ГЕОГРАФИЯ

INTEGRATED WATER RESOURCES MANAGEMENT FOR SEVEN SELECTED WETLANDS IN URMIA LAKE BASIN

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ABSTRACT. The report presents baseline environmental, economic and social information for seven selected wetlands in two sub-basins of the Urmia Lake Basin. It assesses their condition and management requirements (particularly hydrology and ecology), and then makes recommendations for their more sustainable management. All of the wetlands have been affected to some degree by changes to their hydrology and all are suffering from high levels of nutrient pollution (eutrophication), particularly from fertiliser residues in the irrigation drainage waters. They are also threatened to a lesser extent by other activities such as overgrazing, introduction of non-native fish species and disturbance.

The study concludes that the traditional approach to wetland management in Iran is failing to safeguard these important wetlands, in the face of rapid development pressures. A new, more integrated approach is needed, in which the responsibilities for wetland management are shared between all stakeholders. The values and needs of downstream ecosystems should be taken into account when planning and implementing developments such as dams and irrigation schemes, and local communities should be involved in management planning in a participatory way. Such an approach will lead to more sustainable use of wetland resources delivering social, economic and environmental benefits for the present and future generations.

Abbreviations

DOE – Department of Environment of IRAN
IUCN – World Conservation Union
IWRM – Integrated Water Resources Management
LR – Lower Risk
MECO – Mahabad Environmental Conservation Office
MOE – Ministry of Energy of IRAN
MOJA – Ministry of Jihad Agriculture of IRAN
MPO – Management & Planning Organization
MR – Montreux Record
NGO – Non Governmental Organizations
WAECO – West Azerbaijan Environmental Conservation Office
WAWA – West Azerbaijan province Water Authority

INTRODUCTION

The Urmia Lake Basin in NW of Iran (fig.1) contains a number of wetlands of significant environmental, economic and social value. They include the vast hyper-saline Urmia Lake and almost 30 “satellite” fresh-brackish water wetlands, which are particularly concentrated along the flat, southern shores of the Lake(blue points as critical sites in fig.2). Six of these wetlands (including Urmia Lake) have been designated as Ramsar sites (wetlands of international importance) (Bagherzadeh, 2007).

During recent decades, most of the “satellite” wetlands and Urmia Lake itself have been greatly affected by human activities (particularly agricultural and water resource developments related to irrigation) (Lotfi, 2005). These problems were exacerbated by the severe drought that occurred between 1999-2002 and 2006-2008. As

a result, many of the economic, social and environmental values of the Lake and satellite wetlands became degraded or threatened, leading to conflicts between the environmental, water and agricultural sectors, and concern at local community, provincial, national and international levels (Lotfi, 2005). The integrated management is necessary for deduction the degradation trend of wetland. The seven selected wetlands are:

• Mahabad Sub-Basin: Lake Kobi (Goppy Baba Ali), Kaniborazan (pink colored and code 08 sub-basin in south west of Urmia lake in fig.3).

• Gadar Sub-Basin: Shor Gol (Hassanlu reservoir), Yadergarlou, Dorgeh Sangi, Soldouz, Gherdeh Gheet. (pink colored and code 08 sub-basin in south of Urmia lake in fig.3).

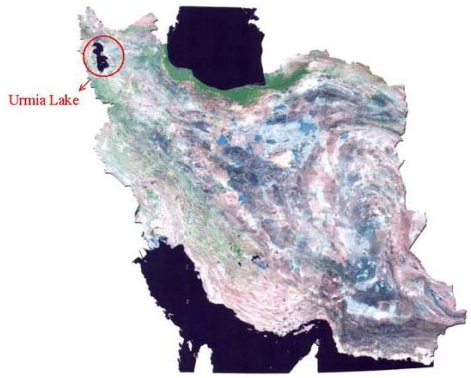

Fig. 1. Urmia lake in NW of IRAN

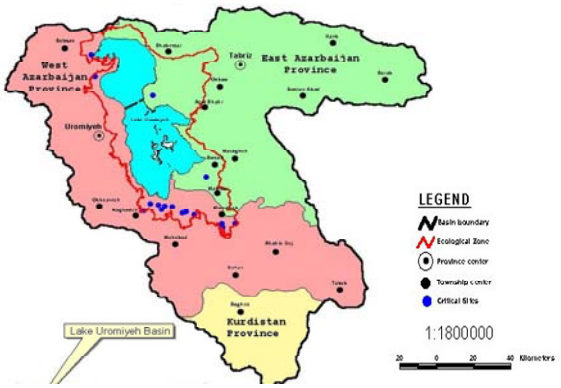

Fig. 2. Urmia lake Basin

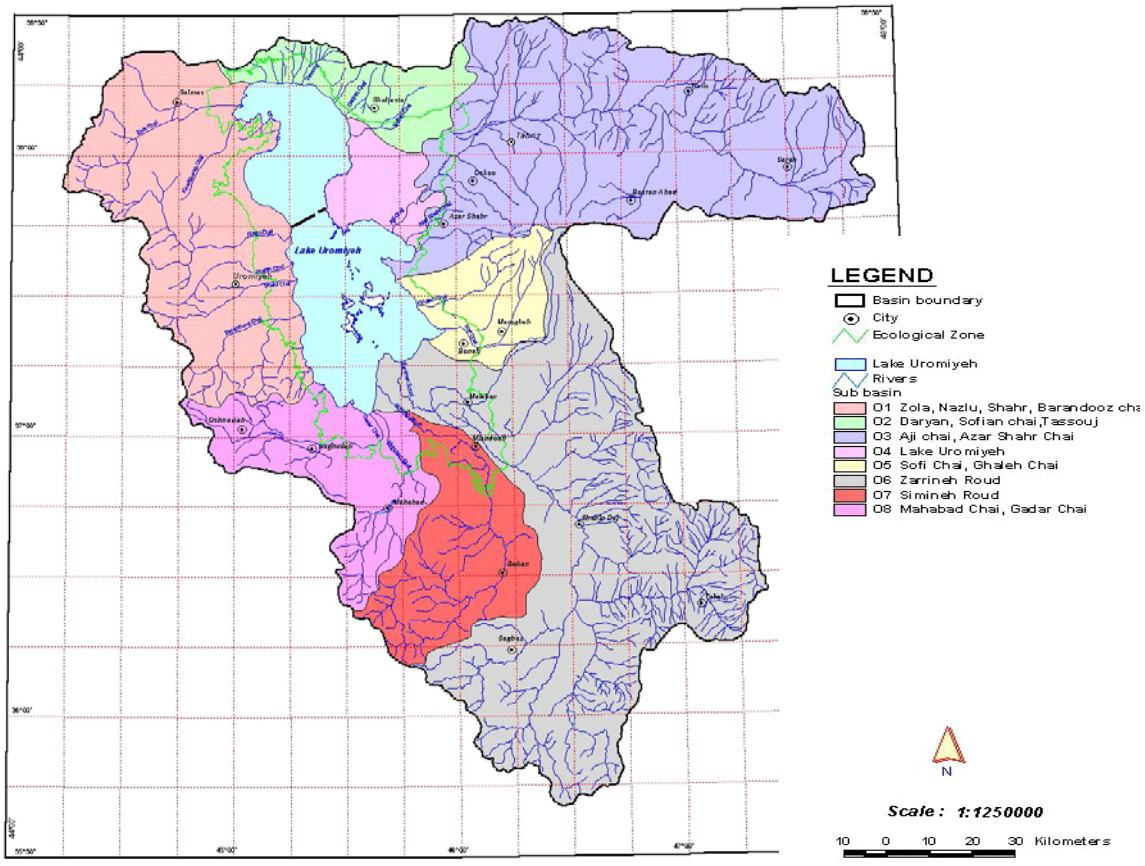

Fig. 3. Basin and sub-basins of Urmia lake

Kobi Lake, Shor Gol, Yadergarlou and Dorgeh Sangi were all designated as Ramsar sites (wetlands of international importance) in 1975 (Bagherzadeh, 2007). Three of these wetlands (Shor Gol, Yadergarlou and Dorgeh Sangi) and Urmia Lake itself have been listed in Montreux Record (http://www.ramsar.org). Whilst Gerdeh Gheet and Hassanlou were and still are "hunting protected areas", none of the other wetlands is included in Iran's network of protected areas. All of the selected wetlands share the same general characteristics of being located at the downstream end of their river system, close to or at the point where the river enters Urmia Lake. They are therefore typical of many wetlands in both East and West Azerbaijan, particularly at the southern end of Urmia Lake.

ACTIVITIES AND METHODS

Background information on the natural, human and institutional environments of the Urmia Lake Basin was collected during the Irrigation Improvement Project (Moser, 2002). This information provided a valuable context for the present study, although no detailed material was available for the selected pilot sites. The fig.4 shows the position of the pilot wetland. Relatively little was previously documented about the status of the pilot wetlands, although some historical information was available from previous studies in Iran, international sources, aerial and satellite photographs etc. This existing information was collected and reviewed for its potential contribution to the project. New field data was collected for the seven pilot site wetlands during a full annual cycle, starting in the fourth quarter of 2003 and ending in May 2006.

The parameters studied and the methodologies are described as follow: Location Maps and Geographical Studies; Climatology; Geology; Geomorphology and Physiography; Soils, Land Use and Land Cover; Hydrology, Hydrogeology and Hydrodynamic (River hydrology, Wetland water level fluctuation, Hydrogeology, Wetlands, hydrodynamics, Water quality); Limnology; Plankton sampling and identification; Benthos sampling and identification.

DATA ANALYSIS

Historical data were summarized to provide an overview of the condition of the wetlands in the mid-1970s, when the earliest surveys were done and the Ramsar site designations were made. This was compared with the current status of each wetland. In particular, satellite images and aerial photographs were used to determine the extent and land-cover characteristics of each wetland and its surrounding basin. Specific analyses were undertaken to determine:

- The boundary of each wetland and its catchment, compared to any legal boundaries
- The hydrological characteristics and requirements of each wetland
- The ecological characteristics and requirements of each wetland
- The social, economic and environmental values of each wetland
- The threats to each wetland

These analyses were then used to formulate priority management recommendations, for incorporation into future management plans.

Status of the wetlands and changes since the 1970s: Considerable changes have occurred in some of the wetlands. Some of the changes were severely destructive (from an ecological point of view), while others only slightly impacted the wetlands. Table 1 briefly describes the changes, losses and gains. Future planned irrigation developments in the Naghadeh Plain may impose further changes to the wetlands, particularly to Dorgeh Sangi. These could be prevented once good coordination is established between the relevant organizations.

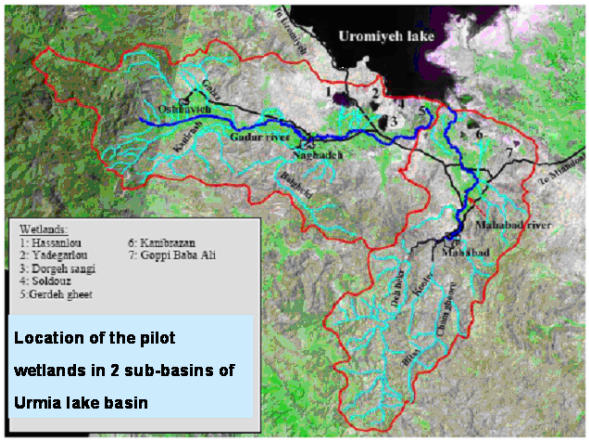

Fig. 4. Location of the pilot wetlands

Table 1

Recent ecological change in the pilot wetlands

Wetland name	Area (ha.)		Wetland characteristics			Ramsar site	Protected area
	Water body	vegetation surrounds	Hydrology	Salinity	Type		
ShorGol (former)*	1,120	1,400	Seasonal	Brackish	Palustrine	*	*
Dorgeh Sangi	490	735	Semi-permanent	Brackish-saline	Palustrine	*	
Yadergarlou**	230	-	Formerly Seasonal	Formerly Brackish-saline	Formerly Palustrine	*	
Soldouz***	200	-	Permanent	Fresh-brackish	Man-made		
Gherdeh Gheet	-	675	Seasonal	-	Formerly Palustrine		*
Lake Kobi	500	1290	Semi-permanent	Brackish-saline	Palustrine	*	
Kanibrazan	690		Semi-permanent	Brackish	Palustrine		

Table1 (continue)

w. name	Changes	Losses	Gains
ShorGol (former)*	From a shallow seasonal fresh-brackish wetland to deep permanent fresh reservoir	- High value wetland for biodiversity - Grazing and fodder - Natural fishery	- Water for irrigation development - Fishery (stocked)
Dorgeh Sangi	- Loss of grazing marsh to agriculture - Less water inflow into the wetland because of more control on the river system - Eutrophication damaging biodiversity	- Parts of grazing marsh - Some biodiversity losses	Agricultural production
Yadergar-lou**	Completely desiccated, with potential for restoration	- High value wetland for biodiversity - Microclimate moderation - Grazing and fodder, reeds	
Soldouz***	A new man-made wetland since 2000	Salt marshes of the LakeUrmia shorelands	-Valuable habitat for waterbirds - Microclimate moderation
Gherdeh Gheet	From a reed bed vegetated wetland to a *Tamarix* woodland Water does not spill onto the wetland mainly because of low water level in the LakeUrmia	High value habitat for waterbirds	
Lake Kobi	Very little change in area / grazing marshlands. More water is supplying from a drainage chanal		
Kanibrazan	From a seasonal fresh-brackish wetland to a semi-permanent brackish-eutrophic wetland. More water is supplying from drainage canals		High value habitat for waterbirds

* in 1999, and following construction of the Hassanlu dam, Shur Gol wetland was converted to a deep, permanent freshwater storage reservoir (Hassanlu reservoir).

** in 1997/8, following completion of the Hassanlu drain, Yadergarlou became completely dry due to seepage into the drainage canal, and has not subsequently reflooded.

*** in 1999, following completion of the Hassanlu drain and construction of a water retaining dyke by the DOE, Soldouz wetland was formed at the outlet of the drain.

The following satellite image (fig 5) shows visible changes to most of the wetlands. As could be seen, Shurgol (1100 ha Ramsar Site) has completely converted into the Hassanlu reservoir for irrigation development, and Yadegarlou (250 ha Ramsar Site) has been desiccated as a result of construction of the Hassanlou drain. Conversely, at the outlet of the same Hassanlou drain, the interesting Soldouz wetland (about 200 ha) has been created, which is playing increasing role in hosting diverse waterbirds that visit the area.

Dorgeh Sangi Wetland (490 ha Ramsar Site) has not significantly changed except for conversion of some 50 hectares of grazing marshes that are now used for cultivation. However, the future developments as presently planned may convert almost the entire grazing marsh west of this wetland.

Gerdeh gheet Wetland has experienced significant changes mainly because of fall of water level in the Lake Urmia. Higher water levels in the lake caused the Gadar river flows to backup and spill over the embankments just before discharging into the Lake, thus supporting a very interesting reed bed of Gerdeh Gheet, which is now completely changed to *Tamarix* woodland. This wetland was and still is one of the hunting protected zones of the area.

Kanibrazan (690 ha) was a seasonal wetland receiving water from a local spring. Presently it is fed by the drainage canal from Mahabad Irrigation System, which provides permanent flow to the wetland. It is now one of the most interesting and functioning satellite wetlands of the Lake.

Goppy Wetland (Lake Kobi) (500 ha seasonal wetland, Ramsar Site) has not faced significant changes except with the source of water supply. Again, a drain from the Mahabad Irrigation System is providing nearly permanent flow to the wetland. An interesting reed bed and grazing marsh is developing at the outlet of the supply canal with good potential for further expansion.

Hydrological status and water resources

Hydrology and sources of water supply to the wetlands are probably the most crucial issue to be considered in their management plans. While in the past most of the wetlands were mainly supplied by fresh water resources directly from the rivers (flood flows), as well as springs or surface runoffs from precipitation, presently these sources supply only a minor part of the water which flows into the wetlands. Drainage and irrigation return flows have instead become the main sources of water supply to the wetlands. Thus both quantity and quality of the water inflowing into the wetlands are affected by human activities, particularly irrigation developments. Table 2 compares the status of the sources of water supply to the wetlands in the past and in the present.

During the present study, based on the information on hydrology and hydrodynamics of the wetlands, climatology of the area, and direct observation of the canal systems that take/convey water from the river to the wetlands, a few typical characteristics of the water supply to the wetlands are presented in Table 2. Wherever possible a tentative water balance has been prepared for each individual wetland and presented in their relevant reports.

In the Table 3, the volume of water indicates both actual current water supply to the wetland as well as that required to compensate the wetland water losses (mainly evaporation and /or deep percolation). Thus, if the later volume of water were provided, then the wetlands would remain permanently full of water.

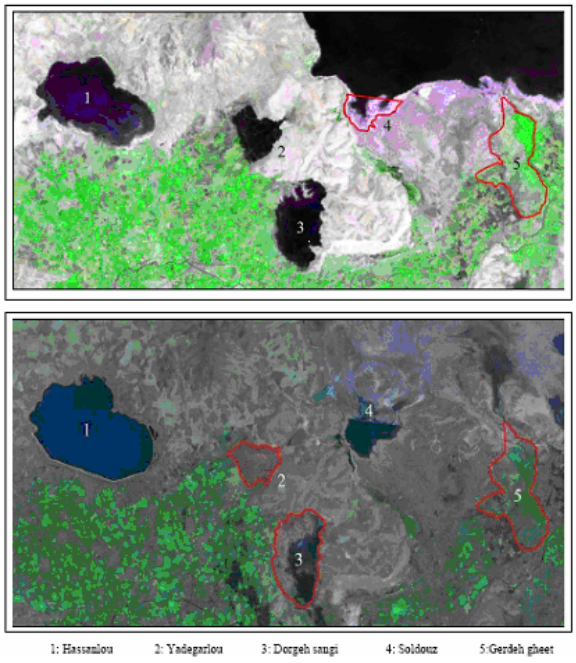

Fig. 5. Changes in pilot wetland of the Gadar chai sub basin above: 1984, below:2002

Table 2

Source of water supply do the wetland

Sub-basins	Wetlands	Past		Present	
		Primary	**Secondary**	**Primary**	**Secondary**
Mahabad chai	Goppy Baba Ali	Surface runoffs from the surrounding areas, ground water seepages	flows from the Mahabad chai and Simineh roud	Drainage flows from Mahabad irrigation system	Surface runoffs,
	Kanibrazan	Spring flows from Ghara dagh	Surface runoffs	Drainage flows from Mahabad irrigation system	Surface runoffs
Gadar chai	Gerdeh gheet	Spills from the river	Irrigation return flows+ surface runoffs	No spill(1)	Irrigation return flows + surface runoffs
	Soldouz	2	-	Drainage flows from Hassanlou drain	-
	Dorgeh sangi	River flows through traditional canals + springs	Surface runoffs + irrigation return flows	River flows through traditional canals + springs	Surface runoffs + irrigation return flows
	Yadegarlou	River flows through traditional canals + springs	Surface runoffs + irrigation return flows	3	-
	Hassanlou	River flows through traditional canals+ surface runoffs from surrounding areas	Irrigation return flows	4	-

1 – The fall of water level in the Urmia Lake is the main reason for the present condition.
2 – This is a new man-made wetland.
3 – There is still potential for restoring water supply.
4 – The wetland is converted into a reservoir.

Table 3

Rough estimates of characteristics of the water supply to different wetlands

Sub-basins	Wetlands	Volume of water supply (MCM/yr)		Max. discharge capacity of supply canal(s) (cms)
		Actual (1)	Required (2)	
Mahabad chai	Goppy Baba Ali	4-6	5 (3)	0.5
	Kanibrazan	7-10 (4)	6	>2
Gadar chai	Gerdeh gheet	-	3-5	?
	Soldouz	10-12 (5)	3	>2
	Dorgeh sangi	4-5	4	1
	Yadegarlou	-	2 (6)	0.7
	Hassanlou	-	8-10 (7)	>1

(1) – The amount of water which currently flows into the wetlands
(2) – The amount of water which is required to compensate water losses from the wetland
(3) – This volume compensates evapo-transpiration as well as deep percolation
(4) – There is an outlet culvert at the eastern end of the wetland.
(5) – There is a spillway on the embankment weir.
(6) – This estimate does not include the seepage outflow to the Hassanlou drain which is roughly about 5 mcm/yr
(7)- This estimate refers to the previous Shurgol (Hassanlou) wetland. It does not exist anymore

The dynamic nature of the wetlands implies that the area and volume of the water body changes according to the season. This provides rather wide range of conditions and tolerances to the wetlands which is the secret for their survival during the course of centuries.

As could be observed, the amount of water which is required for sustainable management of the wetlands (about 10-15 mcm/**y** for Mahabad sub-basin and similar amount for the Gadar Sub-basin) are negligible when compared to the volume of water which is produced and consumed in the sub-basins. Therefore it is easily concluded that any of the sub-basins have the capacities to easily provide adequate water to the wetlands without impairing agricultural developments (note that this conclusion does not apply to the water requirements of Urmia Lake). Drainage outflows from irrigation systems in partial combination with fresh water should be considered as sustainable sources of water supply to the wetlands. However, because of the high nutrient content of drainage waters, the quality of water in the wetlands needs to be carefully monitored and managed, so that if safe levels of nutrients are exceeded, more fresh water is allowed into wetland.

Conversion of wetland habitats

The location of most of the pilot wetlands in the downstream often saline lands adjacent to Lake Urmia has limited the extent of conversion of their habitats for other activities. One exception is Shur Gol wetland (a Ramsar site) which, in 1999 as a result of the construction of the Hassanlu dam, was converted from a shallow, seasonal brackish wetland into a deep permanent freshwater reservoir. This destroyed the natural ecological character of this valuable wetland.

A further major indirect conversion of wetland habitat has occurred at Yadergarlou wetland (also a Ramsar site), because of the digging of the deep Hassanlu drainage canal along its northern fringe in 1997/8(red line in fig 6).

Unintentionally, this has led to the complete desiccation of the wetland, through seepage into the drainage canal. A new proposal to dig a deep irrigation drainage canal to the west of the Dorgeh sangi wetland now threatens this Ramsar site with desiccation similar to that, which occurred at Yadergarlou. This drain should be relocated to avoid possible impact on the wetland.

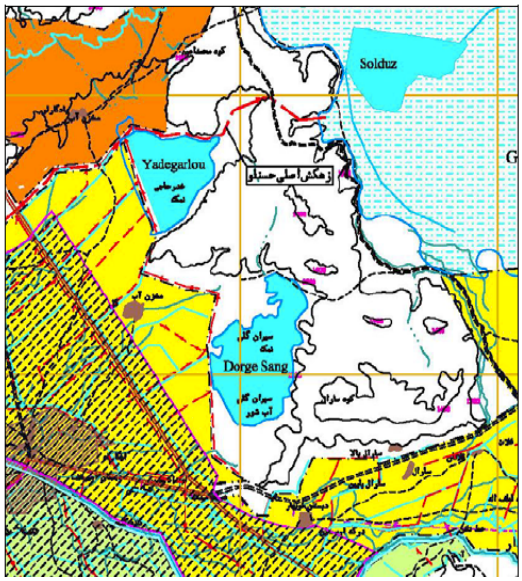

Fig. 6. Irrigation plan very close the wetland Dorgeh Sangi

Agricultural encroachment into the wetlands has occurred only on a limited scale, the main losses of wetland habitats occurring in the grazing marshes to the west of Dorgeh Sangi, where approximately 35 ha of wetland habitats have been lost. Further encroachment should be forbidden.

Other direct conversions of wetland habitat have been minimal, with the roads through the centre of Yadergarlou and Kanibrazan wetlands being the main examples.

In the context of the losses of wetland habitat that have occurred, the creation of the Soldouz wetland by the Department of the Environment should be noted. In addition, attempts are being made by the DOE and local NGOs to restore a small part of the Shur Gol wetland.

Hydrological changes:

Construction of water storage dams and irrigation networks upstream of the pilot site wetlands, as well as increased water abstraction for irrigated agriculture developments, have dramatically changed the hydrological regime of the inflows into almost all of the pilot wetlands. The main hydrological impacts are:

- ***Changes to water quantity:***

an overall reduction in the quantity of water entering the wetlands, which is likely to intensify as further irrigation networks are established. However, this trend is masked by drainage canals (eg. Hassanlou) and increased return flows from irrigation networks which, in some cases are delivering

more water to the wetlands (eg. Soldouz). In addition, some works have been conducted by local authorities (eg. Lake Kobi) and NGOs (eg. Dorgeh Sangi) to increase the flows to the wetlands by water diversions / cleaning of traditional canals.

- ***Changes to the timing of inflows:***

the increasing predominance of irrigation return flows as the water supply to the wetlands, is changing the seasonality of inflows to the wetlands, and thus affecting their ecological character. In particular, the natural peak flows associated with spring snowmelt are being replaced by increased irrigation return flows in summer. In addition, the water storage capacity of upstream reservoirs is reducing the natural variability of flows to the wetlands.

As noted in the previous section the construction of the Hassanlu dam and drainage canal have had large environmental impacts on the wetlands of the Gadar-chai catchment. Some of these impacts could have been avoided with more integrated planning, and this illustrates the importance of following comprehensive Environmental Impact Assessment for projects of this type.

- ***Changes to water quality:***

Water quality in the study area is, and will increasingly be, affected by agriculture. The main impacts are from saline return flows from irrigation developments and the use of fertilizers and pesticides. Other sources of aquatic pollution come from domestic sources (local villages and upstream towns) and livestock. It was not possible to conduct a comprehensive analysis of the sources and relative contribution of pollutants from these various sources, and this is a priority future study. Analyses of water quality in each wetland however, showed the following issues:

Eutrophication: most of the wetlands are to different degrees eutrophic, as a result of pollution by nutrients, particularly from agriculture but also from domestic sources. Closed wetlands such as Goppy Baba Ali and Dorgeh Sangi show higher eutrophic condition. In late summer, water quality in these wetlands becomes very close to polysaprobic (dystrophic) condition. In Kanibrazan and Soldouz, however because of continuous inflow-outflow, high eutrophic conditions prevail without being endangered by polysaprobic problems.

DISCUSSION AND CONCLUSIONS

This study of the seven pilot wetlands in the Gadar chai and Mahabad chai sub-basins has demonstrated a number of issues that are common to all of these wetlands. This commonality arises from the fact that all of the seven wetlands are downstream wetlands, located at the bottom end of their respective river basins. The conclusions are therefore relevant also to those other wetlands around the shores of Urmia Lake (and to the Lake itself) which have not yet been subject to such detailed study.

This section draws together some of the key observations of the study, and makes recommendations for the next steps that need to be applied in the move towards a more sustainable management.

Stakeholder Analysis:

The combined analyses of the values of, and threats to, the pilot wetlands enable identification of the various stakeholder groups that either benefit from or have impacts on the wetlands. These groups, the benefits they receive and likely impacts they cause, are summarized as table. Attempt has been made to quantify the benefits or impacts. Four conclusions emerge from the table:

• Although the Department of the Environment (DOE) is the only organization formally charged with the management of these wetlands, many other organizations and groups have an interest in their management, either because of the benefits received, or the impacts caused.

• The distribution of benefits and impacts is unequal between the stakeholders; some receive limited benefits from the wetlands (eg. water resources managers) but cause major impacts; others receive many benefits (eg. local villagers) but cause limited impacts.

• Some stakeholder groups undertake their activities well outside the wetlands, but still either benefit from or impact these areas. Examples of such groups are livestock grazers in the catchment, or the ecotourism businesses or hunters in other countries who benefit from the migratory water-birds that migrate through the Urmia Lake basin wetlands.

• In developing more appropriate management for these wetlands, it will be necessary to involve representatives of all of these stakeholders both in planning and implementation of management.

Towards Integrated Wetland Management:

The traditional approach to the management of important wetlands in Iran (and many other countries), has been to designate these wetlands as protected areas under national and

international legislation. Responsibility for the management of these protected areas has been vested in the Department of Environment, with other agencies effectively excluded from management responsibilities within the protected area. Conversely, the Department of the Environment has little responsibility for activities occurring outside the protected areas, even though these are the main source of threats to the wetlands. Strict legislation has generally excluded people from benefiting from the multiple values of these protected areas, even for potentially sustainable activities (eg. ecotourism, harvesting).

This "protectionist" approach has gone some way to minimizing direct damage (conversion) to protected wetlands, although there have been notable exceptions, such as the conversion of Shur Gol wetland into the Hassanlu reservoir. However, it has failed to address those indirect threats that arise from human activities elsewhere in the basin, in particular the paramount issues of water quantity and quality. As a consequence, several of the wetlands are suffering severe degradation in the form of changes to their hydrological regime, eutrophication, and consequent impacts on their values.

A new and more integrated approach to managing these wetlands is therefore required, which will overcome the limitations of the traditional approach. This new approach will require a shift from the sectoral "protectionist" approach (although protected areas will still be essential to avoid habitat conversions), to a more integrated "conservation and sustainable use" approach. The principles of the new approach should therefore include:

a) Protecting the wetlands to ensure that their habitats are not converted.

b) Managing wetlands in the context of their river basin: this means that those upstream activities that have an impact on the wetlands need to be taken account in their management.

c) Sharing responsibility for wetland management among all stakeholders: this means that although the Department of Environment should retain lead responsibility for wetland.

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