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**Eutrophication Trend of Anzali Wetland Based on 1992-2002 Data**

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### Extended Abstract

Anzali wetland is located between two different saline-freshwater body where constituted a unique ecosystem, internationally known as an important wetland and is registered as Ramsar site in 1975. Anzali wetland is under several stresses such as sea water level fluctuation, different human induced impact, exotic species and the eutrofication which are the causes of early destruction of wetland. Eutrofication or nutrient enrichment is a problem of wetlands, rivers, streams and lakes all over in the world. Hydrology of the watershed has profound effect on the eutrofication process of Anzali wetland which drains 52 % of its water through Siadarvishan river into central region, 44 % via Pirbazar, Komamrud river into eastern region and 4% by the other rivers. The water from eastern and central regions drains into Caspian sea faster than the western basin which has more retention time.

The Eutrofication of Anzali wetland first reported at 1970 and approved by several other authors. Those reports were base on the biotic and abiotic parameters which describe Anzali wetland were eutroph between the years 1991 to 1995 but the evaluation based on the trophic index of phosphorous to nitrogen shows that most region of Anzali wetland reported to be mesotroph.

In this survey we are going to use the available data from 1992 to 2002 to identify the change in over nutrient an enrichment of Anzali wetland at three periods by employing the trophic state index system.

### Material and Methods

Anzali wetland survey has been conducted during the years 1992-2002. The total sampling station were 40 but varied in some years where at 1995–1998 and 1999-2002 were 39 and 15 sampling station respectively. The sampling frequency at 1992-1995 and 2001-2002 were monthly but at 1996-1998 were seasonally. The samples were obtained by Rutner sampler and the Chlorophyll-a, nitrogen and phosphorous were determined by standard methods.

TSI<sub>(CHL)</sub>; Carlson's trophic state index and TSI<sub>(PN)</sub>; model of phosphorous to nitrogen were used to assess the trophic state statues of Anzali wetland.

Also TSI<sub>(TP)</sub>; the trophic models of total phosphorous, TSI<sub>(TN)</sub>; total nitrogen were used and have been compared through the threshold statues.

### Results

The results shows Chlorophyll-a concentration varied from 8.8 mg/l. at 1993 to 50.2 µg/l. at 2000 while statistically were different among years (Kruskal Wallis test Chi-square=497.9,  $p=0.05$ ).

The mean Chlorophyll-a concentration during the years 1993-1996 were less than 20 µg/l. While after 1996 the mean Chlorophyll-a concentration was increased up to 25 µg/l. (Fig. 1).

Nitrogen concentration was between 0.15 to 1.5 mg/l in different region of Anzali wetland and phosphorous concentration was between 0.17 to 0.05 mg/l. in most years. The extent of eutrofication area of Anzali wetland according to chlorophyll-a concentration model increased from 46% to 91% and on the base of total phosphorous and total nitrogen model changed from 90% to 100% and from 66 % to 97 % respectively (Table 1). According to the phosphate to nitrogen trophy model, Anzali wetland seems to be in the final stage of mesotroph and early stage of eutrophic condition. The mean phosphorous to nitrogen trophic state index varied between 42 from 1995 to 46 at 2002. According to TSI<sub>(PN)</sub> less than 5.2 % surface area of Anzali wetland is in eutrophic condition.

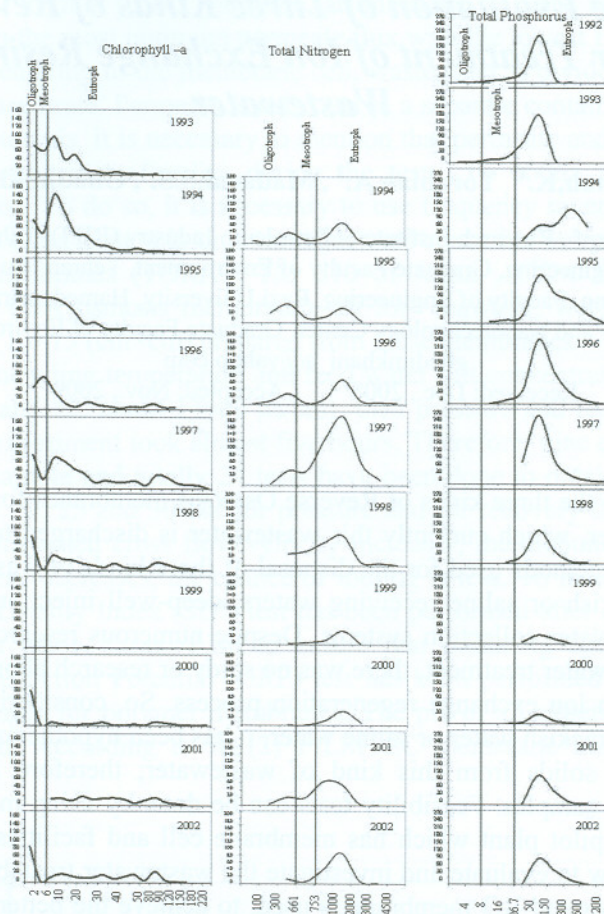
Table 1: Trophic state levels of Anzali wetland at different years

Index	Trophic state	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Chl(a)	Oligotrophic		21	11	25	19	5.2	1	0	1.9	0	1.8
	Mesotrophic		33	31	24	28	17	17	15	13	8.8	7.3
	Eutrophic		46	58	51	52	78	82	85	52	91	91
TN	Oligotrophic			27	51	28	9.4	14	5.2	1.7	15	9.2
	Mesotrophic			6	8.4	2.1	8.6	17	10	1.7	12	3.9
	Eutrophic			66	40	70	82	69	84	97	13	87
TP	Oligotrophic	0.7	1.7	0	0.2	0	0	0	0	0	0	0
	Mesotrophic	8.7	11	0	4	4	0	1.4	0	1.7	0	0
	Eutrophic	91	87	100	96	96	100	97	100	98	100	100
TSI (chl-a)	Oligotrophic		0	0	0	0	0	0	0	0	0	0
	Mesotrophic		40	38	37	33	17	21	10	12	8.4	10
	Eutrophic		60	62	63	67	82	79	90	88	92	90
TSI (tp)	Oligotrophic	0.7	0.7	0	0.2	0	0	0	0	0	0	0
	Mesotrophic	8	10	0	3.1	3	0	0.5	0	0	0	0
	Eutrophic	91	89	100	97	97	100	99	100	100	100	100
TSI (tn)	Oligotrophic			0	0	0	0	0	0	0	0	0
	Mesotrophic			0	0	0	0	0	0	0	0	0
	Eutrophic			100	100	100	100	100	100	100	100	100
TSI (pn)	Oligotrophic			0	6	1.4	0.4	0	0	0	0.6	0
	Mesotrophic			93	89	88	94	94	98	97	98	95
	Eutrophic			7	5	11	6	7	1.7	3.4	1.2	5.2

## Discussion

The data show that according to all trophic state models Anzali wetland is eutroph except the trophic state index TSI (PN) which indicate that Anzali wetland is in the final stage of mesotroph. Similar observation was reported by Kimbal and Kimbal (1974) and Darvishsefat et al., 1999. The mesotroph condition of Anzali wetland could be described by high growth of macrophytes. The concentration of Chlorophyll-which is an index of phytoplankton biomass, is high to gather with the dominance of Cyanobacteria species is the sign of eutrophic condition.

The appearance of some aquatic plant species and vanishing of others were observed during 1988 to 2002 in Anzali wetland also their density has been increased in Siahkeshim, Shijan and a partial of central basin due to high nutrient river load. The presence of exotic species *Azolla filiculoides* Since 1991 were considerable which contribute to the internal nutrient load and had a negative impact on Anzali wetland ecosystem. According to Sabetraftar (1999), about the 2950 h. of Anzali wetland surface area covered by *Azolla* where 45% of them were very dense.

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**Fig. 1: Measurements frequency of Chlorophyll-a, total phosphorus and nitrogen and trophic levels base on threshold statues**

The results of this study show that Anzali wetland does not have enough capacity to reduce all wastewater and solid waste of antropogenic loads from its watershed area; therefore, we suggest that the first effective measure for controlling eutrophication is, to prevent nutrient input load of wetland. The organizations such as FAO experts Holchich and Olah, (1992), Kimbal and Kimbal (1974) and Jica (2004) suggested some recommendation for restoration of Anzali wetland, part of those recommendation must be revised and part of them need to be implemented as soon as possible.

**Key words**

Anzali wetland, Eutrophication, phosphorus, Nitrogen, Chlorophyll-a