MULTI-CRITERIA DECISION MAKING FOR WATER RESOURCE MANAGEMENT: A CASE STUDY OF ANCHAR LAKE, J&K, INDIA

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ABSTRACT

Multi criteria decision making (MCDM) is a framework for ranking or scoring the overall performance of decision options against multiple objectives. The approach has widespread and growing application in the field of water resource management. The Union Territory of Jammu & Kashmir is enriched with number of lakes of different origin. Over a period of time most of these lakes are being over exploited resulting in changing their trophic status. Anchar Lake, one of the lakes needs dire attention for its restoration. In order to formulate the final decision, a minimum of 100 respondents were surveyed including local households, shikara walas, lotus stem cultivators and harvesters residing in the vicinity of this lake. Different criteria's were put forward and were ranked accordingly as per the responses recorded from the respondents.

KEY WORDS: Multi criteria decision making, Over exploited, Trophic status, Restoration.

INTRODUCTION

Water resource management decisions are typically guided by multiple objectives measured in different units. Multi criteria decision making (MCDM) represents a body of techniques potentially capable of improving the transparency, auditability and analytic rigour of these decisions (Dunning *et al.*, 2000; Romero and Rehman, 1987). The MCA framework ranks or scores the performance of alternative decision options against multiple criteria which are typically measured in different units.

MCDM emerged as a decision analysis technique in the 1960s and 1970s, partly resulting from the rapid growth of operations research in WW II. Some early applications of MCDM were in military planning (Eckenrode, 1965). Today MCDM is an established methodology with dozens of books, thousands of applications, dedicated scientific journals, software packages and university courses (Figueira *et al.*, 2005). It has received particular attention in water resource management, partly because water policy is seldom guided by a single objective.

Water is the most fundamental and one of the primary necessities for survival and no one can imagine living life without this natural source (Khanna *et al.,* 2007). The most irresistible character of water is its huge quantity present on the land of earth. Besides, 80% of population of valley is dependent on these water bodies. Anchar Lake is connected with Khusalsar Lake from southern end which in turn is connected with the famous Dal Lakethrough small inflow channel, Nalla Amir Khan. River sindh enters the Lake on its northern side; Lake is also fed by a number of springs present in the basin itself and along its periphery. At the south east of this water basin is situated one of the famous hospital SKIMS (Sheri Kashmir Institute of Medical Science), discharging its toxic wastes into

Lake and this Lake also receives the agriculture runoff and domestic sewage from the surrounding agricultural field and residential areas without any filtration plant and that enhance the nutrient levels of the Lake (Singh and Singh, 2007).

As a result of heavy anthropogenic pressure, due to negligence on behalf of local people of Anchar village and government authorities who can never come forward for the betterment of the Lake and play a positive role (Sharma *et al.*, 2012). So that, the quality of the Lake is deteriorated day by day due to the various factors which can give the birth to threat not only to the biodiversity of Lake but also to the people which are directly or indirectly depend on the source of Lake (Jeelani and Kaur, 2012) and (Bhat *et al.*, 2013), the aquatic life is also badly affected. This encourages us to study the physico-chemical properties of this water body for a period of one year at different locations.

Study Area and Selected Respondents

Proposed survey was carried out to record the perception of different stakeholders regarding the restoration of Anchar Lake, which is popular among the records of Kashmir civilization due to its vast agricultural oùtcomes as well as huge fresh water resources, usable for the survival of life. It is situated 12 km to the North West of Srinagar city in Kashmir valley at an altitude of 1584m a.s.l within the geographical coordinates of 34°20´ - 34°26´ North latitude and 74°.82´- 74°.85´ East longitude. Towards the north east of the lake is situated the complex of Sheri-Kashmir institute of Medical sciences (SKIMS) draining much of its effluents into the lake. Three study sites were selected in the lake that represents different environmental features.

Anchar Lake is facing a serious threat from anthropogenic activities in the catchment, because of which the lake's water chemistry has been altered. Moreover, presence of SKIMS hospital in the vicinity of lake also poses threat to its ecology. In order to know the impact ofthese activities on water chemistry of Anchar Lake, the present study has been envisaged with below mentioned objective:
• To study the perception of different stakeholders for restoration of Anchar Lake.

For obtaining the present objective, a total of 100 stakeholders were survey within the vicinity of Anchar Lake. These stakeholders mainly include Local households (60), shikara walas/fishermen (20), lotus stem cultivators and harvesters (20).

MATERIALS AND METHODS

Multi criteria decision making (MCDM) is a tool which was used for assessing the best criteria available for the restoration of Anchar Lake. MCDA is a decision analysis technique which involves the following steps:
• Identification of the problem related to particular natural resource
• Analysing different criteria for accurate solution of the problem
• Ranking those criteria's on the basis of responses recorded from the respondents
• Selecting the highest ranked criteria

The responses recorded from respondents were of different age groups including both men and women. These responses were recorded on well framed interview schedules.

RESULTS AND DISCUSSION

The study carried was totally based on primary data collected with the help of well framed interview schedule. The respondents of different age groups were randomly selected from the vicinity mainly including local households, fishermen/shikara walas and lotus stem cultivators. As shown in table 1, majority of the respondents belong to the age group of 30-50 years (35%).

Table 1. Selection of Respondents

			(n=125)
S. No.	Age Group (in Years)	No. of Respondents	Percentage
01	10-30	27	21.6
02	30-50	42	33.6
03	50-70	39	31.2
04	Above 70	17	13.6
	Total	125	100

Field Survey 2022

Various criteria's involved in MCDM were put forward before the respondents, depending upon the level of effectiveness. The responses were categorised in these levels and the weighted mean was calculated, which in turn helped in choosing the best criteria among all others. As per Table 2, the criteria (reduction in sewage discharges) has the highest weighted mean of 1.75 making it the best possible criteria among others. The criteria (responsible tourism) have the lowest weighted

Table 2. Selection of effective criteria using MCDM for restoration (n=100)

S. No.	Criteria	Degree of Effectiveness			Weighted Mean Score	Rank
		Most Effective (0)	Effective (1)	Least Effective (2)		
01	Reduction in disposal of solid Waste	65	30	05	1.60	2nd
02	Eradication of weeds	50	40	10	1.40	4th
03	Reduction in use of fertilizers	30	50	20	1.10	6th
04	Afforestation in Adjoining Areas.	30	30	40	0.90	9th
05	Responsible Tourism	00	00	100	0.00	12th
06	Avoiding Land Filling Process	25	55	30	1.05	7th
07	Restoration of Lake inlets and outlets	45	45	10	1.35	5th
08	Reduction in Sewage Discharges	75	25	00	1.75	1st
09	Government Sponsored Cleanliness Drives	30	35	35	0.95	8th
10	Restriction in construction in & around the Lake	30	25	45	0.85	10th
11	Sustainable harvesting of goods from the Lake	20	30	50	0.70	11th
12	Lake Deepening/Dredging	45	55	05	1.45	3rd

mean, as the tourism was long gone from Anchar Lake.

CONCLUSION

Among the respondents of different age groups residing in the vicinity of Anchar Lake, the most important criteria's necessary for the restoration of Anchar Lake were reduction in sewage discharge (1st), reduction in disposal of solid wastes (2nd), lake deepening/dredging (3rd) and others.

From this study we can suggest different criteria's based on the feedback of respondents to the policy makers/Govt. agencies for the restoration of Anchar Lake, as the lake is breathing its last breath.

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