Study of drought impacts on biodiversity of Lake Urmia islands and alternative solutions of water supply

Rainwater Harvesting for Wildlife on Lake Urmia's Islands

SUMMARY

This report presents the conclusions of a detailed review of the best options for rainwater harvesting to provide a reliable source of freshwater for valuable wildlife on the islands of Lake Urmia in the Islamic Republic of Iran.

Rainwater harvesting (RWH) is a modern solution for collecting, conducting and storing rainfall-induced runoff from natural and artificial impermeable surfaces. This method is particularly useful for remote areas where usual water supply systems may not be applicable.

The report was prepared by Iranian Rainwater Catchment Systems Association (IRCSA) for the Conservation of Iranian Wetlands Project. The conclusions are based on a review of international best practices, as well as field investigations at the site. The results are of specific value for addressing current biodiversity conservation challenges at Lake Urmia, as well as of general interest for applying similar approaches in other regions.

Lake Urmia is a vast (5000 km2) hypersaline lake in NW Iran. It is a National Park, UNESCO Biosphere Reserve and Ramsar Site, of great importance to biodiversity and to the more than 5 million people of the region. Over the last 15 years, the volume and surface area of the lake has decreased alarmingly, with a simultaneous increase in salinity such that the lake has lost its important ecological functions. This has occurred as a result of excessive abstraction of water from the catchment for irrigated agriculture, as well as long term climatic changes in this already semi-arid region. The situation at the lake has become a national crisis, and significant measures are being implemented to address the problem.

The Conservation of Iranian Wetlands Project was launched in 2005 with the support of UNDP, the Global Environment Facility and Iran's Department of Environment. It has focused on the introduction of ecosystem-based and participatory approaches for the conservation and management of Iran's wetland protected areas, including Lake Urmia. Since 2014, the Government of Japan has joined the effort to support the restoration of the Lake, with generous contributions via UNDP and CIWP to a number of activities, in particular sustainable agriculture. One sub-

element of this support was directed to finding a solution to the provisioning of freshwater to sustain valuable wildlife on the islands of the lake. In particular, two species of threatened mammals, Dama mesopotamica (Persian Fallow Deer) and Ovis orientalis gmelini (Armenian Wild Sheep) have been introduced to the southern islands of the lake.

Until the severe drying of the lake occurred, the islands provided reliable water and food availability for these valuable mammals and other biodiversity. However, the mammals now disperse from the islands over the bed of the lake in their search for water and food. Occasional counter-measures have been undertaken by local authorities including water transport by ship and helicopter, but these are not sustainable in the long-term. Apart from water scarcity, animal forage has also been affected by the recent drought. Therefore, any solution proposed for providing animal drinking water, should consider the sustainability of food supplies and planting practices at the same time.

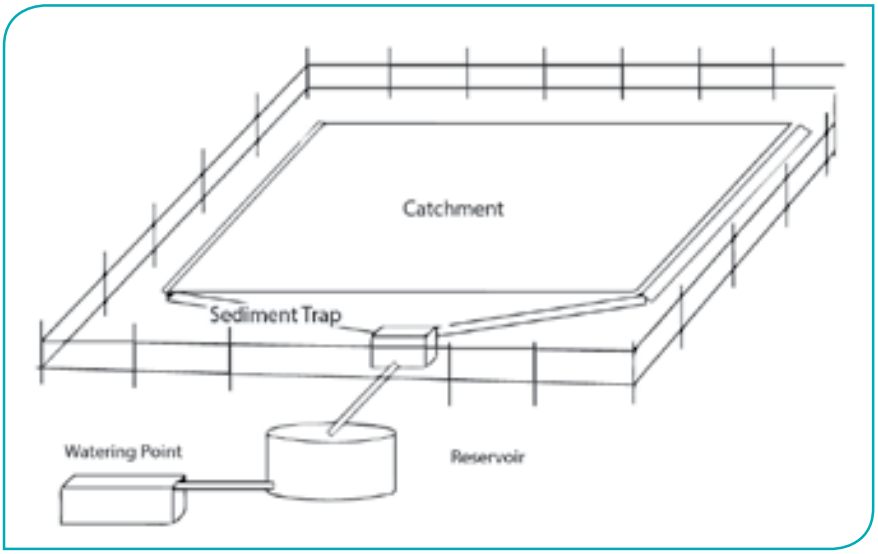
The report contains five chapters:

- **Chapter 1** presents a general reconnaissance study of Lake Urmia, including meteorology, physiography, geology, water resources and bio-diversity. An assessment of the critical facilities for water supply, available within an accessible distance to Lake Urmia's islands is made. These include access to water, electricity and transportation as well as possible shortcomings with regards to what might be required for proposed construction activities. Based on past experiences, an estimation has been made of the wildlife water requirements.
- **Chapter 2** presents common practices for rainwater harvesting in dry-land regions which have been documented by relevant international organizations such as FAO and ICARDA. A review of domestic and local activities with regards to wildlife watering experiences has also been included. A brief introduction is also presented about the most common definitions and categorization of different rainwater harvesting methods and applications.
- **Chapter 3** reports the results of a very comprehensive field survey of Lake Urmia's islands which was undertaken, after all maps and previous studies had been accurately reviewed. Existing water supply potentials, such as stream networks and land cover as well as groundwater aquifer, were considered during many site visits. Detailed specifications such as rock type, topography, catchment's dimension and land cover were evaluated according to prescribed weighting criteria.
- **Chapter 4** introduces the most feasible solutions for supplying water for wildlife on Lake Urmia's islands. The proposed methods are rainwater harvesting from artificial and rock surface catchments as well as construction of underground dams. This selection has been made based on present land surface and stream networks. The most reliable locations with regards to rainfall-runoff characteristics were selected for an immediate construction program. Based upon site selection and project type reported earlier, cost estimates for each individual solution were prepared and presented. Typical drawings for site layout and ancillary structures are presented at the end of the chapter.
- **Chapter 5** presents a special manual that has been developed for rainwater harvesting methods to provide water for wildlife on Lake Urmia's islands. The manual could be applicable

for any similar locations within and outside the Urmia region provided they have the same climatological characteristics. The manual starts with rainwater harvesting categorization and applications. The prerequisite studies are explained and some of the most reliable and state of the art solutions are introduced. Design methods and construction details for rainwater harvesting systems along with operation and maintenance instructions are also presented.

Rainwater harvesting systems are composed of a catchment, conveying devices and storage facilities. The catchment should be almost impermeable and large enough to provide the required amount of water during individual or several consequent rainfall events. Catchment surface may be naturally impervious or can be artificially isolated for maximum runoff production using different material types such as cement, bitumen or PVC membranes. The latter is the most common material used for waterproofing the natural slopes where the ground surface is not impermeable enough. Provided that it is properly installed, 80% runoff coefficient with minimum of 20 years lifetime has been reported from previous cases. Runoff generated by impervious catchments can be conveyed into a downstream reservoir using a pipeline or low height ditches. Reservoir capacity should be tailored with respect to the long-term average monthly rainfall frequency analysis. Another important criterion for selecting reservoir capacity is that the water storage should serve throughout the dry season lasting for more than 5 to 6 months with no rain at all. One can use a prefabricated reservoir or it can be constructed in situ. In cases where water is harvested for plant production, runoff produced from catchment may be conducted directly into the plant root zone. A simple connection between the reservoir and watering point will be established via a pipeline and a floating valve.

Some sort of filtration is required to avoid any debris or birds waste entering into the reservoir. Water quality can be further guaranteed by regular cleaning and fencing the catchment area. Water circulation and aeration can be achieved by proper installation of intake, outlet and ventilation openings.



A schematic layout of Rainwater catchment System for wildlife watering

A pre-feasibility study shows that in three out of four important Urmia islands (i.e. Espir, Kaboodan and Ashk) there exist long sloping rock surfaces with a good distribution which can be used as an impervious catchment for runoff collection. It is only the Arezoo Island that has more gentle topography and is covered with a weathered surface layer so that an artificial impervious catchment may be needed. In order to avoid any habitat damage resulting from prolonged use of forage, the rainwater catchment and watering points should be located at appropriate distances from each other.

The cost of RWH implementing systems includes catchment isolation, cistern, fencing, accessories and installation cost. Construction cost of a 15 m3 capacity RWH system can be estimated as follows:

factor	Unit	Unit Cost (US$)	Total Cost (US$)
PVC membrane	150 (m2)	10	1500
Precast Cistern	15 (m3)	4500	4500
Accesories	10٪	600	600
fencing	50 (m)	15	750
Instalation		1000	1000
Total			8350