

Role of Wetlands in Achieving Sustainable Development Goals

L. Venkatachalam Ph.D.

Madras Institute of Development Studies (MIDS)

Email: Venkat@mids.ac.in

Wetlands:

- “areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres”. Ramsar, 1971.

Wetlands and SDGs:

- SDG 6: Water Supply and Sanitation
- SDG 1: Poverty Reduction
- SDG 2: No Hunger
- SDG 3: Good Health and Wellbeing
- SDG 4: Quality Education (Female Education)
- SDG 5: Gender Equality
- SDG 10: Reduced Inequality
- SDG 11: Sustainable Cities and Communities
- SDG 15: Protecting Terrestrial Ecosystems and Biodiversity

Our Study:

- TN Government with the help of SACON identified 80 prioritised wetlands under Phase I (another set of 61 wetlands under Phase II); our focus is on the 80 wetlands under Phase I;
- Provisioning Services, Regulating services, Cultural Services and Supporting Services (TEEB, 2010 classification) -focus on the first three types of services;
- Most of these services are non-market services, their values are underrepresented and therefore, the wetlands are gradually becoming wastelands;
- Evidence-Based Policy: Protecting and managing the state's wetlands require information on the ecosystem services of the wetlands.
- Valuation data is required for notification and restoration of priority wetlands, selection of Ramsar sites, and for long-term maintenance of wetlands

Objectives:

- To estimate the economic value of ecosystem benefits and their losses in *monetary terms* in order to design appropriate policy instruments for efficient, equitable and sustainable management of wetlands in the state;
- To provide a framework for the decision-making bodies-especially, the Tamil Nadu State Wetland Authority and District Wetland Management Committees in the state-to periodically assess the quantum of ecosystem benefits/costs due to changes (either improvement or deterioration) in the wetland ecosystem; and
- To explore the possibility of introducing innovative institutional approaches, especially, *payment for ecosystem services (PES)*, for sustainable management of the state's wetlands.

Methodology:

- A 'Natural Resources Accounting' (NRA) framework for estimating the physical and monetary values of flow of ecosystem services (ES) for each prioritised wetland;
- Some ES can be quantified in physical and monetary units; some of them are qualitative but still be quantified in monetary units; but, some of them cannot be quantified either in physical units or in monetary units!
- Therefore, a 'Value +' approach (Verma *et al.* 2019) has been adopted:
 - The '**Value**' represents the 'monetary value' of all those services for which such value is derived based on the available knowledge and economic valuation tools and principles; and
 - The '+' represents all those benefits for which economic valuation is currently not possible -they are identified, listed and quantified in physical units wherever possible;
 - Only primary values of ES are estimated, not the secondary benefits to avoid double counting problem.

Data Sources:

- Secondary Sources: SACON (2019), IAMWARM, MIDS, brief documents, published literature, etc
- Primary Survey (2020-21):
 - Beneficiary villages/towns, streets and households in streets for each wetland were selected on the basis of random sampling ;
 - If the number of villages/towns is less, then we selected all of them;
 - To ensure adequate representation of major users, focus group discussion and snowball sampling were used; and
 - Altogether, we completed 5,394 household surveys among the stakeholders of 72 prioritised wetlands (for the remaining 8 wetlands, we used BT values from the 'similar' wetlands from the 72 wetlands);
 - Results from the sample households were extrapolated to the 5,25,586 households in the command area of all the 80 wetlands;
 - Computer Assisted Personal Interview (CAPI) mode of data collection using ODK software.

Food: Fish



Food: Prawns



Food: Crabs



Food: Snails



Food: Mussels



Food: Tubers



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Food: Greens



Food: Greens



Food: Vegetables



Minor Forest Produces...



Continue....



Wood for agricultural implements and cowshed



Fuel wood



Drinking Water: Direct use



Drinking water....



Drinking water: Government Supply



Drinking water: Government Supply



Drinking water: Private Vendors



Drinking Water: Private Vendors



Surface Irrigation



Groundwater Irrigation



Groundwater sales....



Water for Industry



Recreational benefit



Recreational benefit...



Swimming.....



Bathing benefit



Washing benefits



Washing benefits...



Religious benefit



Religious benefit...



Cultural benefits



Benefit for Livestock



Goats Grazing



Grazing benefits



Enhanced fodder availability



Cooling of water buffaloes



Washing Cattle



Washing Machineries..



Grass for commercial purpose



Enhanced availability of medicinal plants



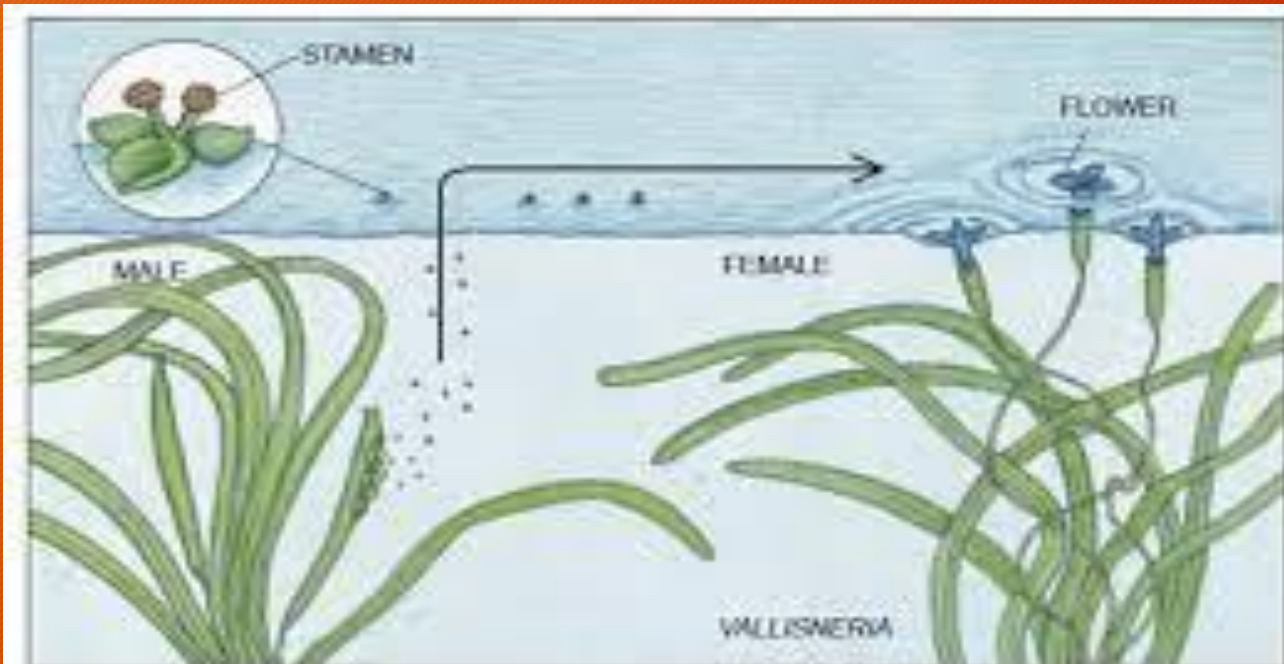
Medicinal plants: *Thoodhuvalai*



Medicinal Plant: *Keezhanelli*



Pollination



ABOVE-SURFACE POLLINATION is one reproductive strategy that hydrophilous, or water pollinated, species rely on. The pollen grains are kept above the water, where they are transported via floating male flowers that plow into female flowers to effect pollination. Examples are *Enhalus*, *Lagarosiphon* and *Vallisneria*.

Fertile soil for agriculture



Clay for Pottery



Clay for Toy Making



Direct livelihoods..



Direct Livelihoods...



Fishing..



Production of Salt



Aesthetic Benefit



Recreational fishing..



Bird watching



Biodiversity.....



Research benefits



Educational Benefits



Flood regulation



Disposal service -industrial pollution



Disposal service -urban sewage



Disposal service -solid waste



Other ecosystem benefits

- Micro climate stabilisation
- Groundwater recharge and improved water quality
- CO₂ and methane absorption
- Soil moisture conservation

Three Economic Valuation Approaches:

- Approach -1: Actual Values of Ecosystem Services currently used: Market Price Method, Production Function Approach, Travel Cost Method and Benefit Transfer Values (for those ecosystem services for which local values cannot be estimated)
- Approach -2: Actual Values of Ecosystem Services based on Household Preferences: The Contingent Valuation method -to elicit the preferences of the users for current as well as future ecosystem values arising from restoration;
- Approach-3: Potential Values: In case the wetlands are restored to their full capacity, what would be the maximum potential value? Benefit Transfer Method (BTM) (De Groot *et al.* (2012); Costanza *et al.* (2014), Russi *et al.* (2013); etc).

Valuation Methods Used:

Sl. No.	Ecosystem Service	Method of Valuation
1.	Food: Fish and other Aquacultural Products	Market Price Method
2	Water for consumption household, industry and commercial establishment	Market Price Method
3	Irrigation Benefits	Net Farm Income/Production Function Approach
4	Water for Allied Activities: Livestock	Income Method/Market Price
5.	Fodder and Open Grazing	Market Price Method -Opportunity cost approach
6.	Minor Wetland Produces (leafy vegetables, lotus and lilly, etc)	Income Method
7.	Minor Forest Produces (fuelwood, etc)	Income Method

Continue..

Sl. No.	Ecosystem Service	Method of Valuation
8.	Recreational Benefits	Travel Cost Method
9.	Cultural Benefits	Benefit Transfer/CVM
10.	Top Soil: Agriculture use, pottery, toy making, etc	Net Income Method
11.	Gene Pool Protection	Benefit Transfer Method
12.	Carbon Sequestration	+ Approach
13.	Microclimatic Regulation	+ Approach
14.	Purification of Water Quality	+ Approach due to double counting
15.	Soil Conservation and sedimentation	+ Approach
16.	Flood Regulation	Benefit Transfer Method
17	Biodiversity	CVM/Benefit Transfer Method

Continue...

Sl. No.	Ecosystem Service	Method of Valuation
19.	Biological Control	+ Approach
20.	Pollination	+ Approach
21.	Research and Education	+ Approach.

Nature of Prioritised Wetlands

Type of Wetlands	Number of Wetlands	Percentage
Man-Made	43	53.75
Natural Inland	33	41.25
Coastal	4	05.00
Total	80	100.00

Ownership of Prioritised Wetlands

Managed By	Number of Wetlands	Percentage
Public Works Department (PWD)	61	76.25
Tamil Nadu Forest Department	10	12.5
Municipality	4	5.00
Tamil Nadu Tourism Department	2	2.5
Forest Department and PWD	2	2.5
Village Panchayat	1	1.25
Total	80	100

'Value +' Approach

Example: Athiyur Wetland, Perambalur District

Sl. No.	ECOSYSTEM SERVICES	Number of Beneficiaries	Minimum	Maximum	Average (Quantity)	Minimum	Maximum	Average Value
1	Irrigation	27	45	6,000	2,032.02	9,00	4,00,000	55,967.04
2	Biomass	2	20	20	20	1,000	8,000	4,500
3	Fishing	2	1	300	150.5	6,00	1,500	1,050
4	Cattle Grazing	26	1	4	2.18	2,430	30,400	9,635.45
5	Fodder Collection	1	150	150	150	3,000	3,000	3,000
6	Water for livestock	12 *	*	*	*	*	*	*
7	Water for Industry	1 *	*	*	*	*	*	*
8	Water for temples or festivals	7 *	*	*	*	*	*	*
9	Ground water use	10 *	*	*	*	*	*	*
10	Wood	13	2	2,400	246.92	50	6,000	1,467.31
11	Bathing and Swimming	46 *	*	*	*	*	*	*
12	Cleaning and Washing	11 *	*	*	*	*	*	*
13	Cultural and religious activities	14 *	*	*	*	*	*	*
14	Duck rearing	1 *	*	*	*	*	*	*
15	Goatery/Goat farming	2 *	*	*	*	*	*	*
16	Photography	4 *	*	*	*	*	*	*
17	Bird Watching	11 *	*	*	*	*	*	*
18	Use of Topsoil	2	12	200	106	5,000	5,400	5,200
19	Recreation	3 *	*	*	*	*	*	*
20	Habitat for Biodiversity	12 *	*	*	*	*	*	*

Approach-1: Actual Values of Ecosystem Services Generated at present (Source: SACON (2019) and Primary Survey 2020-21)

Number of Ecosystems Delivered	<10 ES	11-20 ES	21-30 ES	>31 ES	TOTAL
Number of Wetlands	3	20	43	14	80
% of Wetlands	3.75	25.00	53.75	17.5	100.00

Results: Current ES Values based on Market Price Methods (in Rs. /Yr.).

Nature of Wetlands	Provisional Services	Cultural Services	Regulating Services	Total Value
Kazhuveli	5,29,12,705.97	9,47,74,305.29	51,17,29,388.5	65,94,16,399.80
Point Calimere Wildlife and Bird Sanctuary	8,09,58,484.85	8,623,2,415.12	46,56,07,855.6	63,27,98,755.60
Pulicat	78,03,26,819.90	1,64,97,17,912.00	8,90,75,74,006.00	11,33,76,18,738.00
Pallikaranai	38,32,08,084.20	5,89,24,938.868	9,61,40,689.73	53,82,73,712.80
Total ES Value (Coastal Wetlands)	1,29,74,06,095.00	1,88,96,49,571.00	9,98,10,51,940.00	13,16,81,07,606.00
Total ES Value for 76 Inland Wetlands	11,54,66,97,388.00	1,01,37,21,608.00	4,11,12,16,885.00	30,69,84,82,370.00
Drinking Water Value (Bulk Supply)	14,02,68,46,489.00			
Total Value for 80 Wetlands	26,87,09,49,972.00 (61.26%)	2,90,33,71,179.00 (32.26%)	14,09,22,68,825.00 (6.28%)	43,86,65,89,976.00

Seventy percent value comes from inland wetlands and 30 % comes from coastal wetlands

Results...

- The estimated monetary value of all ecosystem services delivered by the 80 prioritised wetlands comes to Rs. 43,86,65,89,976.00 (or, Rs. 4,386.65 crores) per annum;
- It should be noted that 61.26 per cent (i.e., Rs. 26,87,09,49,972.00) comes from provisioning services, 32.26 per cent (i.e., 14,09,22,68,825.00) comes from cultural services and 6.28 per cent (i.e., Rs. 2,90,33,71,179.00) comes from regulating services (the regulating services are lower);
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- On an average, a typical prioritized wetland delivers ecosystem value equivalent to Rs. 54,83,32,374.7 (or, Rs. 54.83 crores) per annum.

Per ha. Value of Costal and Inland Wetlands:

Name of the 4 Costal Wetlands	Size (in Ha.)	Ecosystem System Value (Rs.)/Yr.	ES Value per Hectare (in Rs.)
Kazhuveli	3,262.00	65,94,16,399.80 (5%)	2,02,151.00
Pallikaranai	834.00	53,82,73,712.80 (4.08%)	6,45,412.12
Point Calimere Wildlife and Bird Sanctuary	2,968.00	63,27,98,755.60 (4.80%)	2,13,207.12
Pulicat	56,781.00	11,33,76,18,738.00 (86.10%)	1,99,672.75
Total	63,845.00	13,16,81,07,606.00 (100.00)	2,06,251.20

Inland Wetlands	Size (in Ha.)	Ecosystem System Value (Rs.)/Yr.	ES Value per Hectare (in Rs.)
All 76 Inland Wetlands	32,016.00	30,69,84,82,370.00	9,58,821.20

The per ha. Value of the costal wetlands is almost 4 times lesser than that of the inland wetlands

Size of Wetland and Size of Ecosystem Benefits

Size of Wetlands	Value (in Rs)/Yr.	Percentage
Less than 100 ha. (22 wetlands)	3,36,86,41,835.00	7.68
100 ha. to 500 ha. (38 wetlands)	6,29,15,88,798.00	14.34
Above 500 ha. (20 wetlands)	34,20,63,59,343.00	78.00
Total ES Value for 80 Wetlands	43,86,65,89,976.00	100.00

Size of the ecosystem benefits is positively correlated with the size of the wetland;

Approach-2: Actual Values of Ecosystem Services: Preference-based Values

Sl. No.	Primary Ecosystem Services (Provisioning)	Number of Household	Percentage
1	Irrigation	1987	37.00
2	Fishing (Fish, Crabs, Snails and Mussel)	1226	23.00
3	Cattle Grazing/Fodder	1069	20.00
4	Wood, Grass and Biomass	300	5.56
5	Cow Dung, Fuelwood, etc	69	1.30
6	Top Soil	50	0.93
7	Vegetable (Vegetables, Wild Fruits, Flowers, Medicinal Plants and Mushroom)	50	0.93
8	Others (MFPs, etc)	663	12.30
	Total Households	5394	100.00

Households use multiple ecosystem services; drinking water use is widely reported

Household Preference-based Values: Money, Labour and Kind

Out of 5,394 sample households, 3,696 households (68.52 percent) were WTP (Money, labour and kind) for improvements in the wetlands

	WTP Value (Money) (Rs.)/Yr. (1863 Hhds.)	WTP Value (Labour)/Yr. (1772 Hhds.)		WTP Value (Kind) -Kg/Yr. (61 Hhds.)	
		Labour Man-Days/year	Money Value (Rs.) = Total Number of Labour X Rs. 256.	Kg.	Money Value (Rs.) =Total number of Kgs. X Rs. 20.00
Minimum Value	100.00	6	1,536.00	5	100.00
Maximum Value	1,00,000.00	120	30,720.00	100	2000.00
Average Value	903.00	37	9393.00	30.32	606.00
Median Value	500.00	30	7680.00	10.00	200.00

Value of ES based on Household Preferences

Type of Services	Value (Rs.)/Yr.	Percentage
Provisioning Services	1,99,91,92,751.00	6.10
Drinking Water (Bulk Supply)	14,02,68,46,489.00	42.50
Cultural Services	14,09,22,68,825.00	42.70
Regulating Services	2,90,33,71,179.00	8.80
Value of All Ecosystem Services	33,021,679,244.00	100.00

Distribution of Values across Coastal and Inland Wetlands (Rs.)/Yr

Type of Wetlands	WTP Value (in Rs.)	Percentage
Coastal Wetlands (4)	12,15,49,16,895.00	36.80
Inland Wetlands (76)	20,86,67,62,349.03	63.20
Total WTP Value (All 80 Wetlands including drinking water values)	33,02,16,79,244.00	100.00

Results....

- The **total WTP** for all ecosystem services (including bulk water used for drinking purpose) is estimated to be at Rs. 33,021,679,244.00 (or, **Rs. 3,302.16 crores**) per annum;
-
- The estimated monetary value of the ES based on the market prices stands at Rs. 43,86,65,89,976.00 and that of in terms of the WTP value is Rs. 33,02,16,79,244.00;
- So, the WTP value is lesser (**by Rs. 1,084 crores**) than the ES values estimated on the basis of market price methods
- Quality of ES, income constraints, poor management/restoration and restrictions to access ES are some of the reasons for the lower level of WTP value.

Negative Impacts:

Sl. No.	Type of Negative Externality	Number of Wetlands Experiencing the Problem
1.	Encroachment	73
2.	Open Defecation	52
3.	Domestic/Urban Sewage	56
4.	Solid Waste Dumping	69
5.	Dumping of Medical Waste	43
6.	Dumping of Animal Carcase	41
7.	Industrial Effluents	57
8.	Accumulation of Silt/Siltation	80
9.	Sand/Silt Mining	07
10.	Invasive Species	77
11.	Hunting / Poaching of Birds and Animals	43
12.	Breeding of Mosquitoes/Insects/Reptiles	65
13.	Problems by Stray Animals	66
14.	Inadequate Restoration	70

Approach 3: Potential Ecosystem Values - Benefit Transfer Method

1. Coastal Wetlands (4 wetlands):

- a. The global value of Coastal wetland is US \$ 1,93,845.00 per ha per year (2012 prices). The US \$ value is converted into INR value. The exchange rate between US\$ and the INR in 2007 was: 1 US\$ = Rs. 41. 35. So, $US \$ 1,93,845 \times Rs. 41.35 = Rs. 80,15,490.75$ at 2012 prices.
- b. Since we want to estimate the current year's value, the above value has to be converted into 2019 prices. This can be done by using the 'GDP deflator' (which is 1.8) for the year 2019
- c. The domestic value in INR in 2019 is: $Rs. 1,44,27,883.35 \times 0.178 = Rs. 25,68,163.24$ (with adjustments for any change in the estimation till 2019).
- d. The economic value of the FOUR coastal wetlands is: $Rs. 25,68,163.24 \text{ per ha} \times 63,845 \text{ ha} = Rs. 1,63,96,43,81,821.57$ (or **Rs 16,396.43 crores per year**).

Continue....

- The potential values of ecosystem services from all the 80 wetlands (i.e. the value that could be achieved in case the wetlands are restored to the full capacity) stands at **Rs. 17,467. 90** crores per annum;
- The estimated current ES value stands at **Rs. 4,386.60** crore per annum (at market prices).
- Deducting the current value from the potential value yields a 'net loss' of ecosystem values worth of **Rs. 13, 081.00** crores per annum
- This is a lower-bound value since some of the important values (e.g., carbon sequestration) has not been estimated and added to it.

Differences in Actual and Potential Values

Among 22 wetlands, the actual values are much lesser than the potential value (by Rs15,203 crores)

Total Current ES Value (crore in Rs.)	Potential Value (in Rs.)	Value of Current Loss (ES - Potential value) (in Rs.)
15,82,25,98,129.41	1,67,85,40,74,413.67	1,52,03,14,76,283.96

Among 58 wetlands, the actual value exceeds the potential value (by Rs. 2,121.85 crores)

Total Current ES Value (crore in Rs.)	Potential Value (in Rs.)	Value of Current Loss (ES - Potential value) (in Rs.)
28,04,39,97,847.17	6,82,54,53,332.17	21,21,85,44,514.38

The gains are offset by the loss of value of ecosystem services

Results...

- The net loss is: Rs. 13, 081.00 crore per annum
- The cost of restoration of the 80 prioritised wetlands, estimated on the basis of the secondary sources, stands at Rs. 230.19 crores per annum (cost incurred in the past is not included here).
- Incurring Rs. 230.19 crores in restoring the wetlands would result in a net gain of Rs. 12,850.81 crores (and the additional gains from all other ES)
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Recommendations:

- A 'natural resource accounting approach' should be adopted in assessing the wetlands so that the stock of water in the wetlands and flow of ecosystem services can be constantly measured and monitored;
- Of all the 80 prioritised wetlands, for 58 wetlands the estimated actual value of ecosystem services exceeds the potential value approximately by Rs. 2,121.85 crore. This means that these wetlands are being currently over-used. There is, therefore, a need for regulating different uses of wetland ecosystems so that the uses are optimised and the benefits are reaped on a sustainable basis;
- More attention has to be given to restoring and managing those 22 wetlands whose current values are much lesser than the potential values so that the users (both current and potential) of the wetlands could gain a net amount of Rs. 12,850.81 crore worth of income every year.
- Our study results suggest that restoration of wetlands and expanding the size of the wetlands by way of removing the encroachment will increase the ecosystem benefits considerably. For example, when we move from smaller (less than 100 ha.) wetlands to medium wetlands (101 ha. - 500 ha.), the value of ecosystem benefits increases by two times; similarly, when we move from medium wetlands to larger wetlands (above 500 ha.), the value increases by ten times. Therefore, expanding the size of the wetlands wherever possible can be a better option for increasing the size of the ecosystem services. Alternatively interpreted, preventing the wetlands from shrinking will lead to avoid significant loss of ecosystem services.

Recommendations.....

- Most of the wetlands at present are managed by a single government agency (mostly by PWD with 76.25 per cent priority wetlands under its direct control) and as a result, the 'collective action' from various line departments required for efficient, equitable and sustainable management of wetlands is not strengthened. In order to strengthen the institutional governance, we need to involve all the agencies and departments with clear roles specified to them in managing the wetlands. For example, the TNSWA, PWD, Forest Department, Tourism Department, Fishery Department, etc. should be involved in decision-making and should be closely working with each other in a cooperative manner; the TNSWA should assume responsibility for overall coordination of activities among all the stakeholders;
- In addition to coordination among the above agencies, there should be a close coordination of government agencies with other major stakeholders, namely, the community, Non-Governmental Organisations, Corporate firms, industry organisations, water user associations, farmer producer organisations and panchayats, not only in generating information for management decisions but also for decisions regarding restoring, managing and monitoring the wetlands. The conventional way of preparing the 'management plan' and the 'brief documents' by a single government agency (e.g., forest department) should be done away with. In future, they should be prepared in meaningful consultation with all the stakeholders mentioned above. The preferences of all the stakeholders in general and that of the local community in particular should be taken into account in all management plans and policies. Stakeholders' consultation and involvement in all restoration and management related activities would create a situation where the optimum level of potential benefits can be fully realised and shared by all the stakeholders;

Recommendations...

- The 'payment for ecosystem services' (PES) mechanism for water resources has a great potential in Tamil Nadu for creating a win-win outcome for all the stakeholders of wetlands.;
- The community shows considerable interest in participating in the PES scheme proposed. For example, 4,675 sample households (approximately 86.67 per cent) expressed their interest to participate in the PES scheme on a benefit-sharing basis while 13.33 per cent does not show any interest. This implies that the community can be effectively involved in implementing the PES scheme which will not only improve the quality of the wetlands but also the wellbeing of the community on a long-term basis;
- Data-base on wetlands and their ecosystem need to be strengthened. In order to do this, there is need for building capacity within the line departments. The officials of the line departments should be trained in environmental economics, social benefit-cost analysis, project evaluation, survey methods and data collection, and economic appraisals of wetland related policies. They need to be given periodical trainings on the above topics. The information collected and all other outputs will have to be maintained under the close supervision of the TNSWA.



Thank you