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Ranking of Ecosystem Services and Drivers of Deterioration of Koothapar Big Tank Wetland in Tiruchirappalli District

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ABSTRACT: The present study dovetailed to study the multi various ecosystem services provided by Koothapar big tank wetland in Tiruchirappalli district of Tamil Nadu, India and investigate its scope and importance by ranking it. It further aimed to study the drivers of deterioration of it and then to explore further, the attitude of stakeholders towards the conservation of wetland was studied. Thus, the study is wholesome to understand the present scenario of wetland, scope for its improvement and also for future research in this domain. From the study area, 110 farmers (50 agricultural, 20 cow grazing, 20 goat and sheep grazing and 20 farmers engaged in aquaculture) and 50 residents were selected randomly by adopting a multipurpose random sampling method. The primary data were collected from 160 respondents. The percentage analysis results revealed that irrigation was the major ecosystem service which ranked first with 99 per cent, household sewage and solid waste dump were ranked as the major driver that deteriorated the wetland most with 86 per cent and 72 per cent of the respondents were interested to get involved in protection and conservation activities. It was concluded that encroachment should be removed to increase the wetland size resulting in an increase in the benefits from ecosystem services. Installation of sewage treatment will prevent the breeding of mosquitoes and pollution of the tank water. The Government should take initiatives to restore the Koothapar big tank wetland with eco-tourism and avail facilities of boating, walking tracks, herbal plantation and theme parks.

Keywords: Koothapar big tank, ranking, ecosystem services, drivers of deterioration, percentage analysis, and eco-tourism.

INTRODUCTION

Globally, ecosystems are acknowledged as natural capital assets that supply and sustain various kinds of services that are vital for human existence (Millennium Ecosystem Assessment, 2005). The Ramsar Convention's (Article 1.1) definition of wetlands deliberately involves a wide range of land types, including "areas of marshes, fens, peatlands, or water, whether natural or artificial, permanent or temporary, with water that is flowing or static, fresh, brackish, or salty, including areas of marine water the depth of which at low tide does not exceed 6 meters". Wetlands are considered as "the kidneys of the landscape" and "biological supermarkets" because they perform various functions and support biodiversity and enormous food webs (Mitsch and Gosselink 1993). The Millennium Ecosystem Assessment (2005) classified the ecosystem services of wetlands into four categories as provisioning services (food, fresh water, fiber, fuel, wood, fish, duck rearing, grazing and biochemical), Regulating services (climate regulation, erosion control, pollination, flood storage, carbon sequestration, groundwater recharge), Cultural services (recreational, aesthetic, spiritual and inspirational, educational) and Supporting services (soil formation, nutrient cycling, biodiversity conservation). The Economics of Ecosystems and Biodiversity (2013) reported the supporting services of wetlands including gene pool protection and lifecycle maintenance. The wetlands services in New Zealand has a significant source of food, fish, birdlife and a water-retaining horticultural medium for orchids, sphagnum moss, and plants that are used for making rope (Kapa and

Clarkson 2009). The wetlands provided vegetation, animal and mineral products that can be used for human and commercial use and the cultural services of wetlands include spiritual, aesthetic, educational values, recreation and tourism (Ramsar, 2009).

Ecosystem services of traditional water bodies include tanks that provide services that are being used as 'public good' i.e. both non-rivalrous and non-excludable, as most of them are non-marketed and are undervalued (Costanza *et al.,* 2014). The tropical wetlands are highly degraded due to the overloading wetlands with pollution, draining wetlands for agriculture and other land uses, diverting water away from river flood plains and conversion of mangrove swamps to fish ponds (Barbier, 1993). Most wetland losses were due to eutrophication, toxicity, fire suppression, toxic metals and pesticides contaminated the wetlands (Brinson and Malvárez 2002). Water bodies are highly encroached by pollution, land mafia, sewage and garbage (Kang, 2013). The wetlands are very sensitive and from the beginning of the 20th century, humans deteriorated 60 per cent of the European wetlands. Many other areas were degraded due to water abstraction, nutrient lacking and intensive agriculture (Global Nature Fund, 2004). According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES, 2019), due to anthropogenic forces, around 85 per cent of the wetlands have been lost across the globe. In this context, the present study aims to rank the ecosystem services, drivers of deterioration and attitudes of stakeholders toward protection of Koothapar big tank wetland in Tiruchirappalli district. Results of this study will help the stakeholders to understand the economic importance of wetlands in their livelihood.

MATERIALS AND METHOD

Salim Ali Centre for Ornithology and Natural History (SACON) identified four prioritized wetlands in the Tiruchirappalli district. The Koothapar big tank wetland was selected for this study and it is one of the prioritized wetlands in the Tiruchirappalli district (Fig. 1). The five villages that benefited from this tank namely, Koothapar, Tiruverumbur, Vengur, Natarajapuram and Krishnasamudram were purposively selected for this study. From the study area, 110 farmers (50 agricultural, 20 cow grazing, 20 goat and sheep grazing and 20 farmers engaged in aquaculture) and 50 residents were selected. 10 agricultural farmers and 10 residents were selected from each village. 4 aquaculture farmers, 4 cow grazing and 4 goat and sheep grazing farmers were selected from each village and the total sample size was one hundred and sixty. Thus, multi stage random sampling was adopted for the study. The primary data were collected using a personal interview with the help of a well-structured and pre-tested interview schedule from the sample stakeholders during the months of May 2023 to June 2023. The percentage analysis was employed in this study.

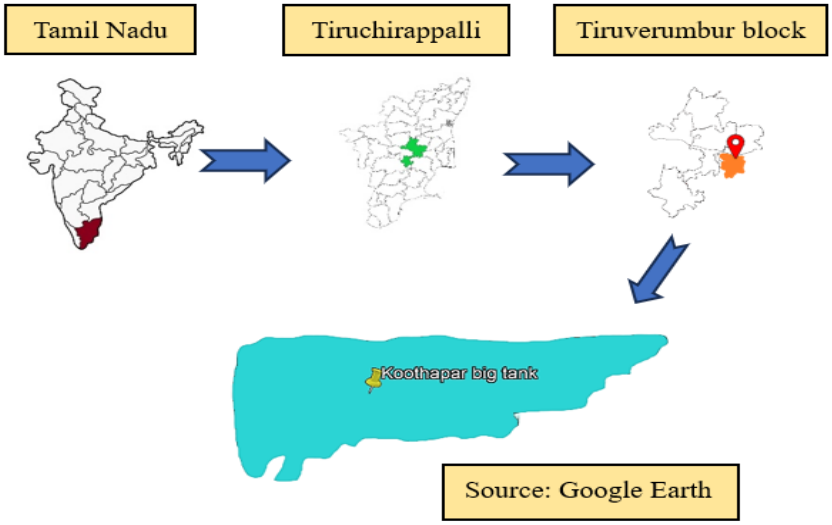

Fig. 1. Selection of Koothapar big tank wetland.

RESULT AND DISCUSSION

Ecosystem services of Koothapar big tank wetland. Eleven ecosystem services were identified from the Koothapar big tank wetland. Irrigation, fishing, bathing and washing, cattle grazing and goat and sheep grazing were the five identified provisional services. Flood storage, carbon sequestration and groundwater recharge were the three regulating services. The two cultural services included aesthetics and photography and habitat for birds. The one supporting service included biodiversity conservation. The respondents were asked to rank the services as strongly agree, agree, neutral, disagree and strongly disagree based on their own perceptions. The percentage of perception of sample respondents (N=160) toward various ecosystem services is presented in Table 1. From the results, it was inferred that in all ecosystem services, there were few disagree responses and there were no strongly disagree responses.

Table 1: Perception of respondents towards various ecosystem services of Koothaparbig tank wetland.

Sr. No.	Goods/services	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)
1.	Irrigation services	62	37	1	0	0
2.	Habitat for birds	31	51	18	0	0
3.	Groundwater recharge	38	43	19	0	0
4.	Biodiversity conservation	33	45	22	0	0
5.	Aesthetics and photography	20	53	27	0	0
6.	Goat and sheep grazing	25	46	28	1	0
7.	Cattle grazing	31	36	33	0	0
8.	Carbon sequestration	21	42	26	11	0
9.	Flood storage	20	33	37	10	0
10.	Fishing	25	26	33	16	0
11.	Bathing and washing	0	18	43	39	0

Table 2: Ranking of ecosystem services of Koothapar big tank wetland.

Sr. No.	Ecosystem services	Percentage (%)	Rank
1.	Irrigation	99	1
2.	Habitat for birds	82	2
3.	Groundwater recharge	81	3
4.	Biodiversity conservation	78	4
5.	Aesthetics and photography	73	5
6.	Goat and sheep grazing	71	6
7.	Cattle grazing	67	7
8.	Carbon sequestration	63	8
9.	Flood storage	53	9
10.	Fishing	51	10
11.	Bathing and washing	18	11

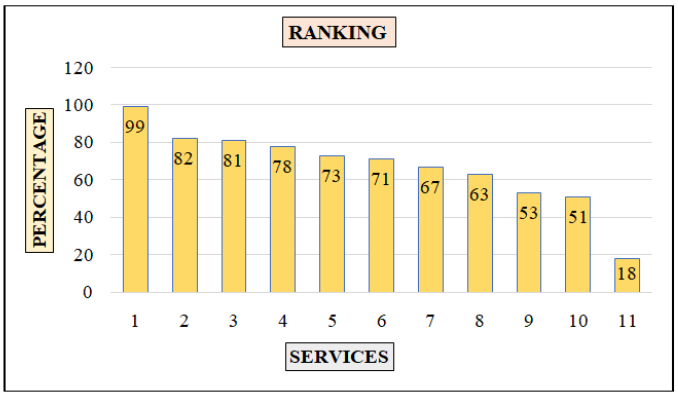

Fig. 2. Ranking of ecosystem services of Koothapar big tank wetland.

Ranking of ecosystem services. The ecosystem services were then ranked based on the perception of the respondents with strongly agree and agree responses and which is presented in Table 2 and depicted in Fig. 2.

From Table 2, it was inferred from the results that irrigation was the major ecosystem service which ranked first with 99 per cent. The koothapar and the nearby five villages are utilizing this water for paddy cultivation. The Habitat for birds was ranked second with 82 per cent. One of the Important Bird Areas (IBA) in India was Koothapar big tank and it attracts many water birds including resident migratory, migratory, local species and waterbirds including aerial foragers which effectively depend on the tank for foraging (Mohanraj and Pandiyan 2022). The groundwater recharge was ranked third with 81 per cent followed by biodiversity conservation with 78 per cent, aesthetics and photography with 73 per cent, goat and sheep grazing with 71 per cent, cattle grazing with 67 per cent, carbon sequestration with 63 per cent, flood storage with 53 per cent, fishing with 51 per cent. The last rank was bathing and washing with 18 per cent.The hazardous pollution throughout the year as a result of the irregular addition of household waste, industrial waste, agricultural runoff, open defecation and other wastes that are dumped into the Uyyakondan channel through drains without being properly treated. It concluded that water is suitable for other uses but not for drinking in the Koothapar wetland (Ravichandran and Teneson 2015). In a similar attempt in raking the use value of Vellayani lake in Kerala revealed that drinking water ranked first among use values with a score of 0.99 and irrigation water ranked last with a score of 0.47 (Aswathy, 2015).

Drivers of deterioration. Eight drivers that deteriorated the tank and the livelihood of the stakeholders were identified in the study area. The identified drivers were encroachment, breeding mosquitoes, invasive species, household sewage and

solid waste dump, waterbody shrinkage, open defecation, animal and medical waste dump and industrial pollution. The respondents were asked to rank the drivers as strongly agree, agree, neutral, disagree and strongly disagree based on their own perceptions. The percentage of perception of sample respondents (N=160) towards various drivers is presented in Table 3. From the results, it was inferred that in all drivers, there were no disagree and strongly disagree responses.

Table 3: Perception of respondents towards various drivers of Koothapar big tank wetland.

Sr. No.	Drivers	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)
1.	Household sewage and solid waste dump	47	39	14	0	0
2.	Animal and medical waste dump	38	47	15	0	0
3.	Waterbody shrinkage	35	48	17	0	0
4.	Breeding mosquitoes	38	41	21	0	0
5.	Encroachment	38	39	23	0	0
6.	Invasive species	35	39	26	0	0
7.	Industrial pollution	34	39	27	0	0
8.	Open defecation	34	38	28	0	0

Table 4: Ranking of drivers of deterioration of Koothapar big tank wetland.

Sr. No.	Drivers	Percentage (%)	Rank
1.	Household sewage and solid waste dump	86	1
2.	Animal and medical waste dump	85	2
3.	Waterbody shrinkage	83	3
4.	Breeding mosquitoes	79	4
5.	Encroachment	77	5
6.	Invasive species	74	6
7.	Industrial pollution	73	7
8.	Open defecation	72	8

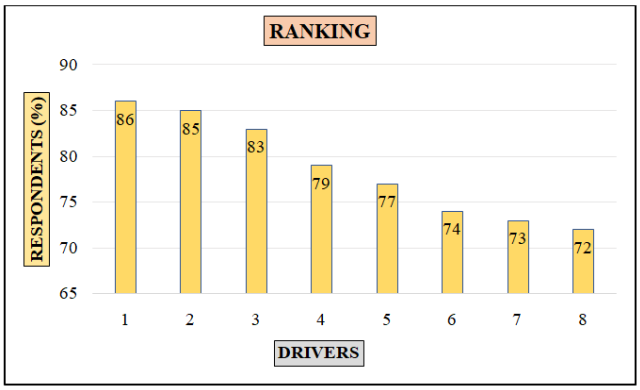

Fig. 3. Ranking of drivers of Koothapar big tank wetland.

Ranking of drivers. The drivers were ranked based on the perception of the respondents with strongly agree and agree responses and which is presented in Table 4 and depicted in Fig. 3.

From Table 4, it was inferred from the results that household sewage and solid waste dump were ranked as the major driver that deteriorated the wetland most with 86 per cent. Due to the irregular addition of industrial wastes, domestic sewages, agricultural runoff and other wastes, the Uyyakondan channel has been highly polluted and it is not suitable for human consumption (Jameel and Hussain 2005). The animal and medical waste dump was ranked second with 85 per cent followed by waterbody shrinkage with 83 per cent, breeding mosquitoes with 79 per cent, encroachment with 77 per cent, invasive species with 74 per cent, and industrial pollution with 73 per cent. The last rank was open defecation with 72 per cent. According to Ravichandran and Teneson (2015), the total coliform count was higher than expected in every season in Koothapar wetland. Coliforms in the water are a sign of fecal contamination caused by the mixing of home sewage and open defecation close to wetlands. In a similar attempt in raking the threats of Vellayani lake in Kerala revealed that pollution ranked first with a score of 0.94 and reclamation ranked last with a score of 0.55 (Aswathy, 2015).

Current status of wetland. From Table 5 it was depicted that 85 per cent were responded as depleting, 14 per cent as improving and the remaining 1 per cent as no change in the Koothapar wetland.

Table 5: Current status of Koothapar big tank wetland.

Sr. No.	Current status	No. of respondents
1.	Improving	22(14)
2.	No change	2(1)
3.	Depleting	136(85)
Total		160(100)

Figures in parentheses indicate percentage to total

Table 6: Response of stakeholders to the impact of Koothapar big tank wetland destruction.

Sr. No.	Responses	No. of respondents
1.	Yes	117(73)
2.	No	43(27)
Total		160(100)

Scenario, if Koothapar big tank wetland is completely destructed. The respondents were asked about the destruction of wetland and is presented in Table 6.

Figures in parentheses indicate percentage to total.

From Table 6, it was inferred that 73 per cent of the respondents answered "yes", that the complete destruction of the Koothapar tank would affect their livelihood and the remaining only 27 per cent answered "no". The reasons those who replied "yes" to the question were the wetlands provided many services to the village people which included irrigation, flood storage, groundwater recharge and generating employment through fisheries. Those who replied "no", also tried to substantiate the reasons, that in the absence of the wetland, they get water from other sources in that area. They were not dependent on the wetlands for their livelihood.

Attitudes of respondents towards the Protection of wetland. The stakeholders were asked about their degree of interest in the protection of the Koothapar big tank wetland. The percentage of interest of the respondents towards the protection of wetland is presented in Table 7 and depicted in Fig. 4.

Table 7: Interest of respondents towards the protection of Koothapar big tank wetland.

Sr. No.	Degree of interest	Percentage (%)
1.	Highly interested	62(39)
2.	Moderately interested	53(33)
3.	Not interested	45(28)
Total		160(100)

Figures in parentheses indicate percentage to total.

From Table 7, it was inferred from the results that 39 per cent of the respondents showed a great degree of interest, while 33 per cent showed a moderate degree of interest. 72 per cent of the respondents were interested to get involved in protection and conservation activities such as supporting labour, Willingness To Pay (WTP) and organizing awareness programmes. 28 per cent of the respondents were not interested in conservation activities.In a similar attempt in interest of respondents towards the conservation of mangrove ecosystem in Kolavipalam, Kerala, revealed that 36 per cent of respondents showed a greater degree of interest, 22 per cent were moderately interested while remaining 42 per cent did not show any interest towards conservation of mangroves (Supriya, 2020).

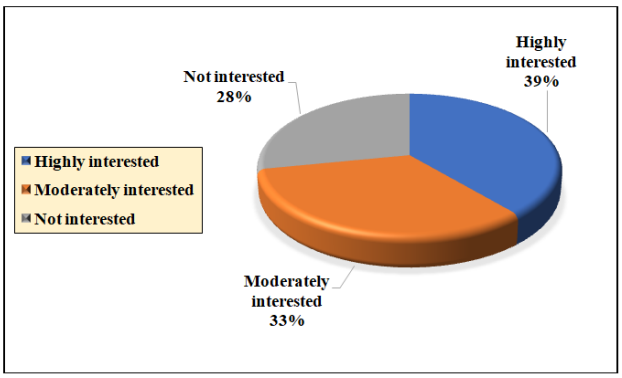

Fig. 4. Interest of Respondents to the Protection of Koothapar big tank wetland.

SUMMARY AND CONCLUSION

Wetlands provide enormous beneficial services to the community people. The common-pool resources such as tanks form an important source of livelihood activities such as agriculture in the form of irrigation water, silted soil, and livestock rearing for millions of rural people in India. In recent decades, the wetlands are deteriorated due to biotic and abiotic threats. The Koothapar big tank wetland is one of the four prioritized wetlands in the Tiruchirappalli district and

most of the farmers benefited through this tank are small and marginal. This study was conducted to throw light on different ecosystem services provided by the Koothapar big tank wetland and the drivers that deteriorate the tank. The empirical results of the study concluded that irrigation was the major ecosystem service which ranked first with 99 per cent, household sewage and solid waste dump were ranked as the major driver that deteriorated the wetland most with 86 per cent each and 72 per cent of the respondents were interested to get involved in protection and conservation activities. Results of the study recommended that encroachment should be removed to increase the wetland size resulting in an increase in the benefits from ecosystem services. Installation of sewage treatment will prevent the breeding of mosquitoes and pollution of the tank water. Currently, The Koothapar big tank wetland is managed by a single government agency i.e. Public Works Department. For efficient, equitable and sustainable management of wetlands, collective action from various lines departments such as Tamil Nadu State Wetland Authority(TNSWA), Forest Department and Fishery Department should be required. The extension programmes should be conducted by TNSWA, Forest Department and NGOs to promote awareness of wetlands services, functional benefits and threats among the stakeholders. The Government should take initiatives to restore the Koothapar big tank wetland to eco-tourism and avail facilities of boating, walking tracks, herbal plantation and theme parks.

FUTURE SCOPE

The present study can be extended and enhanced in the future by evaluating the economic worth of the wetlands and also including the behavioural economic components for Payment for Ecosystem services which is an important domain of research which need to be conducted. The study scope can also be expanded by including institutional arrangements for the conservation, protection, management, development and restoration of the wetlands.

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Conflict of Interest. None.

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