RESEARCH ARTICLE **(Open Access)**

The rehabilitation of irrigation system, as a tool for maintaining and improving natural equilibrium of surface and ground waters in Divjaka area

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Abstract

At the present, one of priority objectives of Albanian Government in the agricultural field is the rehabilitation of existing irrigation/draining schemes in river basins. One of the most critical schemes remains that of Divjaka system. The proximity of the Karavasta Lagoon and the intercourse of draining waters within the lagoon body urge the careful management actions to be undertaken on the site. This paper intends to offer a model for integration of actions on the rehabilitation of irrigation system in Divjaka area, in order to maintain the ecological status of surface and ground waters in this region. It aims also to contribute for the improvement of the salinity balance at Karavasta Lagoon, considering the irrigation system water as the main resource of freshwater of the lagoon.

The authors have considered all available data on lagoon and ground waters quality, collected data on the quantity of fertilizers and pesticides used in the agricultural lands, the land use of the site according Karavasta/Divjaka Management Plan, etc. Suggestions how the environmental management tools can use the irrigation and draining waters as an instrument to maintain natural status of surface waters in the site and to reduce as much as possible salinization of ground water, by its overexploitation for irrigation purposes, have been provided. Proposal and application of the proper mitigation measures, implementation of the monitoring program and improvement of the administrative interactions are considered as some of the main tools that will contribute in successful accomplishment of such objective.

Key words: irrigation system, eutrophication, salinity balance, Karavasta Lagoon.

1. Introduction

Divjaka is located on the Albanian coastal plain, about 40 km south of Durrës, close to the mouth of Shkumbini River. On its southern side, the region is bordered by the lagoon of Karavasta, covering 4 500 ha, which is the widest and most important lagoon in Albania. Environmentally, this area is significant for its large quantities of wintering birds, including many rare and globally threatened species such as the remarkable Dalmatian pelican, the pygmy cormorant, the white-headed duck, the spotted eagle and the pallid harrier. [1,5,10] The presence of the nesting site of Dalmatian pelican *"Pelecanuscrispus"* considered as endangered species in Europe, in a small island of Karavasta lagoon, is one of the reasons of its international concern.

The lagoon is shielded from the sea by a sandy littoral bar (Divjaka) covered with an ancient coniferous forest. This 1 200 ha area between the mouths of the Shkumbini and Semani Rivers forms the Divjaka National Park. The Divjaka Pine Forest was denoted in 1966 as a Strictly Protected Reserve. Due to its exceptional value, the Albanian government declared the complete Karavasta - Divjaka wetland complex as a special protected natural ecosystem (1994) and later it was declared as a Wetland of International Importance under the Ramsar Convention (1995).

Agriculture is by far the most important activity in the region and remains the most important financial source for the community living in the area [1]. The main products are potatoes, watermelons and vegetables. Fishing is a secondary activity- the Karavasta lagoon, plays a very important role, due to

the presence of fish with high economic values [5]. On the other side, because of the rich biodiversity, its visual and recreational assets, the site is considered as very important for tourism and recreation.

The intensive human activity in Divjaka region has already affected the environmental quality of thorough area and, in particular, of Karavasta lagoon ecosystem. Some research studies have concluded that although the ecological quality of Karavasta lagoon is still acceptable, the responsibility to protect and use the lagoon properly must be taken most seriously, since the lagoon seems at significant risk of serious eutrophication. [8,9]. The limited water exchange with the marine environment due to the irregular dredging of the communication channels has worsened the situation.

Other studies on physical, chemical and biological water quality characteristic have evaluated a transitory status between a mesotrophic and oligotrophic level for Karavasta Lagoon [7]. Increased temperature and salinity values measured in hot months lead to reduction of dissolved oxygen in the depth of lagoon and consequently in damaging or reducing of living organisms. The heavy metals Cr, Pb and Cu in some station are found to be close or higher than the values allowed by EU standards [6]. Issues on lagoon body quality have incited the drastic reduction of fish with high economic values, and over all, of the species which use the lagoon as nursery area [2].

Although the use of chemicals (fertilizers and pesticides) is reduced in the last 10 years [2], it still remains far from the traditional agriculture, as conditioned by Management Plan of National Park. The use of fertilizers in cultivated area represents a potential risk for groundwater pollution [11]

In regard to irrigation and/or draining schemes, Divjaka system is one of the most problematic ones in the country. Currently, the Divjaka drainage and irrigation system, with large pumps and many reservoirs in the adjacent hillsides, is poorly maintained and hardly functioning. The proximity of the Karavasta Lagoon and the intercourse of draining waters within the lagoon body urge the careful management actions to be undertaken on the site. Investments to establish an appropriate irrigation/draining system, which are very important for Divjaka community, are being considered by the Albanian Government.

In this paper, suggestions for the implementation of some effective measures with low and appropriate costs, to make fully operational and to maintain the recently designed system are presented. The authors intend also to offer a model which try to integrate the actions on the rehabilitation of irrigation system in Divjaka area, in order to maintain the ecological status of its surface and ground waters.

This study is part of the Environmental and Social Management Plan, carried out in the framework of the Project for Rehabilitation of Divjaka Irrigation and Draining Scheme.

2. Methodology

The authors have applied the classical methodology for environmental studies, based on the best international practices and experiences, keeping in mind the imperative needs for rehabilitation of irrigation/drainage (I/D) schemes and improvement of water balance and quality.

The methodology is based mostly on Environmental Management tools, according WB Guidelines, BE Operational Procedures and Albanian Legislation. Several field surveys, consultation with irrigation experts, water board representatives, protected area administration and environmental experts, farmers and fishers, have served to verify the data and provide the best outputs.

The preliminary design for rehabilitation of Divjaka irrigation/drainage (I/D) system is created in strong collaboration with a detailed environmental management plan, which considers the site characteristics, the importance of irrigation and draining system for the community, as well as the importance of conservation of the National Park assets as it is conditioned by national and international framework for natural specific sites. The management

plan is focused on impacts characterization, mitigation measures and monitoring program, for construction and implementation/maintenance phases.

3. Results and discussion

The DivjakaI/D scheme is located in Lushnje District occupying part of the Lowland Zone and with a command area of 3,000 ha. Divjaka irrigation/draining scheme site is part of the Myzeqeja field. Myzeqe plain is characterized by its very low altitude (< 20 m. a.s.l.), with a slight slope towards the west. The altitude is below sea level in some places. This makes drainage difficult during the wet season, as it is the case in the former marshes of Tërbuf and Divjaka (Lushnje). Besides the east-west slope of the plain, there is a land depression between two adjacent riverbeds (of Shkumbini in North and Semani in South).Two large drainage channels drain the agricultural plain landwards of Divjaka region, with Tërbuf in the north and Myzeqe in the south. The coastal plain contains a rich alluvial groundwater aquifer, which is used as drinking water from a large number of individual wells, as well as for irrigation purposes. The I/D Divjaka scheme is entirely within the traditional use zone of the Karavasta/Divjaka Protected Area. The location of the Divjaka I/D scheme in relation to the Karavasta/Divjaka National Park is shown in the figure 1.

Upon the original design, the I/D scheme covers an area of 2240 ha, including highly productive, agricultural land surrounding Divjaka city and the villages of Xengu, Mize and Sulzotaj.

The condition of the main and secondary canals is poor, as they have not been maintained for years and are subsequently damaged. Because of the malfunctioning of this system, the farmers on the area are using groundwater for irrigation purposes and for drinking water. Such overexploitation has created problems in water cost (energy consumption), as well as on salinization of ground waters, due to the advancement of the salted sea waters in the body of fresh ground waters.

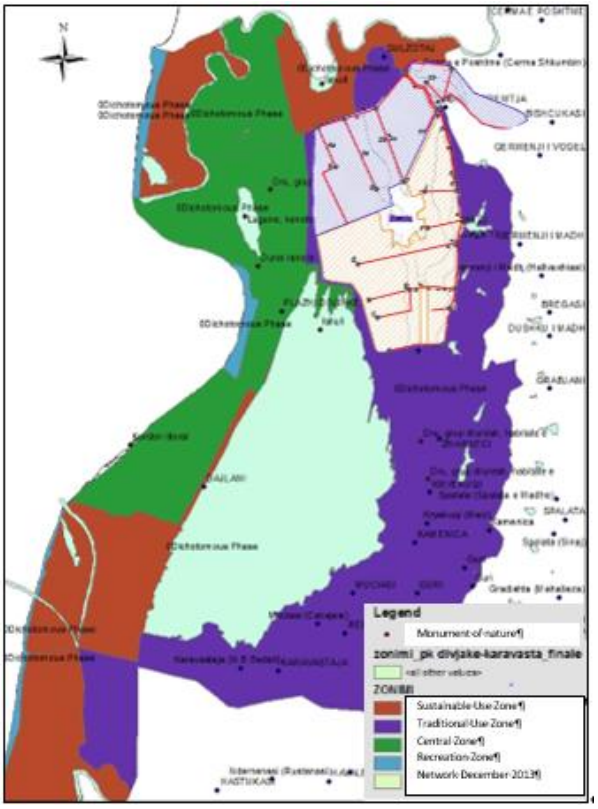

Figure1: Proximity of Divjaka I/D Scheme in relation to Karavasta Protected Area

Six of the draining channels of I/D system that discharged their waters into the lagoon body were the only source of fresh waters, contributing in the maintenance of the salinity balance in the lagoon body. Actually, the channels are partially working, causing the reduction of fresh water into the lagoon. In case of over raining, the waters are flashing the agricultural lands (top soils), and an important parts of pesticides and fertilizers are discharged from flashed soils into lagoon bodies, creating problems in lagoon water quality. During atmospheric events, in high tide period, the waters are coming back from the lagoon to the irrigation/draining net, flooding the area covered by scheme and causing salinization of waters and agricultural soil. For that reason, the I/D administrators, have constructed a mechanic anti salt barrier, which has been damaged with the time and, actually is not working. In fact, in case of overflow events, sediments block the barrier and the mechanic command door doesn't operate.

The rehabilitation of Divjaka I/D scheme is likely to improve agricultural productivity, as it will supply a convenient irrigation to existing I/D areas, even in summer months. Such an investment might have significant impacts to the natural and human environment. The enhancement of irrigation capacity will probably generate an increase in community incomes, leading to improved standard of living on all related communities. On the other side, increasing the running water capabilities by reconstruction of irrigation canals, will help to restore typical and historical wildlife habitats, which are seriously reduced in the last 20 years. An efficient and effective I/D scheme will help to restore the main habitats of the lagoon, by furnishing the lagoon with fresh water, thus maintaining the appropriate ratio between salt water coming from the sea and fresh waters discharged from 6 channels.

However, the likely intensification of agriculture may increase risks of groundwater pollution related to the increased use of pesticides and fertilizers. Furthermore, as it has been demonstrated in previous studies there is a higher risk of surface water pollution to the Karavasta Lagoon due to increase water flow, bringing higher levels of pesticides and fertiliser into the drainage channels.

In order to avoid, reduce, mitigate or compensate the adverse environmental impacts, enhancing the beneficial ones several mitigation, monitoring and institutional strengthening measures are necessary to be undertaken. We recommend some of them, which might be feasible and contribute to increase the agricultural efficiency and improve the environmental conditions.

To develop the maximum benefit from a water supply and to help the disposal of drainage water, strategies for water re-use have been evolved. Re-use is an important and natural method of managing drainage water [4]. Application at DivjakaI/D system of water re-use method, using draining channels to feed back the irrigation ones, may contribute in reducing the consumption of irrigation waters taken from reservoir, as well as in maintaining the surface waters of the system for a longer period over the groundwater basin. It is recommended that where an irrigation project is located nearby a natural wetland (as Divjaka I/D system), the drainage water can be re-used in the wetland [4].The system will work, most of the time, as a water self-circulation system, and when needed, the draining water will be discharged in the lagoon body contributing in maintaining of the salinity balance at Karavasta Lagoon, as the main resource of freshwater of the lagoon.

This measure ensures a better efficiency use of the irrigation waters within the dry season, utilizing existing capability of Divjaka irrigation reservoir and two main income channels of Tërbufi and Divjaka. Besides, such a measure is less expensive than the exploitation of ground-waters by pumping, used nowadays by more than 80% of farmers. The water circulation up to the ground water basin, can also help on furnishing the water basin with freshwater, which can then reduce the fast salinization process of the site ground waters. The risk of surface and ground water pollution by the drainage water re- use should be mitigated by a strict control of intensive pesticide and herbicide use in agricultural lands at Divjaka I/D scheme. Applying a traditional agriculture, as it is conditioned in Karavasta/Divjaka National Park land use, by the Protected Area Management Plan, may notably reduce the risk of contamination by fertilizers and pesticides flashed from irrigation waters.

The self-circulation system, can be easily adapted in the site, but will also require careful measures to avoid possible floods during atmospheric events. The implementation of an electric system of command control gates, together with repaired and well maintained salt barrier, etc, which could operate upon the data offered by flood warning system, might be one of the priority and indispensable measures. The electric system can ensure reaction in real time for gates opening/closing procedures. A group of workers (already employed in the system) and a better drain control mechanism, can ensure the efficiency of this system

Another proposed measure which can contribute on lagoon water quality protection is the use of bio-barriers at the end of drainage system. Studies refer the water resistant plants (e.g. *Canebrakes*) as artificial mechanic barriers, which allow the water but catch the sediment, impeding in this way an important amount of organic matter and other chemicals to discharge in lagoon. Similar protection can be applied in Karavasta/Divjaka lagoon, but it has to be emphasized that the periodic seasonal cleaning of such plants is very important. In cases of not cleaning, the sediments collected in such bio-filters can be barriers for water draining, causing floods in the agricultural areas.

A successful implementation of mitigation measures proposed above requires an effective monitoring system and a strong collaboration between I/D administrative authorities and Protected Area Staff, as well as Regional Environmental Agency of Lushnja and National Environmental Agency. Such a process would require several actions to be carried out, but we would put emphases at: An effective monitoring plan to be designed and implemented for monitoring of water quality in discharge points of drainage channels at Karavasta Lagoon; A detailed modelling of water circulation and oriented possibilities on water use associated with a physical modelling, to be prepared by a hydro-geological; and an agreement between PA management authority, Lushnja Municipality and I/D system administrators, with clear defined responsibilities and penalties (when the system usage can damage the lagoon waters or ground water basin), to be established and enforced.

4. Conclusions

The rehabilitation of Divjaka I/D scheme is very important, due to the spatial position related to the Karavasta Lagoon, a protected area and Ramsar site. It may have a strong contribution in agricultural productivity through provision of more reliable irrigation to existing I/D areas, but also a significant impact in safeguarding natural and human environment. The increased running water capacities in channels will create the appropriate conditions for maintaining the right salinity balance at Karavasta Lagoon. Improving the irrigation capability will cause direct positive impacts, such as increased community incomes and improved standard of living on all related communities. On the other hand negative impacts during the operational phase should be considered, as they are associated with risks to groundwater pollution and surface water pollution from the increased use of pesticides and fertilisers. The risk of deteriorating surface and groundwater quality should be mitigated by strict control of intensive pesticide and herbicide use in agricultural lands at Divjaka I/D scheme.

Application at Divjaka I/D system of water re-use method, using draining channels to feed back the irrigation ones ensures a better efficiency use of the irrigation waters. In the mean time the water circulation up to the ground water basin, can help on furnishing the water basin with freshwater, that can reduce the fast salinization process of the groundwater of the site.

The successful implementation of mitigation measures requires an effective monitoring system and a strong collaboration between I/D administrative authorities and Protected Area Staff, as well as Regional Environmental Agency of Lushnja and National Environmental Agency.

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