WaterStrategyMan
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MANUAL OF THE INTEGRATED DECISION SUPPORT SYSTEM

Chapter Four

Strategic Options for IWRM

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Chapter 4 - Strategic Options for IWRM

This chapter describes the strategic options currently available within the decision support system. They are grouped under four categories:

1) Measures related with Supply Enhancement, introducing new structural interventions to increase water availability;
2) Measures of Demand Management, aiming to control and limit water demands;
3) Regional Development measures, affecting the socio-economic preferences given to certain types of water use with respect to others and finally,
4) Institutional policies, such as changing water pricing.

Table 1. Summary Table of Policy Options and related Actions

Policy Options	Actions
A. Supply Enhancement	A1. Unconventional/untapped resources A2. Surface Waters and precipitation (direct abstraction, dams, reservoirs) A3. Groundwater (drillings, wells) A4. Desalination A5. Importing A6. Water Reuse
B. Demand Management	B1. Quotas, Regulated supply B2. Irrigation method improvements (drip irrigation, enclosures) B3. Conservation measures in the home (water saving plumbing systems) B4. Recycling in industry and domestic use B5. Improved infrastructure to reduce losses (networks, storage facilities) B6. Raw material substitution and process changes in industry
C. Social-Developmental Policy	C1. Change in agricultural practices (low irrigation crops, genetic improvement) C2. Change of regional development policy (tourism/agriculture limitation)
D. Institutional Policies	D1. Institutional Capacity Building (Education and awareness campaigns, Use of standards, Public participation, Stakeholder involvement, Conflict resolution, Contingency planning) D2. Economic Policies (Water pricing, Cost recovery, Incentives) D3. Environmental Policies (Enforcement of environmental standards and legislation, Monitoring, Penalties and fines, Impact and risk assessment)

Within the Water Strategy Man Project, a strategy is intended as the employment of all the policies/options available in the case study region for mitigating water stress conditions and accomplishing the objectives of an integrated water resource management, based on principles such as economic efficiency, environmental sustainability and social equity. Equity relates actions for minimizing water shortage and for distributing costs equitably among domestic, tourist, agricultural and industrial users. Environmental protection is connected to regulation enforcement and impacts mitigation whereas economic efficiency is founded on cost recovery of direct, opportunity and environmental figures, also on a local level.

According to the definition of a strategy as above, the DSS user is supported to apply and evaluate the effects of every single strategic option by itself, but the real objective of the DSS Strategy Module is to assist in building a combination of management measures in a timeframe into a strategy.

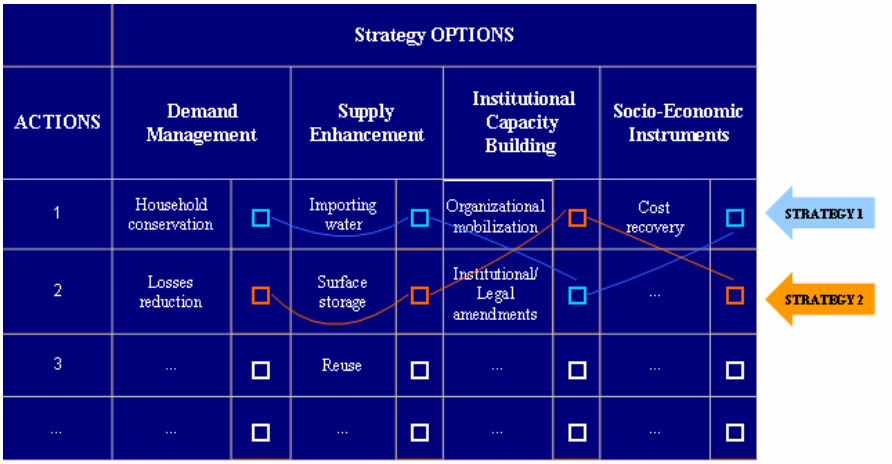

Figure 1. Combining options into strategies

The *Strategy Panel* of the WSM DSS is reachable from the *Apply Strategy* menu of every Water Management Scheme in the Manager Panel. The window is split in three sections:

a) a tree view, listing the pending or the already applied actions;

b) a form containing descriptive detailed information for each action, that is used for its definition, and

c) the Map Window with the region and the water resource network system.

At the top of the window there are four drop-down buttons, listing the types of actions that can be implemented for each policy option category included in the current version of the DSS. By selecting an option from a list, the form with all the data fields and information specific to the action is loaded and the selected action appears in the tree view under *Pending Actions*. At the bottom of each action form there is the *Apply Action* button that allows applying the selected action to the water management scheme under analysis: in this way the option moves from the list of *Pending Actions* to the *Already Applied Actions* one. It should be noted that every action can also be applied through proper modification of the attributes of the network nodes/links or through network

editing using the Modify Map and Modify Data options. However, the Apply Strategy module provides an easy-to-use interface which also allows for the successive implementation of actions and their organization in both space and time.

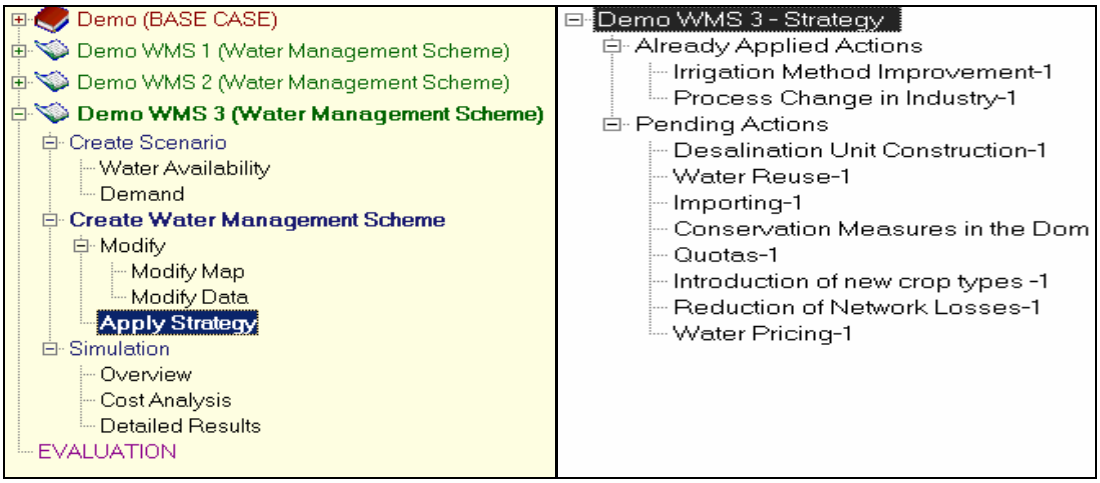

Figure 2. Running the Strategy Options Panel from the Navigation Panel (left), and the tree view of pending and applied actions (right)

The supply enhancement options currently implemented in the DSS are:

1) Desalination Unit construction,
2) Water Reuse and
3) Importing.

The *Desalination Unit Construction* form permits the construction of a new plant (desalting sea or brackish water) to provide some settlements or tourist sites with potable water. Regarding the simulation of the water system, this implies that those demand nodes will count on more available potable water from a certain time step on in the simulation period. The amount of water supplied to demand nodes depends on the capacity of the plant and the rate of distribution losses of the pipelines connecting the nodes. The time at which the new network node becomes active is set in the *Construction Year* field of the form whereas the *Operating Lifetime* field implicitly sets the year in the simulation the node stops working. The form also presents Unit and Process type of the desalination plant, cost figures relating construction, operation and maintenance costs and energy consumption. Part of the form lists the settlements and tourist sites of the network that can be connected to the new treatment plant. The connection is conceptually established by ticking in the dedicated field and a supply priority of the link can be assigned as well. The desalination unit is finally sited on the region according to a user-selected distance from the source of sea or brackish water and the distance from the settlements.

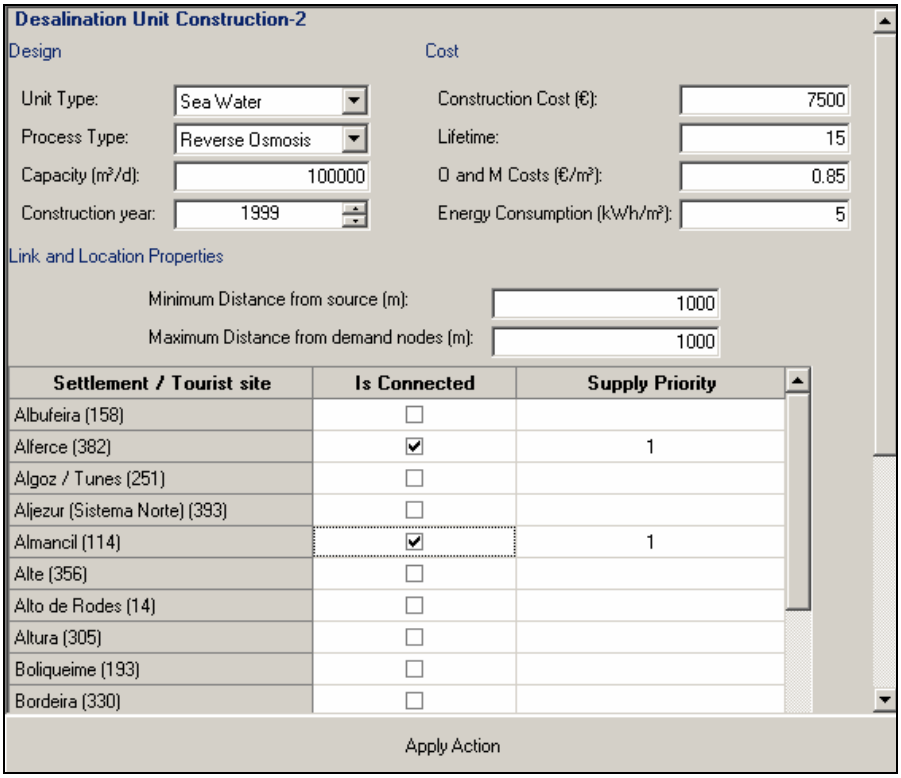

Figure 3. Supply Enhancement – Desalination Policy Form

The *Water Reuse* measure of the Supply Enhancement category permits to connect existing waste water treatment plants to irrigation sites, in order to reuse urban return flows for agricultural purposes. Similarly to the desalination form, it presents economic and process type details about the plants, and a field setting the implementation year for the implementation of the action. The DSS user has to go through the list of irrigation sites of the network and choose the ones to be provided with treated wastewater effluents. Once a site has been ticked properly, the supplying treatment plant is to be selected from the drop-down box at the top of the form and a supply priority has to be defined. While selecting the plants, the corresponding removal rates for all quality variables are displayed in the specific table. These data are those edited in the Data Editor and can be modified there.

The *Importing* action concerns the activation of a new node that symbolizes the importing of water from outside the regional area for meeting high water requirements either in settlements, animal breeding sites, irrigated districts or industries. The operation period of time of the new importing transfers are determined by the information in the *Implementation Year* and *Infrastructure Lifetime* fields of the form. A maximum amount of water to be distributed each month among the selected demands can be defined in the *Maximum Quantity* entry. The resulting import node is situated on the map according to restrictions concerning the maximum distance from the boundary of the region and the distance from the demand nodes to be served. The form also allows for the assignment of water transfer costs (per cubic meter of water actually imported in the region).

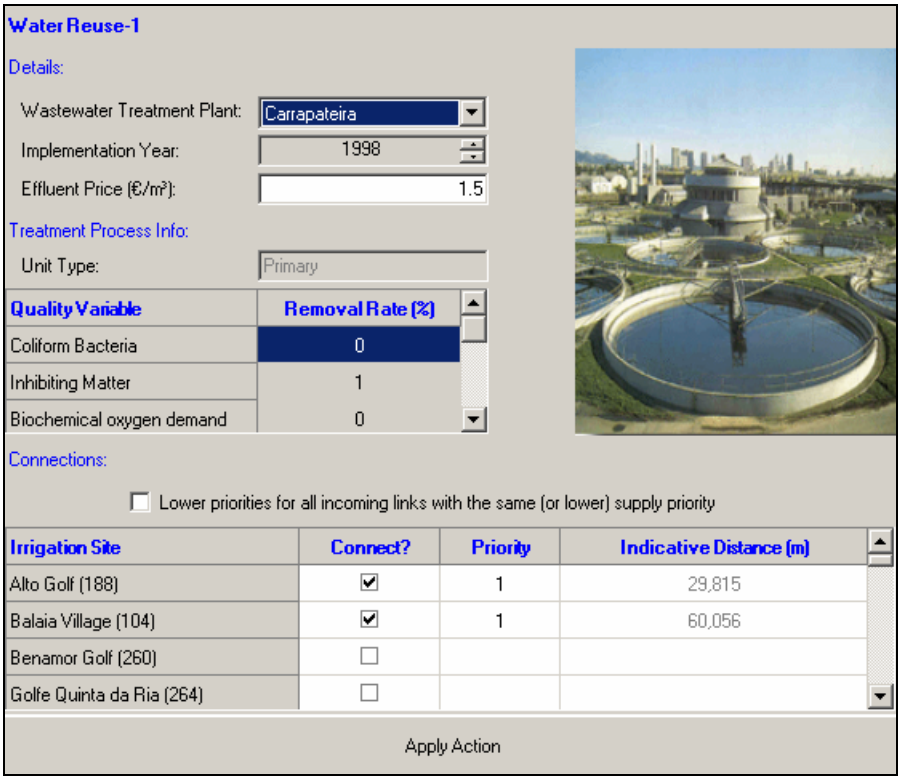

Figure 4. Supply Enhancement – Water Reuse Policy Form

The demand management options currently implemented in the DSS are:

1) Conservation measures in domestic sector;
2) Limitation to water use in terms of quotas;
3) Irrigation method improvements;
4) Process change in industry;
5) Introduction of new crop types, and
6) Reduction of network losses.

Conservation measures address a reduction of the daily per capita consumption in settlements to be applied from the implementation year of the option up to the end of the simulation horizon. The consumption rates to be reduced are those entered by the DSS user in the *Data Editor* for each settlement node in the water network. The decrease is a percentage of the rate and can affect either residential or tourist consumptions. A cost per cubic metre of water conserved helps defining the economic sustainability of this action.

Another action aiming to decrease the water demands from a certain time step in the simulation is that of establishing *Quotas* of water use. Limitations to water volume allocated can be defined in terms of intensity and period of time the option will be applied to. From the quantity point of view, quotas are represented by a maximum volume per month allocated or by a rule that limits the volume supplied to a percentage

of the previous year demand. Quotas can be activated: a) always throughout the year, b) only during summer months or 3) only in August.

In order to modify the demand pattern of irrigation sites, the option improving the current irrigation methods can be implemented. The window relevant to this type of action displays the list of irrigated districts in the case study region, each one with the percentages of irrigation methods used originally in management scheme. New methods and corresponding irrigation efficiencies can be set, starting from the *Year of Implementation* of the action.

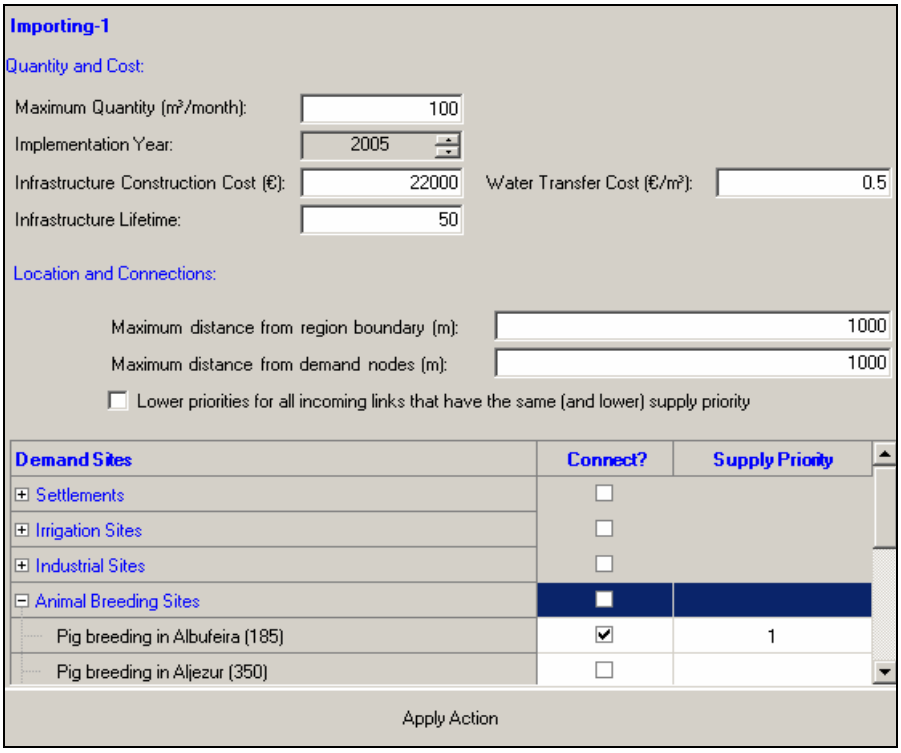

Figure 5. Supply Enhancement – Importing Policy Form

Another action that addresses the agricultural use of water concerns in particular the cropping pattern. The action name is *Introduction of New Crop Types* and allows for the partial or complete replacement of a crop with another on the basis of the cropping factor and market value: arrangements have to be accepted between cultivating crops that require less water and those which have a higher market value.

Demand management actions can also affect the industrial use of water: the DSS user is enabled to modify the consumption rates per production unit and the ratio of consumptive demand over the total, in the window of the *Process Change in Industry* action. The procedure to build the action is similar to the one of *Conservation Measures*: the industrial site nodes, which are the target of the demand reduction measure, are selected from a list and new values are set. Then, by pressing the *Apply Action* button, the action is implemented.

The last strategic option for demand management that is here described aims at reducing the distribution losses in the urban network of aqueducts. It works either on settlement

nodes, by considering a replacement or maintenance of their internal distribution networks, or on the pipelines and canals that connect the resource nodes to the demand nodes. In both cases, the list of settlements or pipelines can be filtered, according to a targeted loss coefficient: by entering the target value in the relevant field of the action window, the number of network elements displayed is updated to those having a loss value greater or equal to the targeted one. Then the new losses rate can be assigned to all the resulting elements or just some of them. Selection is made by ticking the node or link, as it is for all the options in general. A replacement cost can also be specified.

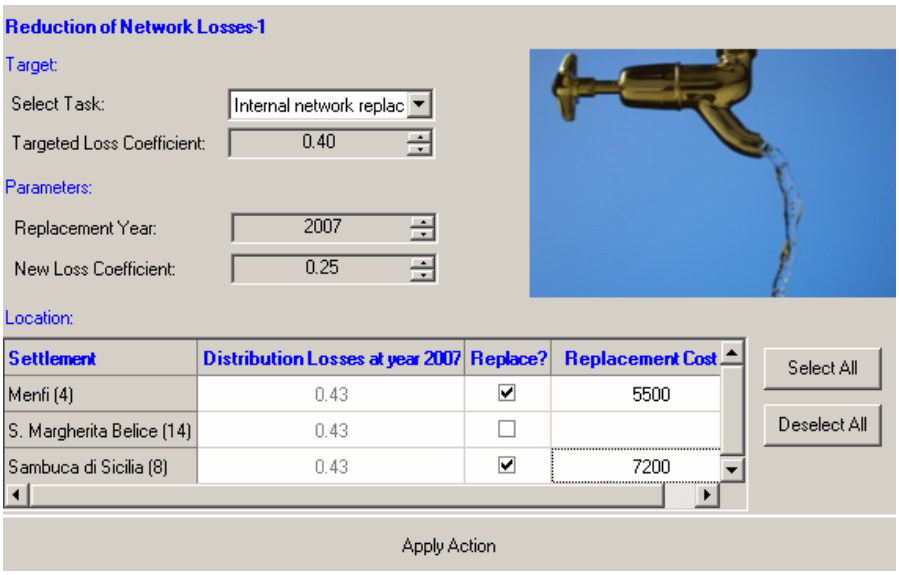

Figure 6. Demand Management – Reduction of Losses Form

From the side of the *Institutional Policy Options* category, the WSM Decision Support System currently includes a *Water Pricing* measure, which affects and influences the water demand of whatever use by setting information about demand elasticity and applying a new pricing scheme. Demand or price elasticity can be defined as the proportionate change in demand, when a change in price occurs, and it is given by the change in demand divided by the change in price. As it is for all the actions, the *Water Pricing* interface prompts the DSS user with the lists of settlements, irrigation sites, breeders and industries that exist in the case study, each one having the water selling price that has been attached in the Data Editor and that would originally be used during the simulation. By changing demand elasticity for selected demand nodes, and thus implementing the water pricing option, the DSS simulates an external institutional intervention to become active at a certain time - the *Implementation Year* - during the water allocation simulation.