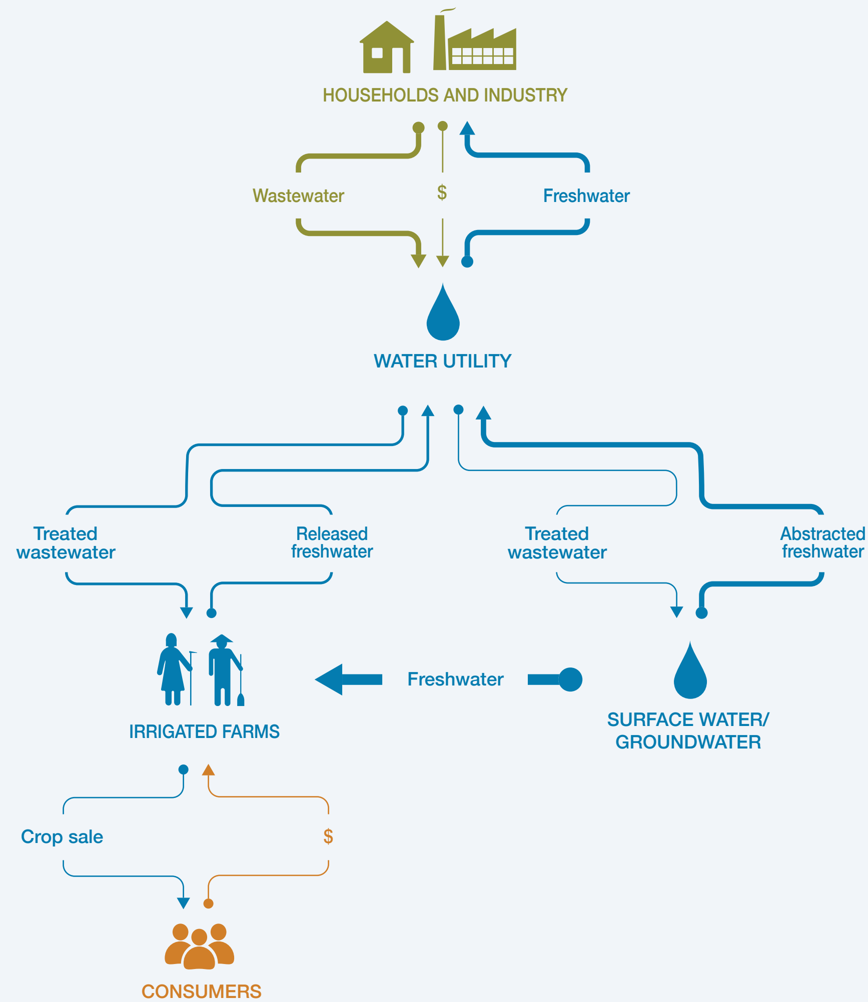
Key characteristics

Model name	Inter-sectoral water exchange
Waste stream	Urban wastewater
Value-added waste product	Reclaimed water for domestic and industrial use
Geography	Seasonally or continuously water short areas where urban and agricultural water demands could be better aligned
Scale of production	Medium- to large-scale (no defined range)
Supporting cases in the book	Mashhad, Iran; Llobregat delta, Spain
Objective of entity	Cost-recovery [ ]; For profit [ ]; Social enterprise [X]; Insurance [X]
Investment cost range	Can vary in large margins depending on (i) how far existing treatment infrastructure meets standards for irrigation, and (ii) distance for water transport
Organization type	Public, public-private, private
Socio-economic impact	Increased freshwater supply for urban households in periods of drought; guaranteed agricultural supply with reclaimed water in all seasons
Gender equity	Beneficial in particular to urban women and children due to time savings in water access; improvement in hygiene and living conditions 

Business value chain

To address increasing urban water demands in basins with limited water resources, or to cope with severe periods of drought, water reallocation within and across basins can be important adaptation strategies. Even without increasing the overall water volume, reallocating freshwater from agriculture to urban use in exchange for reclaimed water can help within the same basin urban needs, and help optimizing water allocations with sector specific water quality requirements. Such a water swap requires investments in appropriate treatment as well as incentive systems that farmers actually release their surface- or groundwater for urban use. This water can then be sold at a higher price to urban consumers than farmers would ever pay. The obtained revenues can support cost recovery of water transport and treatment, with an increasing probability of a positive benefit-cost ratio the larger the water volumes exchanged (Figure 248). The situation looks even better from an economic perspective: In the case of Spain, the direct and indirect costs of the affected regional economy due to multiple months of water scarcity in 2007–2008 were estimated at EUR1605 million or 0.48% of the regional GDP. The order of magnitude of these estimates is similar to others reported in the USA and Australia in recent years and easily outweighs the total investment costs in climate change adaptation measures in the region, including wastewater conveyance and treatment for reuse (Martin-Ortega et al., 2012).

FIGURE 248. VALUE CHAIN SCHEMATIC – INTER-SECTORAL WATER EXCHANGE



The business concept depends strongly on the incentives offered to (and accepted by) farmers, i.e. the contractual agreement (such as transfer of water rights) as otherwise farmers might absorb the wastewater to expand their operations without releasing freshwater. The exchange might only work where defined water rights exist, freshwater can be transferred to urban consumers without allowing access by third parties, and wastewater has to be redirected to farmers, e.g. pumped upstream (from city to farmers) as otherwise at least some downstream farmers will be able to access the urban return flow without contract.

Business model

This business model transfers freshwater from agricultural use to urban areas for domestic use in exchange for treated wastewater. This model is complex as it can entail many partners across the agricultural – water supply – wastewater and health sectors, different time horizons and mechanisms to support farmers' buy-in.

The main contract is between the public or private water utility and the farmers or their water users associations. The urban partner has to invest in additional treatment capacity as conventional treatment might result in water with too high in contaminants or salinity for crop irrigation. In addition, investments in water conveyance are needed although in many situations one of the flows might follow gravity.

Contracts can span the whole year where urban areas face a permanent supply deficit or be seasonal. If seasonal, the water swap can be limited to certain months or only be activated in times of severe drought. Water volumes can be defined or remain flexible according to the supply gap. Obviously, the pay-back period for treatment infrastructure and water conveyance increases when actual water swaps remain seldom, and/or volumes are low, like in the case of the Llobregat delta. However, in this case, the investment is more like a water supply insurance for parts of the 1.6 million city of Barcelona, aside other, and often more expensive, risk reduction and mitigation measures (desalination, long-distance water transfer).

Farmers, who have to give up on parts or all of their freshwater rights, need to understand the reasons and incentives to accept what looks per se as a disadvantage. These investments in awareness creation and incentives, and the contract, which builds on them, are the heart of the business model. The incentives can have pull and push factors. Depending on the local context, the authorities might limit farmers' freshwater withdrawal through regulations for times of drought while offering reclaimed water as substitute. To support farmers acceptance, the volume of supplied wastewater, can, like in the case from Iran, be higher than the released freshwater. Obviously, options to charge farmers for the water could be counterproductive. In contrary, wastewater acceptance could be bundled with financial incentives, such as access to micro-credit. Accompanying training in its safe application, protective gear and awareness creation on reduced fertilizer needs should be part of the package. Most important, as the studied cases stress, is the reliability of the supply and an acceptable water quality for plant growth. Social and economic benefits of the water exchange will be very high as the case from Iran shows where households and the local (tourist) economy depend on the additional freshwater year-round (Figure 249). On the other hand, the economic damage can be very high if a city is not prepared to adapt to such climatic extremes as the case from Spain shows.

Potential risks and mitigation from the urban perspective

In designing any optimized business model based on case studies, it is assumed that generic business risks are known and will be taken care of. However, some risks might be more model specific and will be acknowledged in the following:

Market risks: The market could be characterized as fragile as business success depends on willingness and availability of enough farmer or farmer associations to exchange freshwater against reclaimed water, which appears on the first view as a 'bad deal'. The business thus requires awareness creation on the reasons for the exchange, education on the advantages of wastewater (nutrients, reliability) and in addition tangible incentives for the farmers to accept the swap; all under the assumption of a water supply gap, thus a market for the released freshwater. Where urban water is constantly in short supply, long-term contracts would have an advantage; where the exchange is more an instrument for time of water crisis, also flexible contracts are possible. Market risks might be lower in societies where farmers have limited political power to negotiate agreements in their interests.

Competition risks: Different perspectives of competition are possible in a water swap:

a) farmers continue using freshwater;
b) the city receives freshwater through desalination or long-distance transfer at lower costs or less (human) risks (as the water exchange requires negotiations with farmers, reliance on behaviour change, etc.); and

FIGURE 249. BUSINESS MODEL CANVAS – INTER-SECTORAL WATER EXCHANGE FROM THE PERSPECTIVE OF THE WATER UTILITY

KEY PARTNERS

- Farmers or their associations
- If available, private entity managing water supply and sewerage
- Authorities (e.g. health, agriculture)

KEY ACTIVITIES

- Awareness creation for water swap
- Negotiation of water swap
- Treat wastewater fit for irrigation
- Convey wastewater to farmers/ freshwater to city
- Monitoring of water exchange agreement
- Households water supply
- Selling fresh water

KEY RESOURCES

- Treatment technology
- Capital
- Legal entitlement to exchange water rights

VALUE PROPOSITIONS

- Mitigating conditions of drought or general freshwater shortage through inter-sectoral water reallocation

CUSTOMER RELATIONSHIPS

- Negotiations to agree on formal contracts
- Inter-institutional collaboration
- Automated billing services to urban households

CHANNELS

- Negotiation roundtables
- Piped supply, direct or bulk sales
- Automatic billing through internet or supermarkets

CUSTOMER SEGMENTS

- Irrigating farmers
- Water demanding industry
- Urban residents

COST STRUCTURE

- Capital investment in treatment and water conveyance
- O&M (in particular water pumping, quality monitoring)
- Cost of awareness campaign for exchange, and safe wastewater reuse training

REVENUE STREAMS

- Sales of wastewater (optional)
- Sales of gained fresh water
- Indirect revenues (saving on socio-economic costs and damage claims from inability to supply water in (prolonged) periods of drought)

SOCIAL & ENVIRONMENTAL COSTS

- Possible health risks for farmers and consumers if wastewater quality does not meet agreed standards, or gets mixed with untreated wastewater before use, and insufficient risk reduction options have been put in place

SOCIAL & ENVIRONMENTAL BENEFITS

- Climate change adaptation measure to reduce the impact of extended water scarcity on agriculture and society
- Contribution to food security and continuing social welfare

c) technical advances allow to treat wastewater to potable quality making the swap redundant (assuming the water consumer accepts the reclaimed water).

Technology performance risks: The technology needed to upgrade existing treatment plants to meet the WHO guidelines for wastewater reuse in agriculture are common and in general not at risk of failure. However, the technology depends on political will and investments to meet the contractual quality and quantity targets the farmers are expecting. A severe performance risk concerns the limitations of the swap. In times of prolonged drought, also farmers' freshwater supply might decrease, reaching a limit where there is no more water to swap.

Political and regulatory risks: The business requires that farmers have well defined water rights or entitlements, which can be transferred, and regulations that allow the use of (partially) treated wastewater on farms serving local markets. Particular challenges relate to the regulation of groundwater usage and rights, e.g. where urban and rural users share the same aquifer. This also applies to the need of defining the ownership of raw wastewater as well as reclaimed water.

Social equity related risks: The model links different interest groups in need of water: farmers and urban dwellers/industry. This requires an inclusive process of planning and implementation where all parties can express their interests during fair contract negotiations. The reality might look different depending on the political power farmers have compared with the significant power of urban centers.

Where women farmers had no water rights before the swap, the model will not improve their situation unless the contract with the local community earmarks additional entitlements to reclaimed water for women. The swap is considered to have more advantages of social nature for women in the urban sector which vary with the scale of the prevented water shortage in terms of time and cost savings in water access, maintaining standards of hygiene and general living conditions.

Safety, environmental and health risks: Foreseeable health risks arise from the use of partially treated wastewater on farms, to farmers themselves, or, depending on the produce and the way it is consumed (e.g. cooked or uncooked) also other stakeholders along the value chain (Table 59). Perfectly treated wastewater which takes care of all pathogens, as well as inorganic and organic contaminants is still seldom, especially in low-income countries. Risks may be mitigated by following the WHO Sanitation Safety Planning process, including quality control measures or by regulation on the type of crops allowed to receive wastewater. As the Iran case showed, not only the quality of the replacement water matters, but also if the treated effluent is mixed with untreated wastewater before farmers access it. Therefore, this model should include the adoption of the multi-barrier approach for health risk reduction along the farm-to-fork value chain (WHO, 2006, 2015; see the introduction to Chapter 18).

Business performance

The model ranks high on the innovation criteria as it involves diverse actors across sectors and extends the value chain beyond cost recovery to social gains. The **scalability** of the model is contractually defined by the water volumes which have been negotiated between the parties, but ultimately by the physically available wastewater volume (and quality) which the city can offer to farmers as freshwater replacement. The essential building blocks for scaling are the existence of additional capacity to treat wastewater, latent irrigation demand in the area, and cooperation among farmers, industry partner, and municipality.

Where alternative adaptation measures to drought are not feasible, like seawater desalination, water swaps with farmers are possible if farmers can be convinced and incentivized to release their freshwater

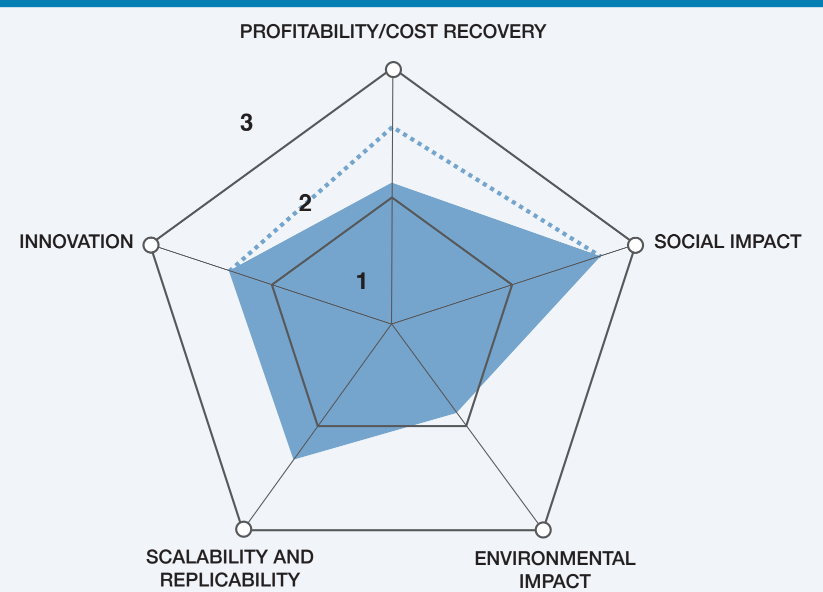
TABLE 59. POTENTIAL HEALTH AND ENVIRONMENTAL RISK AND SUGGESTED MITIGATION MEASURES FOR BUSINESS MODEL 20

RISK GROUP	EXPOSURE					REMARKS
	DIRECT CONTACT	AIR/ ODOR	INSECTS	WATER/ SOIL	FOOD	
Farmer	Medium risk	Medium risk	Medium risk	High risk	Not applicable	Higher risk possible where reclaimed water offered to farmers is poorly treated WHO's multi-barrier approach highly recommended along food chain
Community	Low risk	Low risk	Low risk	Medium risk	Not applicable	
Food consumer	Not applicable	Not applicable	Not applicable	Not applicable	Medium risk	
Mitigation measures				Pb Hg Cd	Pb Hg Cd	

Key: NOT APPLICABLE; LOW RISK; MEDIUM RISK; HIGH RISK

rights, or do not have sufficient political power to resist. There are different options to facilitate farmers' buy-in, of which the receiving water quality ranks highest. Surplus water allocations appear as another strong factor for decision support. The actual amounts to be exchanged, and the timing, depend on the local freshwater deficit and regularity of supply.

FIGURE 250. RANKING RESULTS FOR THE INTER-SECTORAL WATER EXCHANGE BUSINESS MODEL



Note: The dotted line represents the anticipated change in returns under increasing periods of drought until the available water limit has been reached.

The water swap has a high potential for **replication** wherever cities outgrow local water supply. Cost recovery (from the urban sector) depends on the frequency and volume of the exchange. However, like with any insurance scheme, this is foremost a social responsibility model where the investment will pay off with the occurrence of any prolonged drought given the associated financial and economic losses, which will accompany any water supply scheduling or interrupting, aside the social and health related challenges. Depending on the available wastewater volume also ecosystem services can be supported with reclaimed water, beyond what Figure 250 indicates, although under severe drought highest priority is usually given to immediate socio-economic needs and benefits.

References and further readings

Martin-Ortega J., González-Eguino, M. and Markandya, A. 2012. The costs of drought: The 2007/2008 case of Barcelona. Water Policy 14: 539–560.

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