Political Ecology of Wetland Management: the post aquaculture demolition case of Lake Kolleru in India

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ABSTRACT

The present study highlights the uncertainties that govern wetland management using the Kolleru Wetland case study. The largest fresh water lake and an Ramsar site of international importance it has circled around over past half century from being a fresh water balancing reservoir to agriculture land and shifting as a aquaculture treasure island and lastly ceasing to the aquaculture demolition *vis'-a-vis'* restoration conflict in 2007. As nearly all stopovers of this journey was driven by policy shift that demanded economic benefit while surpassing ecological and social community growth. We hereby discuss the event and the analysis of the present state of affairs also spotlighting the major concerns on multiple fronts.

Keywords*:* Uncertainty, Wetland, Management, Lake Kolleru, Aquaculture, India

1. INTRODUCTION

To address the current management problem in wetland systems requires a paradox shift in conventional undertanding of these resource units. While in traditional system of resource management, these were invariably tagged as waste lands (Vijayan *et al*., 2004; James, 2004) or potential reclamation agricultural zones (Selvam, 2003; Thornton *et al,* 2003); it took a awhile for them to be recognized as mainstream resource units in the list with forests, water resources, wildlife and biodiversity. This was credited to the Ramsar Convention in 1971 an intergovernmental treaty with 158 contracting parties that initiated the mainstreaming of wetlands ecosystem on the global framework for national action and international cooperation for the conservation and wise use of wetlands and their resources at presents stands with 1747 Ramsar wetland sites of International Importance totalling to 161 million hectares covered by the 'wise use' and 'sustainable management' concept; although the practice is slightly underway in conception (www.ramsar.org; Ramsar, 1971).

While the environmental, societal, and economic benefits attached to wetland systems are numerous; the broad perspective wherein all these attributes are addressed simultaneously is much rarified (Chopra and Adhikari, 2004). Besides, it would require the interest of multiple sectors, to facilitate a long term vision for sustainable management (Nagabhatla *et al*, 2007; Davidson and Finalyson, 2007). Furthermore, the complex dynamics and the uncertainty attached with these systems rarify the scenario. As we content that managers and decision makers have to device potential solutions addressing the conflicting multistakeholder interest, integrate environmental dynamics and address the principles of 'Sustainomics' (Munsasinghe, 1994). The case of uncertainties in managing resource systems is explained here using Lake Kolleru as an example of a complex and highly dynamic inland wetland system in the Indian subcontinent.

The research assignment was the regional component under the Global Wetland Inventory and Mapping (GWIM) project initiated at IWMI that focused to develop a consortium of researcher collaborations and form a collaborative and distributed network within the framework of the Multilateral Environmental Agreements (MEA's) with a defined focus on the wetland–livelihoods–poverty nexus.

Kolleru Lake is one of the largest natural fresh water lakes in India with the catchment spread to 4,763 sq. km; of which 3,403 sq. km. covers the upland region and 1,360 sq km in the delta spread to +10 m contour. Located between the deltas of the Krishna and Godavari rivers it falls in India's Andhra Pradesh state (highest administrative division in the country. While the major portion with seven mandals (.the third-level administrative area under the state) falls in the west Godavari district (the second-level administrative area under the state), the Krishna delta with two mandals contributes the rest. While in the Godavari district, the Eluru mandal is the largest with fifteen villages and majority (39.7%) of government owned area; whilst the Nidamaru mandal had about 25.9% land owned by the private stakeholders. On the other hand the Krishna district had a total spread of 18 villages as can be seen in table 1.

Table 1 - Area statistics along with demographic and hydrological details of Kolleru Lake represented by nine mandals of Krishna and Godavari Basin

Mandal	*Govt. Land (Ha)	Private Land (Ha)	Total (Ha.)	% Govt Land	%Private land	% total Land	No of village in each Mandal
West Godavari District Total villages : 51							
Eluru	9245.1	424.8	9669.9	39.7	5.4	31.0	15
Unguturu	12.1	42.1	54.2	0.1	0.5	0.2	5
Pedapadu	118.5	200.7	319.2	0.5	2.5	1.0	6
Denduluru	8.1	229.0	237.1	0.0	2.9	0.8	3
Akiveedu	744.5	2052.9	2797.4	3.2	25.9	9.0	4
Nidamarru	112.9	2653.8	2766.7	0.5	33.5	8.9	5
Bhimadole	7061.5	1161.2	8222.7	30.3	14.7	26.3	13
Krishna District Total villages : 18							
Kaikaluru	3201.2	963.8	4165.4	13.7	12.2	13.3	-
Mandavalli	2790.1	187.7	2977.5	12.0	2.4	9.5	-
TOTAL	23294	7916	31210.0	100.0	100.0	100.0	
	75%	25%					

Hydrology : Water spread area of Kolleru Lake

Contour (MSL)	Hectare
+10	
+ 7	91155.8
+ 5	31216.7
+3	13658.2

The entire region up to +5m contour (in the survey sheet) was designated as a Wildlife Sanctuary in 1999 and recognized as a wetland of international importance (Ramsar Site) in 2002. The sanctuary is populated by 46 bed (inside the lake bed) and 76 belt (on the sanctuary boundary) with an estimated population of 0.3 million (the details of the land distribution and the hydrological flow at different contour levels is summarized in Table1). In terms of the ecosystem services it functions as a natural flood balancing reservoir and has well represented often conflicting multiple uses of space between increasing human populations, wetland-dependant biodiversity; and national and state political economies in an era when the need to find mutual space for conservation and development is accredited as a cardinal need for a sustainable future. Also, as one of the Ramsar sites; it symbolises the account of wetland status in the region, although contrary to the notion of 'wetland wise use' theory promoted by the Ramsar, to which member countries including India subscribe.

In line with the above background the present script summarises the aquaculture status and dynamics for Lake Kolleru, using a set of anecdotal information and spatial data to highlight the pre and post aquaculture demolition scenario for the fresh water wetland.

2. THE PAST SCENARIO

On the political front as early as 1963, the Government of India (GoI) issues a declaration assigning 20km radius of Kolleru Lake as Bird Sanctuary. During 1977-78, the Government granted 'pattas' [Government lands assigned under various Revenue Laws including 'D'-Form pattas] in lake bed and belt villages for the communities to practice agriculture. The distribution of 'patta' (both D-form and Private) lands in the nine 'mandals' constituting Kolleru is shown in Figure 2b. Furthermore, during the crop cultivation days the major source of irrigation for the belt villages was Godavari canal and the Eastern Krishna; whilst in the bed villages, the irrigation was mainly by pumping of Kolleru. Interestingly, the inflow to the lake sums from four seasonal rivulets *viz.*, Budameru, Tammileru, Ramileru and Bulusuvagu along with 15 major drains and about the same number of field channels while it outflows through a single outlet 'Upputeru' into Bay of Bengal. This inflow-outflow mechanism was appositely maintained through during the agriculture era. In the context of other land use activities, the fishing operations with traditional means and use of 'patta lands' for the specified purpose was on the list of government files; however the carp culture took over the entire lake surface and catchment by early 2000 (figure 2a). This was result of the economic boost up policy of the governments that favored the culture of 'carp' over 'crop'. The fish tanks had adversely the hydrological spectrum along with the inflow–outflow flux, gradually ramping up the flooding issues in the region (the district wise land distribution for different land-use activities is shown in figure 3a). By, 2002 the gravity of the booming aquaculture industry was coercing the government to address the problem of submersion of surrounding agricultural lands and protection of sanctuary

The forest department and the revenue authority along with the communities from the bed and belt villages are the major stakeholders of the resource system. Other point of concern is the separation of power to regulate the social and natural sector; whilst on one hand the floral and faunal diversity is managed by the Forest Department; the Revenue department governs the social dynamics, in other words to harmonies both is very unlikely. To explain this setting a small example is quoted; while discussion a forest official explicated as the main reason of conflict is the helplessness of the Department to exercise powers under Forest Act /Wildlife (P) Act, 1972 for eviction of encroachments as the social set-up within the sanctuary premises is under the control of Revenue department. This state of affairs clearly indicates the conflicting interest of the involved stakeholders and the gaps in the existing policies to address natural and social capital concurrently.

Nonetheless, after the declaration of the Lake area as sanctuary in 1999; though following were on the list of activities; cancellation of all 'D-Form Pattas' inside the sanctuary, annulment of leased lands given to fishermen societies inside the sanctuary; termination of all annual licenses issued by Fisheries Department; acquiring any private lands; building any new fish tanks; disconnecting of all electricity connections to fish tanks and check on the encroachments. However major of these activities remained in paper as of the high business influence of the aquaculture sector. While on the other hand the permitted set of activities that included traditional fishing (using nets in the open lake waters).; conventional agriculture without using pesticides and chemicals; use of ordinary boats without motor for the movement of the people; right of way on the existing roads without permitting new roads and culverts and maintaining of water courses and drains and electric supply only for domestic use were lined up for execution. The insurrection against the unrepentant rise in aquaculture in the lake took a legal step in 2001 with a principal aim to restore the pristine glory of Kolleru; that strictly ordered no permission for the pisciculture/aquaculture/ shrimp culture should be permitted inside the sanctuary area except traditional methods of fishing; whilst removing all encroachments and acquire private 'patta' lands located within +5m contour; disconnect

power supply to the illegal pump sets operating inside the sanctuary area to prevent drawl of lake water wherein the different stakeholders were given a set of activities to execute. As the Forest Department was mainly allotted the work to prevent fresh encroachments; and prepare an action plan to for Lake Management, the urban development authority was allotted to fabricate sewage treatment plants; the Pollution Control Board were activated to enforce the water & air Act.; the Police Department was asked to govern the arising conflicts. However the matter that was insignificantly addressed was the livelihood uncertainties issues that would take stage following the aquaculture demolition process.

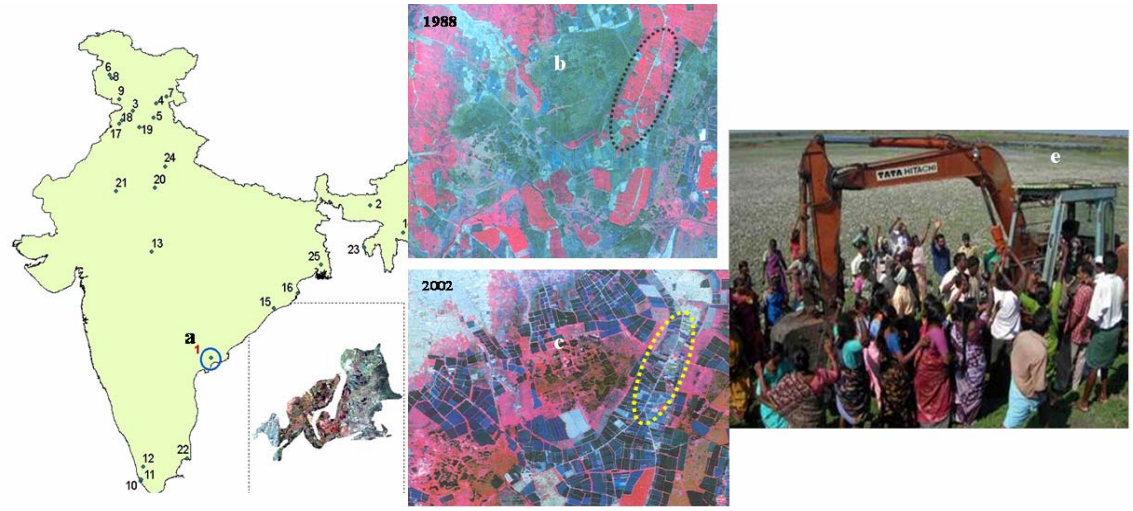

Figure1 - A synoptic view of Lake Kolleru: (a) Location, (b) Zoomed Satellite image of 1988, (c) Google image-2002, (d) a scene from the demolition operation, (e) the graphical representation of the area recovered from aquaculture from 1997-2007.

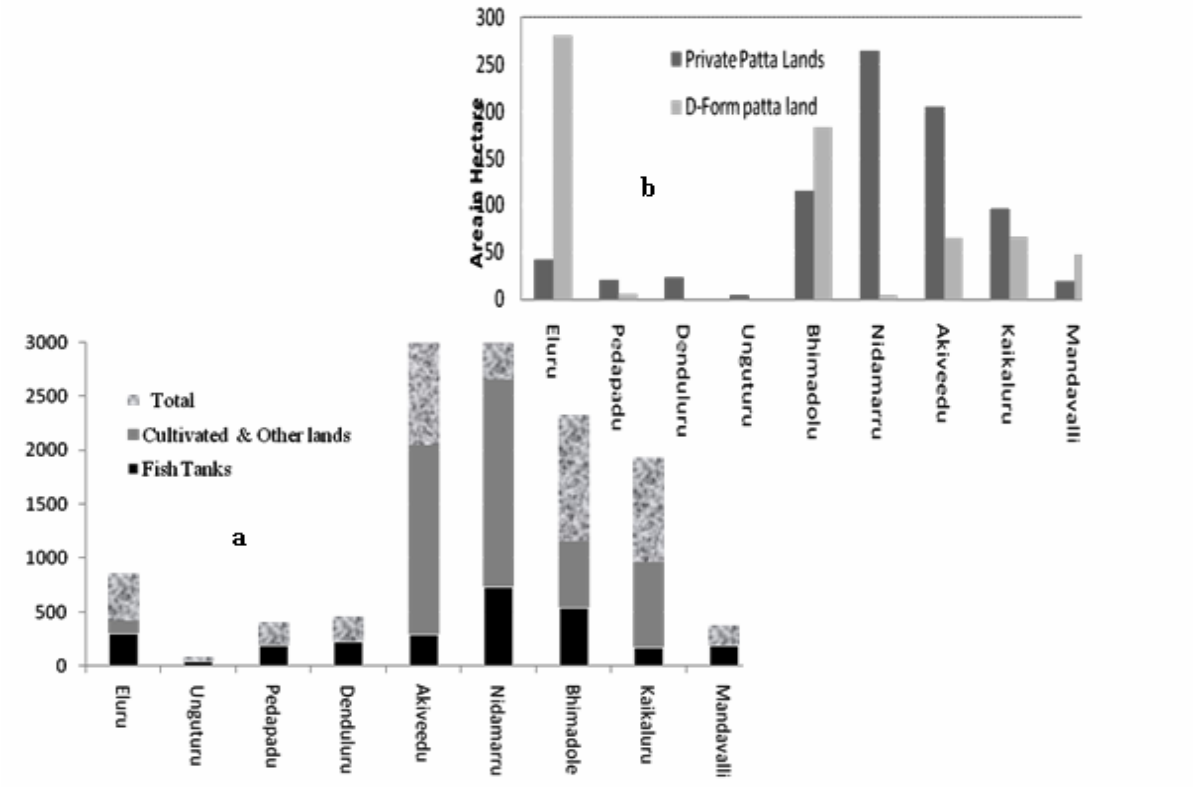

Figure 2 - a) The nine mandals in two districts with the distribution of aquaculture and agriculture lands; (b) Representing the comparative account of of Private and D-form Patta lands in the nine mandals, the patta lands were the core regions that had undergone conversion to fish tanks.

3. THE SHIFTING LAND USE PATTERN AND THE MANAGEMENT INTERVENTIONS

Over the passing decade, the Kolleru crisis gained attention at various management levels also involving frequent political interventions. Before the existing conflict on land-use the entire lake area was cultivated for paddy both as Rabi [is the spring harvest also known as the winter crop] and Kharif [is the autumn harvest also known as the summer or monsoon crop]. Even now (2007) about 12% area is under cultivation, as analyzed from the spatial analysis (table 3). Also it is appealing to note that people shifted from agro based economy to carp culture as the record (from forest department statistics and management plan) shows that the farmer derived INR 12,500 per acre (Indian currency) from fish tanks as compared to INR-7500 from paddy cultivation. However, the increasing incidence of aquaculture ponds in the region in past decade was the cause of the unusual hydrological events resulting in flooding of the agricultural land in the sub-catchment. Although the Revenue Department in 2000, ordered the division of lake area into critical and most critical zones for the purpose of channelization in order to tackle the problem of submersion of surrounding agricultural lands. The removal of encroachments was thought as serious step by the Revenue Department for the protection of sanctuary in order to restore its function as a balancing reservoir in the event of flood, even so nothing much came into practice.

In addition the treatments of catchment area the other recommendation of the management was to increase in the carrying capacity of the existing outlet (Upputeru) into the sea to facilitate draining of flood water was also among the listed set of activities; it took awhile for them to be executed, when finally in June 2006 the aquaculture demolition came about. Also, the lake reclamation activities took more ground; whilst the complete cancellation of the 'pattas' and the acquisition of private land inside the sanctuary were the issues of concern. With the target to free the sanctuary land from all encumbrances the Forest Department took over an active role; nevertheless the dynamics of illegal activity or re-activation or/and repairing of the breached fish tanks in the region is not an uncommon event. Such reports in majority of cases are blamed to the acute shortage of vehicles and funds hindering patrolling activity. The event of flooding in the region in 2005 (www.thehindu.com- Wednesday, December 07, 2005) created a lot of hue and cry among the different stakeholders; as the principal need was to maintain the flood balancing reservoir service of the landscape. If not for this an alternative need to be designed to build a channel for quick discharge of flood water that facilitates the gradual diminishing of the lake in the monsoons. Although the former seems more economical for the State Legislative Assembly (the local governing body entitled to allocate funds) the uncertainties attached were innumerable. To discuss one of these, we are quoting the non-cooperation/ acceptance gradient of the private lands owners inside the sanctuary area. As for the latter situation a mammoth fund is required to re-locate the community and compensate for the land value (also keeping in mind a minimum of 10% appreciation in land value each year).

Also, it came to light while discussing with the forest officials that the process of revering back from aquaculture to agrarian system was taking deep root in 2005, when the Minister for Agriculture along with other stakeholders such as Revenue, Irrigation and Forest Department started the talk in October, 2005 to overcome the present situation and to facilitate the process for acclivity in paddy crop. As a proffer it was coiffed that irrigation water at the initial stage would be catered by breaching fish ponds and gapping in the roads which falls in the alignment of water courses and weeding out the irrigation canals. Furthermore, the issue of facilitating the Upputeru free flow system gained roots. This proposition was operationalised by appointing teams from each and representivity from the stakeholder section. However it was discernible from our discussion with the community (bed and belt villages inside the sanctuary); that their representation as the stakeholder was not wholly addressed.

Table 3 - Spatial statistics (2007) for the land cover/use (units) for the Kolleru -post demolition

Land cover / use units	Area in hectares	Area %
Aquatic vegetation	10685.3	28.4
Marshy land	6432.4	17.1
Open land	4655.2	12.4
Agriculture	4412.9	11.7
Open Lake with floating vegetation	6672.8	17.7
Aquaculture	1495.6	4
Settlement	2623.3	7
Cloud	693.9	1.8

4. THE POST DEMOLITION SCENARIO

Following the above discourses; the demolition of 380 fish tanks covering an extent of 21,796 acres (8820.5 hectare) was initiated to ease free flow of water in June, 2006 (as per the Forest Department records- refer to figure 1d). It was seen that of official demolition records that off the 76 tanks in the encroached region in west Godavari region, 50 were breached that amounts to 191.5 hectare whilst in Krishna a total of 94.4 hectare of encroached area under aquaculture was demolished. The details on the other mandal can be seen in table 2. On the contrary, the spatial analysis approach adopted in the present study also checks the statistical notes provided by the stakeholders departments post demolition, while evidently keeping a monitor on new encroachments. In addition, removal of weeds and clearing of drains was taken up to add to the process. However, the operation met resistance from fish tank owners even though all these fish tanks were illegal and most of them were actually encroachment over drains and government lands (figure 1c). Fleeceable people especially from the bed villages were motivated by the tank owner against the breaching operation, wherein they demonstrated their protest in from of 'dharnas' (local strike). Directly after the aquaculture breaching operation in 2006, livelihoods to the poor stood as a major concern. Subsequently, Kolleru was on the forepart of the political parties; on the mottoes of all farmers' organizations and wish list of environmentalists and people at large within the district, state and at national level. What was needed on precedence was to assess the changes experienced by the ecological, hydrological and the social sector.

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Table 2 - District wise statistics of aquaculture demolition in Kolleru; the selected areas depict the impact in each district (Source of data: Forest Department Survey Statistics for selected mandals)

District	**Mandal**	**Encroached area**		**No. of Tanks Breached**		**Balance**	
		No. of Tanks	Area in Hectares	No. of Tanks	Area in Hectares	No. of Tanks	Area in Hectares
West Godavari	Bhimadolu	36	186.7	13	131.7	23	55.0
	Nidamarru	1	1.6	0	0.0	1	1.6
	Akiveedu	20	23.6	20	23.6	0	0.0
	Eluru	19	37.8	17	36.1	2	1.7
Total of West Godavari		76	249.8	50	191.5	26	58.3
Krishna	Kaikaluru	15	83.7	0	0.0	15	83.7
	Mandavalli	2	9.7	0	0.0	2	9.7
Total of Krishna		17	93.4	0	0.0	17	93.4
Total of both districts		93	343.1	50	191.5	43	151.6

With a specific objective is to highlight the post-demolition scene from multiple fronts, the present analysis started with the quantitative characterization of the ecological spectrum of the lake using the earth observation data from 2007-Indian Satellite Series (IRS)- LISS III (with a spatial resolution of 23.5m) using a 'WINDOWS' based ERDAS IMAGINE 8.6 image processing software and refined and validated based on the information collected from the reconnaissance survey (spread from 2006-2007; pre and post classification). With a opinion that the significance of digital image processing and GIS analysis of the satellite sensor data in precisely valuing the physical landscape conditions and changes therefrom in inaccessible terrains, such as in the case of the Kolleru lake, so that appropriate preventive and/or sanative framework can be designed to sustainably manage such threatened but important wetland ecosystems**.** It was brought to our notice by the Forest Departemsnt officilas that by 2005, more than 50 % of the lake area was cultivated for fish (as per survey statistics), while the post-demolition spatial analysis for 2007 relfects the aquaculture zone narrowing to 4 percent. On the other side the openland (lake bed region) along with marsh and the aquactic vegation cover around 48%, hence reflecting an disposition towards resoration (table 3). The post demolition spatial output for 2007 was also schematically compared with anecdotal map records of the Forest department as we can see in Figure 3; so as to capture the visual transition and the aquaculture spread from 1975 (figure 4). This recent evaluation of the landscape following the demolition phase, would certainly provide valuable input to assess the status of landscape, also highlighting the options of the utilising the changes in the land cover {such as conversion of breached fish tanks beds into natural vegetation with reed and sedges}as a alternative livelihood source.

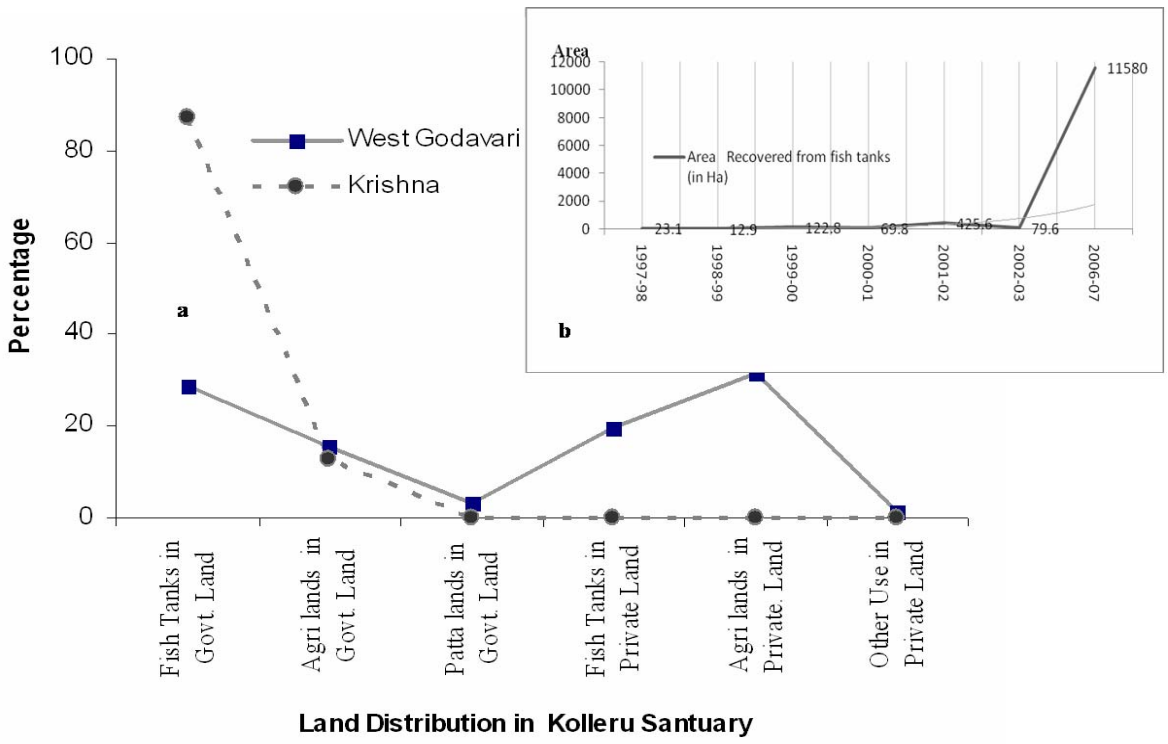

Figure 3 - a) The two districts forming the region of Kolleru *viz.*, Krishna and West Godavari with the portion of land under each activity; it shows that extent the aquaculture penetrated the government lands inside the sanctuary; (b) this subset reflects rise in the lake restoration area from fish tanks during 2006-07 demolition.

On the social front the post demolition survey (below +5 contour area) by the management authorities that centered on the socio-economic activities ascoiated with the lake identified about 14,000 families in about 44 villages that were affected by the demolition of fish tanks (gathered from the discussion by Forest department officials). These were foreboded to be covered under the Livelihood Enhancement Action Plan that supports alternative livelihoods for the affected families covering nine mandals and two districts using live participation of the community. Also, it was brought to the notice that during the stakeholder discussion, it was seen that 107 different livelihoods with an outlay of INR 6700 million is recommended (with maximum limit of INR 25,000 (equivalent to USD625 per family). It also came out of the stakeholder discussion that need of relevant scineftic information related to the present status of agriculture scenario in both bed and belt villages along soil and water assessment are needed to plan the sustainable livelihood strategies. Activities such as seed ranching, imparting training to self-help groups, and establishment of post harvest centre, revival of traditional fisheries, craft industry, fish drying, and pension scheme were suggestion to assist the communities sustain with the changing phase of land use pattern. Eco-tourism was seen as a potential tool to involve in the lake conservation campaign. Withal the response of the community gathered based on our focal group discussions and the research survey in 2007 does not quite overlap with the government plans, as on one side people ill founded apprehensions on the role of Forest Department in wake of sanctuary becoming a reality. The restrictions and sanctions that are likely to come in the way of their way livelihood and life style were sensed negatively by the people. At the present as government has been closely negotiating with communities to commence with the sanctuary restoration, considering such uncertainties is very unlikely that the balanced trade is expected.

The post-demolition soil analysis that both in bed and belt villages the black clay soils with a pH from 6.5-7.5 and appropriate phosphorous and potash content supports paddy as a Rabi crop (report by Forest Department); however the annual and seasonal variation in the rainfall pattern and the flood water dynamics in the wet season makes it slightly uncertain. Palpably, the drainages of the Kolleru wetland had been severely impacted (blocked) by the by construction of large number of fish tank in the past; at times also inundating the Kharif crop, such incidences were recorded in 1986, 1996 and 2005 (Rao and Sekhar, 2002; The Hindu-2005). In addition, Kolleru occasionally receives the back water flows form the sea through the Upputeru that tends to spreads into the paddy field below +5 contour, therewith impacting the crop productivity and the soil salinity. While, the seepage from the fish tanks into the surrounding cultivated areas adds to the salinity. As of now, the backwash of the aquaculture necessitates the rehabilitation of the cultivated area to handle the salinity issues, before the farmers get back to this livelihood practice. Also the proposed set of post-demolition activities to restore the ecological and the socio-economic attributes of the lake; include the raising the traditional fishing; also it says that's more than 60 species of fish can be cultured. The low density stocking mosty by natural feeding is also among the permitted set of activities.

From the management side it was declared that after the demolition, the hydrological impacts for the agricultural zone can be explained the dip in the surface water level from 5-7 feet (prior to tanks demolition) to 1-1.5 feet. That came as a sign of relief for the adjoining farming community. The government order [G.O.Ms.No.120] for demolition also posited that the Kolleru Lake restoration cannot be treated in isolation of people living in that area and hence the plan of action should integrate respective departments and should put people in the Kolleru bed villages primal to the planning. However, in practice a little of these were followed and what stood as the greatest worry was; are we intending just for management or do we require 'just' and 'sustainable' management. And incase, we opt for the latter we feel that a need of a comprehensive plan of action for future is apparent and it is pertinent to build consensus among the governing authorities and elevate community participation in the decision making process.

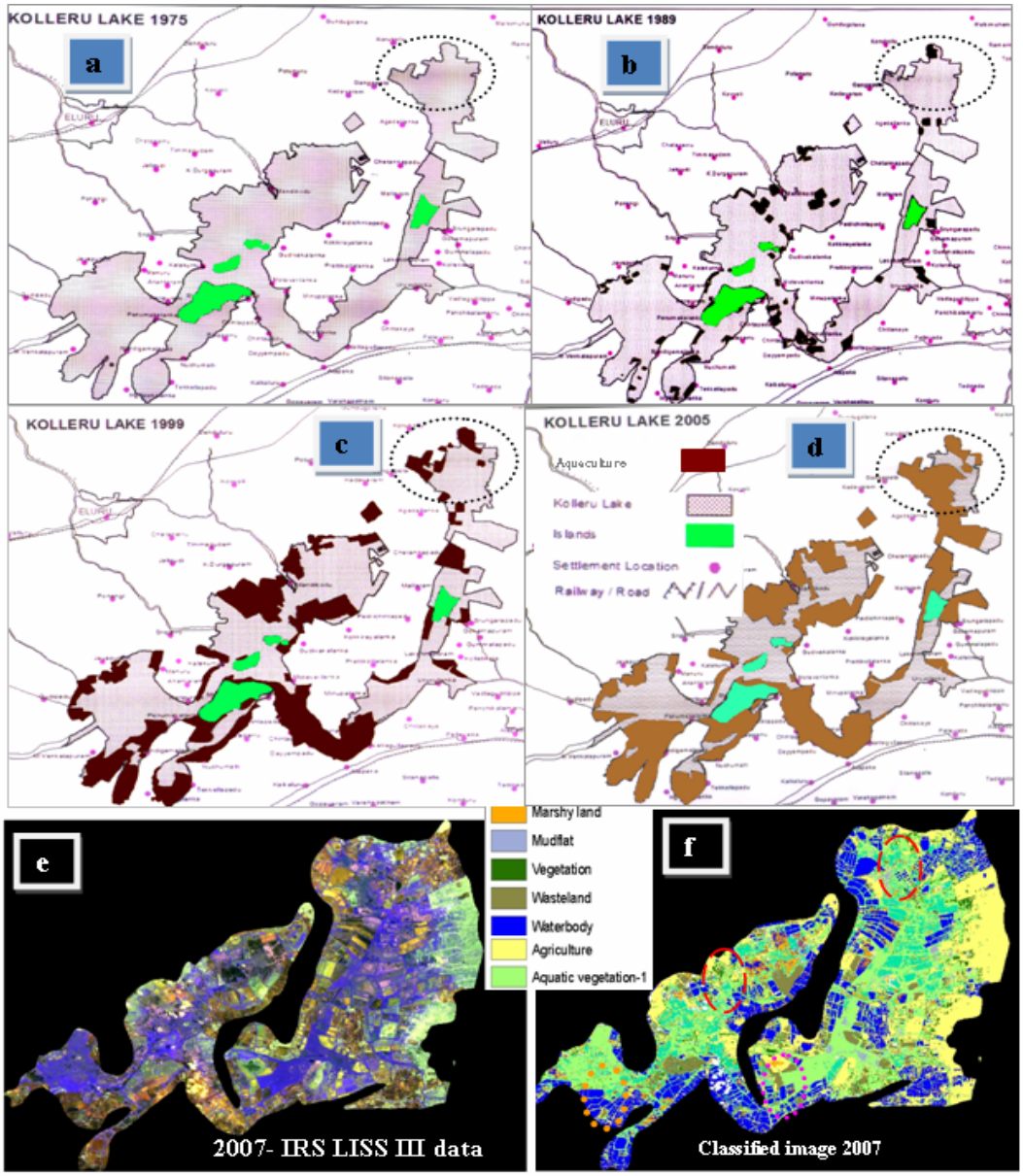

Figure 4 - The aquaculture dynamics of Lake Kolleru from 1975 to 2007: the travel of pre-demolition aquaculture is well depicted using a combination of survey synthesis by Forest Department (a, b, c, d) and the post-demolition scene is shown using geospatial images from 2007 (e and f).

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