

## Use of ecological services as an ecological indicators to propose appropriate tourism type "Case study: Sorkhankol wetland wildlife refuge"

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### Extended Abstract

#### Introduction

The extensive presence of tourists around the wetlands not only has caused serious issues for these sensitive and vulnerable ecosystems, but the local communities and their settlements have experienced various effects of tourism in different degrees and forms. In case of uncontrolled tourism, the identity and cultural fundamentals of the local communities could face threats in addition to the destruction of the natural resources in touristic destinations; i.e. systematic instability is created in the region. After the Second World War, the economic and social consequences of the war drew attentions to tourism as a path toward economic development and meanwhile various ideas emerged from their comprehensive growth to sustainable development.

The wetlands and aquatic ecosystems of the country are counted as valuable assets regulating the underground waters of the surrounding environment, microclimate adjustment, hunting, hunting birds and fishing, supplying feeding sources for the livestock, weaving, etc. Preserving these complex ecological systems and benefiting from numerous economic, resor, and genetic resources, etc. require an accurate study and recognition of each wetland. Unfortunately, in developing countries, the policy-makers, planners on one hand, and the citizens and the villagers themselves on the other hand do not significantly value the protection of these wetland. Finding a proper type of tourism through ecosystem services of the wetland and using ecological indices for the recognition and examination of the changes of the ecosystem, which is one of the main objectives of this study, have always been a great interest by the planners in the field of environment.

The changes of an index in response to facing stressors are counted as valuable information resources for the planners in the field of environment to prepare different scenarios for the future of an ecosystem which has faced man-made disturbances. The indices are counted as prerequisites to prepare the strategies. Employing the indices reflect the pressure and states of the key factors which are used as tools in the analysis of the system. From evaluators' points of view, in the evaluation of the states and the systems procedure, humans' and environment's objectives are the indices for environmental and ecologic programs which use factors or dimensions of the phenomena associated with the environment to illustrate and evaluate the environmental conditions or for setting environmental goals.

Ecosystem services could also be construed as direct and indirect sectors of ecosystem and functional structures besides other factors in human's welfare (objective). Employing indices estimations require using them toward the specified objectives and spatial sensitivities. Each type of tourism and each touristic place has its specific priorities. The priorities in rural tourism are different than natural, urban, etc. tourism. In this study, the effort was to find the indices which determine the suitable touristic type of the region after describing the pressure, thresholds, system state and its impact on sustainable tourism while evaluating them leads to the monitoring of variations threshold, in the form of using ecosystem services as ecologic indices.

Among the available methods for the evaluation and conceptual modeling in this field, DPSIR model is counted as one of the most comprehensive models. This model was proposed by UNEP (United Nations Environment Program) and it is sued in the European environment agency assessments. DPSIR model is the acronym for five words including Driving forces, Pressures, State, Impact, Responses which state the causal relationship. Driving

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forces are the forces which lead to environmental issues. Pressures are the human activities which lead to the destructions and responses are the activities by the human community with the objective of reducing the environmental pressure and improving the quality of the environment

### Material and Methods

In this research, DPSIR model abilities are used to analyze the relationships of environmental and human systems of the wetland with a focus on ecosystem services and the functions affected by the driving forces and a focus on tourism.

Sorkhankol wildlife refuge is part of Anzali international wetland. Finding the proper type of tourism through the wetland ecosystem services and using them as ecological indices through DPSIR model is defined as the objective of this research.

In general, the following steps were performed in this research:

- Introducing different possible types of tourism in the region
- Finding the indices associated with the most important environmental issues of the region for each type of tourism based on DPSIR model
- Classifying the identified indices in categories including driving force, pressure, state, etc. according to the conceptual model
- Introducing the index associated with each component of the developed conceptual model
- Finding the relationship among different components based on DPSIR model
- Weighting the effect of driving forces according to an experts' point of view
- Analytic hierarchy process on the driving forces in a geographical data system environment
- Calculating the incompatibility coefficients for the effect components in different types of tourism
- Suggestions for reducing the negative impacts in the form of possible reactions.

### Discussion of results

In rural tourism, rural houses, rice cultivation and cow husbandry, and fish farming pools, as the main attractions of rural tourism, lead to the increased visit of tourists to the agricultural lands, development of rice farms around SusarRuga, and the consumption of agricultural inputs, particularly water and pesticides in the vicinity of the wetland, specifically Siah Darvishan. The presence of attractions such as natural and pristine landscapes, flora specific to the region (Indian lotus), terns' nests, pharmaceutical plants and handicrafts lead to pressures such as increased visit of tourists in the region of Nahang Ruga to Susar Ruga. Rural road constructions are performed by machinery in Hendkhaleh and Siah Darvishan and reed beds in Siah Darvishan are cut.

In urban tourism, traditional and historical buildings and markets, malls and shopping centers, cinemas, and hotel and in cultural and historical tourism, traditional and historical buildings and markets, festivals and performances, hotels, and accommodations are considered as the most important attraction for the tourists which have led to pressures such as the tourists visiting traditional and natural regions and change of land use of the wetland. In ecotourism, natural zonings with a focus on the protection of plants and animals species, protective measurements for the terns' nests, designing paths for boats, interest in learning from nature, the presence of piers, accommodations, infrastructures, besides the conflictions of interests with the local beneficiaries (21 unions of tourism and boating) with trustee offices of the environment and water affairs were identified as the driving forces which provided the basis for the focus of the tourists to visit the protected species zones, increased number of motor boats, leakage of hydrocarbon spots from motor boats, smoke exhaustion from these boats, noise, disturbances in the safety and social tensions.

In order to find the more suitable tourism in the protected region of Sorkhankol wetland based on four common types of tourism including urban tourism, rural tourism, cultural-historical tourism, and ecotourism, the driving forces were identified. These driving forces are counted as the main tourism attractions in any type of tourism. Certain pressures are applied to the system which induces certain condition in each type of tourism that affects ecosystem services in terms of the values and benefits for the humans. These effects were determined in analytic hierarchy process with the coefficients among which the minimum value was 0.070 which implies the minimum compatibility and the highest compatibility of 0.29 was obtained. The services or functions which are affected in each type of tourism are as follows: in rural tourism: decreased production, reduced hydrological balance (water consumption for agriculture), change of land use of protected areas to agricultural areas, destruction of habitats and compromising the safety of the habitat, less aesthetic aspects, reduced genetic resources; in urban and cultural-historical tourism: enhancing and regulating the air, self-purification, less aesthetic aspects and sense of belong to ecotourism, destruction of habitats and compromising the safety of the habitat, less aesthetics aspects, enhancing and regulating the air, self-purification, aesthetics and sense of belonging, destruction of the habitat (through the concentration of tourists on visiting protected zones and the presence of motor bats and consequently, noise generation, smoke and hydrocarbon spots due to motor boats which affects the self-

purification and the absorption of pollutions and less social and political safety and reduced ability to exploit resources for educational and bird watching tours). Each of these items is classified in one group of ecosystem services including productive, regulatory, supportive, and cultural. Regardless of which value or function or ecosystem service is found to be more compatible by each resultant coefficient, it is verified in which type of tourism, the resultant drives have applied certain pressures on the ecosystem such that higher compatibility is obtained between the effect and the function. The obtained coefficients were 0.26, 0.24, 0.23, 0.23, 0.24, and 0.13 for rural tourism, 0.23, 0.23, 0.23, 0.07, 0.21, 0.23, 0.23, 0.23, and 0.14 for urban tourism, 0.23, 0.25, 0.23, 0.20, and 0.21 for cultural-historical tourism, and 0.29, 0.28, 0.26, 0.29, 0.29, 0.25, and 0.23 for eco-tourism.

## Conclusions

The resultant driving forces due to the function of ecotourism and rural tourism in Sorkhankol wetland includes the zoning of protected plant and animal species, protection of terns' nests, designing paths for boats, building 12 piers, developing service infrastructures, building accommodations, the conflicts of interests with the local beneficiaries (21 unions of tourism and boating) with trustee offices of the environment. Water affairs have led to pressures such as the entrance of tourists to private grounds owned by the locals, development of rice farms around Susar Ruga, consumption of more agricultural inputs, particularly water and pesticides in the vicinity of the wetland, rural road construction, excavation and extracting rocks and materials using machineries in Hendkhaleh and Siah Darvishan regions, increased visit of the tourists in the region of Nahang Ruga to Susar Ruga, the immethodical cutting of the plants in Siah Darvishan, increased number of row boats instead of motor boats in bird watching educational tours (the only positive pressure), noises, dense number of tourists for visiting the protected species zones, increased number of motor boats, leakage of hydrocarbon spots from motor boats, exhaustion of smoke from the boats, increased number of foreign and domestic tours, inability to exploit the resources for the tourists.

Given what is stated, preparing and implementing ecotourism services standards, preparing comprehensive educational documents and organizing ecotourists in smaller groups in Sorkhankol wildlife refuge are necessary, particularly in the water body of the wetland such that one could reduce the pressure on the environment through designing the paths for motor boats and changing them from motor boat type to row boats as much as possible. It is worth noting that due to the volume of the sediments entering Sorkhankol wetland and shrunk aquatic area of the wetland on one hand, and considerably reduced depth of the wetland on the other hand, such that the depth of Sorkhankol wetland was measured to be 30-50 ml in a field observation, the movement of the boats faces serious technical issues which is considered as a technical issue for visiting the Indian lotus as the main attraction of Sorkhankol wetland beside being an environmental damage. However, the Indian lotus currently acts as a sediment trap which intensifies the choking phenomenon of the wetland which is a serious conflict among the attractions of Sorkhankol wetland and its health which requires the urgent and strategic actions of the experts.

**Keywords:** DPSIR model, ecological criteria, recreation, Sorkhankol wetland.