

Citizen-Science approach to engage and knowledge-empower communities to sustain ecosystem services

In the context of East Kolkata Wetlands,
only Ramsar site of West Bengal, India



Project implementation & report by
South Asian Forum for Environment

Supported by
EARTHWATCH INSTITUTE

East Kolkata Wetlands recycles
1380 million liters of city's sewage per day..

Save the ailing kidney of Kolkata



East Kolkata of Wetlands

Project summary:

Wetlands are the greatest natural resource recycling ecosystems with multiple nature services through a confluence of terrestrial and aquatic habitats. Their biotic and abiotic systems facilitate micro-climate regulation & carbon sequestering, flood control, erosion reduction and maintain groundwater levels. Their functions accordingly enable water recycling / purification particularly in urban areas with implications for management of pollutants, toxins, heavy metals etc.

However, issues related to climate change, waste, water, food, energy, consumption, land management, ecosystem services and survival of species have imposed additional challenges on the form and function of wetlands. The situation becomes more complex when peri-urban wetlands are considered. They are areas that respond to urban demands, but face ecosystem degradation amidst rising poverty. Planners often respond to immediate needs of these spaces in an ad-hoc manner, lacking adequacy in sustainability perspective. Whereas, nature capital in peri-urban areas has immense potentials in extending ecosystem services especially to urban poor, it can as well develop resilience to climate impacts on urban sector. Ecosystem services of peri-urban ecosystems in urban context are currently ostracized from conservation priorities in developing global south.

Therefore, prioritizing the need for looking at issues affecting peri-urban areas, this community based action-research would try to focus on a select internationally acclaimed Ramsar wetland at the peri-urban interface known as East Kolkata Wetlands, wherein intensification of sustainable agro-aqua-farming can bring benefits to marginalized communities. Thus, defining a roadmap for enhancing ecosystem services of the wetlands towards sustainable food production and poverty alleviation will be the ultimate aim of the program wherein community would be adequately enabled through technology collaboration and capacity building, financial inclusion and environmental stewardship inviting participation, partnership, equity and reciprocity.

Project Objectives :

This project attempted to:

- Capture prevalent understanding of various environmental issues linked to EKW through experiential learning based on the citizen science framework: Develop and use locally adapted communication modules.
- Prepare communities comprehend challenges and evolve solutions centred on the rudiments of bio-rights approaches that have emerged already at the site: Enhance their levels of understanding.

Project Activities :

1. Preparing a correlation matrix for livelihoods and Ecosystem Services at the present situation:

1.1. Socioeconomic Survey in the study area for identification of primary beneficiaries and their livelihood dependency on the ESs extended by East Kolkata Wetlands Ramsar site:

• *Introduction :*

Located at the east of the city of Kolkata the East Kolkata Wetland (22° 27' N 88° 27' E) is a unique wetland ecosystem which not only provide habitat for a wide range of biodiversity but also offers livelihood to thousands of local community. The uniqueness of the wetland lies in the fact that the whole wetland functions as a resource recovery system. It acts as the sink and natural purification system of the urban waste water and after purification the water is used for fish cultivation and agriculture.

The whole region has gone through various phases of evolution which has their prominent effect on the life and livelihood of the people around it. Although providing wide number of benefits, the wetland is suffering from various crises which in turn adversely affect the livelihood of the community dependent on the Ecosystem Services of the wetland.

The present study aimed at identifying the primary beneficiaries of the wetland as well as understanding their degree

of dependency on the wetland. In this regard a socio-economic survey has been conducted in the East Kolkata Wetland with structured questionnaire which covered 300 beneficiaries of the wetland.

Aims and objectives :

The main objectives of the survey were:

- To identify the primary beneficiaries of the wetland.
- Livelihood dependency level of both the direct and indirect beneficiaries on the Ecosystem Services of the wetland.
- Socio-economic condition of the beneficiaries.



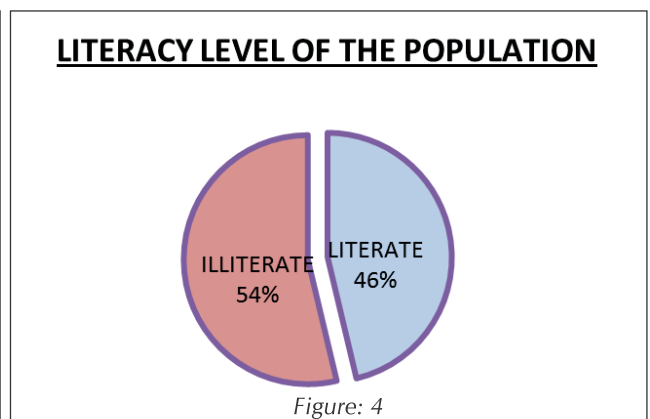
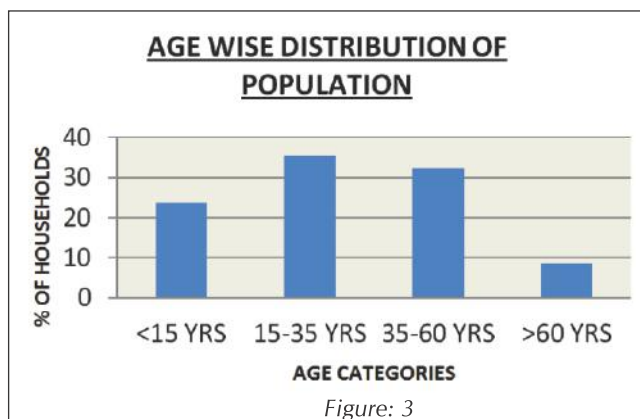
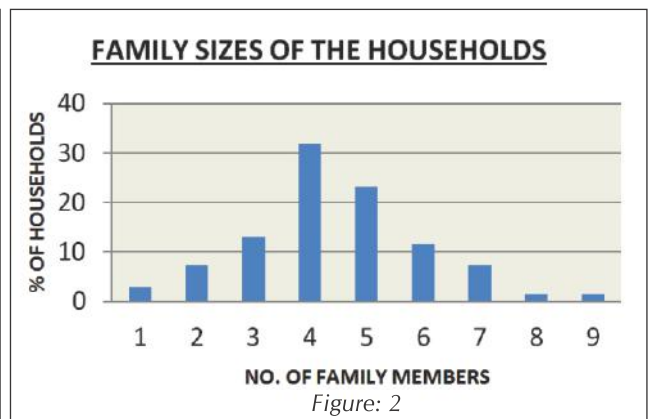
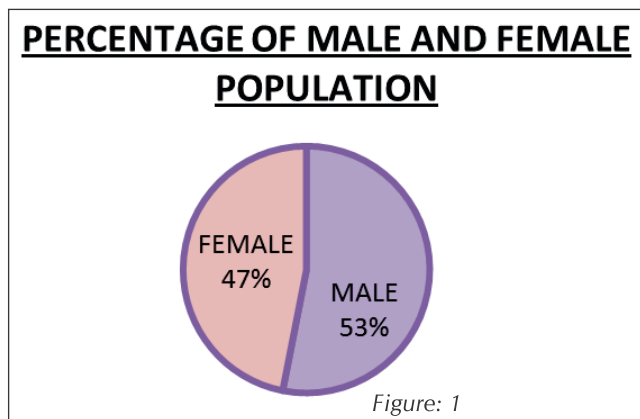
SAFE field-survey team interviewing farmers at EKW agriculture area

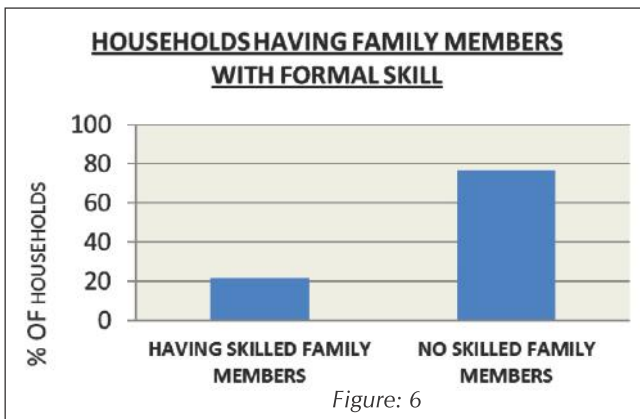
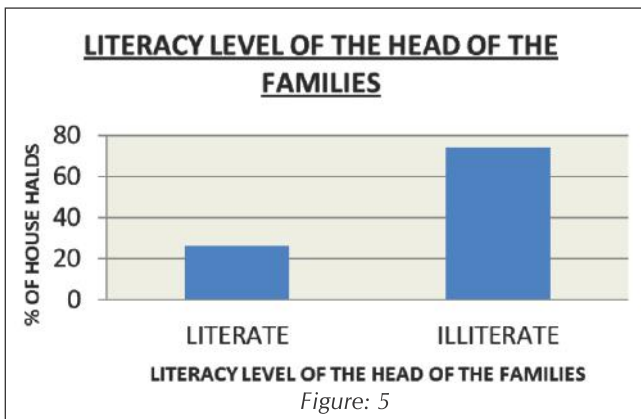
Results and Discussion :

Various aspects of social, economic and demographic aspects of the beneficiaries have been taken into account to analyze the present socio-economic condition of the wetland community.

Socio-Demographic Profile:

The study shows that of the total surveyed population 53.09% are male and 46.91% are female and the sex ratio is 883. Family size of the households vary from one to nine persons per family whereas most of the families have four (31.88%) to five (23.19%) family members. Of the total surveyed households, 37.68% of the households have female head of the family. The age wise distribution of population shows that 23.56% of the population has

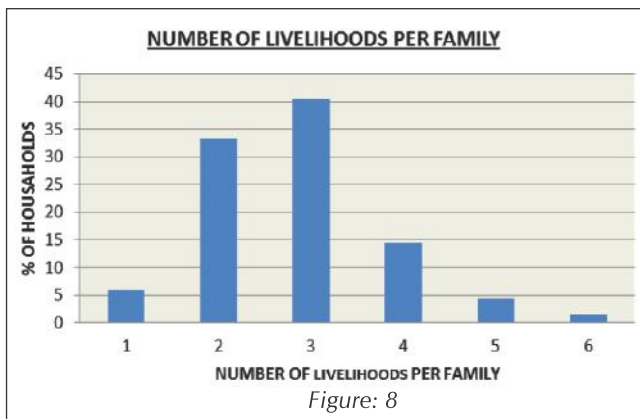
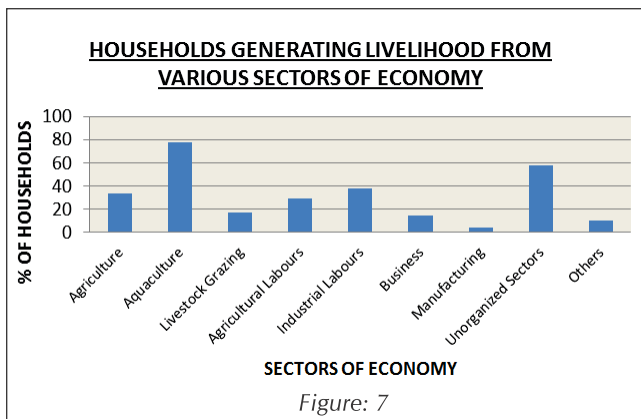




age below 15 years, 35.65% have age between 15-35 years and 32.33% have age between 35-60 years while 8.46% have age over 60 years. Average dependency ratio is 0.54. Of the total surveyed population 46.27% are literate and 53.73% are illiterate. Only 26.09% of the families have literate head of the family and only 21.74% of the families have at least one person having specialized skill. Thus the region is still backward in respect to literacy level.

• **Livelihood Strategies:**

The wetland provides mainly two livelihood opportunities namely agriculture and aquaculture. The local people of the surrounding areas started fish farming in the interconnected water bodies and vegetable farming in the surrounding areas of solid waste dumping sites in traditional way without much of agricultural inputs. Natural nutrient supply in the water bodies and high fertility of the land areas surrounding dumping ground resulted in high productivity of both fish and vegetables. It encouraged more and more people to be engaged in this occupation and as a result more and more land had been converted into Bheries and vegetable farming grounds. But in march of time due to various causes fertility of the vegetable farms has decreased and the fish farms are also suffering from various problems. As a result production in both the sectors has reduced and as a result has become economically less viable. As a result of this more and more people are getting engaged in livelihoods other than agriculture and aquaculture. The study reveals that of the total surveyed households (who originally belonged to either agriculture or aquaculture community) 89% households have at least one family member who has shifted from traditional livelihood. Besides as an adaptive strategy each family is having more diversified livelihoods. The study reveals that 40.58% of the families have three types of livelihood. The study also shows that 78.26% of the total households have family members working in fish farms and 33.33% households have family members engaged in agricultural farms. There is continuous shifting of working population from agricultural to non-agricultural sectors. As most of the labours are unskilled they are getting absorbed into the unorganized sectors of economy. The study shows that 57.97% of the surveyed households have at least one family member engaged in unorganized sector of economy. There is lack of constancy in the availability of works in the unorganized sectors. The study shows that 46.38% of the total surveyed households have at least one family member who was jobless for at least one month in the last year.



• **Other Indicators:**

Some other indicators have also been taken into account (such as health care condition, natural capitals of the households, and water availability) for better understanding of the living condition of the community living in EKW.

The study shows that average time taken by the people to reach nearest government hospital is 80 minutes (with maximum 150 minutes and minimum 15 minutes). 46.38% of the total surveyed households have at least one person suffering from chronic diseases. 80% of the households consume unfiltered water and 49.27% of them have at least one person suffered from water borne diseases in the past 12 months.

The study also tried to assess the availability of natural capital (here land is considered as natural capital) to the households. The study shows that about 30% of the households do not have own land. About 80% of the households have very small land holdings (1.5 to 2.0 kottah). Most of the farmers within EKW cultivate on the land on lease basis.

The survey reveals that there are major issues regarding availability of water in the EKW. About 81.16% of the respondents have reported to have water conflict in their locality. About 30% of the respondents have reported that the availability of water is not consistent. 43.48% of the surveyed households purchase drinking water.



SAFE field-survey team at EKW vegetable cultivation site

1.2. Assessment of Livelihood Vulnerability Index based on inputs gathered from the target beneficiaries and developing a statistical correlation matrix thereto:

Introduction:

Vulnerability assessment describes a diverse set of methods used to systematically integrate and examine interactions between humans and their physical and social surroundings. The LVI uses multiple indicators to assess exposure to natural disasters and climate vulnerability, social and economic characteristics of households that affect their adaptive capacity, and current health, food and water resource characteristics that determine their sensitivity to climate change impacts.

Discussion:

Two approaches of LVI are presented here: the first expresses the LVI as a composite index comprised of seven major components while second aggregates the seven into IPCC's three contributing factors to vulnerability- exposure, sensitivity, and adaptive capacity.



SAFE project team observing fresh catch at chotopresh bhery, EKW

• **Index Method:**

To calculate LVI by index method seven major components and twenty six sub-components have been taken into consideration. :

1. **Socio-demographic profile** : The socio demographic profile of EKW shows that
 - 37.68% households have female head of the family,
 - Dependency ratio is .54,
 - 73.91% head of the families have not attended school,
 - 76.81% families have no family members without any formal skill.

Thus the overall index value of the component is 0.48225, which shows that socio-demographically the community is moderately vulnerable.



A morning at Bantala-II bhery fishers engage in segregating fish catches

2. **Livelihood Strategy:**

- 89% households have at least one person working out of the community,
- The average livelihood diversification index is 0.28,
- 70.76% households depend primarily on agriculture,
- 18.84% households have no bank account,
- 46.38% households have at least one family member who had no job for at least one month in last 12 months.

The overall index value in 0.45996, and thus the livelihood strategy of the community is moderately strong.

3. **Health** : The health indicators shows that,

- The average time to reach the nearest medical centre is 80 minutes,
- 46.38% households have at least one family members suffering from chronic illness,
- 13.04% households have no toilet facility at home,
- 49.27% and 55 households have at least one family member who has suffered from water borne and vector borne diseases respectively.

The index value of this major component is 0.33802, which indicates moderately strong health care condition of the community.

4. **Social-network**: The social network analysis shows that

- 18.84% households have less social connection as they neither have helped any neighbor nor have received help,
- 33.33% households have neither lent nor borrowed money from the neighbor,
- 47.83% households have not visited any local authority for any help.



Conducting survey with fishers cooperative members at Sukantanagar Bheri, EKW

The index figure for social network component is 0.33333 which shows moderate strength of the social network.

5. **Food security:** The food security component shows that

- 14.49% households depend on family farms for food,
- 89.86% households do not store crops.

The index figure for this component is 0.52175, which shows moderate food security of the community.

6. **Water availability:** The water availability components shows that

- 81.16% households face water conflict,
- Average time to reach water source is 15 minutes
- 30% households have no consistent supply of water
- Inverse of the average number of liters of water stored per household is 0.04.

The index value for this component is 0.37565, which shows that water availability is moderately higher.

7. **Natural Disaster and climatic vulnerability:** The sub-components of this major component shows that,

- The average frequency of climatic hazards reported by the respondents is three,
- 94.2% of the households have not received any warning about the pending natural hazard,
- Livelihood of 72.46% households have been affected by climatic abnormalities in the last 6 years.

The index value of this component is .7246, which shows moderately high climatic vulnerability.

The overall LVI value for the primary beneficiaries of EKW is 0.45699, which shows that the community is moderately vulnerable to natural disasters (0 is least vulnerable and 1 is most vulnerable) (Please refer Appendix 1 for the calculation matrix: Table 2).



Fish farm effluent used for vegetable cultivation



Urban waste water used for fish cultivation at EKW

• **IPCC Method:**

An alternative method has been formulated for calculating LVI which incorporates the IPCC vulnerability definition. Here exposure is measured by the number and effects of natural hazards that has been taken place in the region. Adaptive capacity is quantified by the demographic profile, livelihood strategy, and strength of social network of the community. Sensitivity is measured by assessing the current state of food and water security and health status of the community (Please refer Appendix 1 for the calculation matrix: Table 3).

The LVI value by IPCC method is calculated with the help of the following equation:

$$LVI - IPCC = (\text{Exposure of the community to natural hazards} - \text{Adaptive Capacity of the community against natural hazards}) \times \text{Sensitivity of the community to natural hazards}$$

The study shows that the LVI value for the primary beneficiaries of the EKW is 0.118, which means that the community is moderately vulnerable (-1 is least vulnerable and + 1 is maximum vulnerable) to natural hazards.

2. Hands on identification of ecosystem services (provisioning, supporting, regulatory & cultural) for inventory preparation based on TEEB classification of Ess

2.1. Field survey and ocular assessment of existing ESs and categorization based on significance of services extended

One of the major objectives of the present project was to find out the current Ecosystem Services (ESs) of the East Kolkata Wetland and categorization based on significance of services extended. To identify the major Ecosystem Services TEEB Checklist has been followed. According to the checklist the Ecosystem Services have been classified into four major categories namely Provisioning Services, Regulating Services, Habitat and Supporting Services, and Cultural Services.

Table: 1: Major ESs provided by the East Kolkata Wetland

MAJOR CATEGORIES OF ECOSYSTEM SERVICES	SUB CATEGORIES OF ECOSYSTEM SERVICES
PROVISIONING SERVICES	LAND FOR AGRICULTURE
	AQUACULTURE
	LAND FOR LIVESTOCK GRAZING
	HUNTING
	FIRE WOOD
	RAW MATERIAL FOR CONSTRUCTION
	RAW MATERIAL FOR CRAFT
	FRESH WATER FOR DRINKING
	FRESH WATER FOR DOMESTIC USE
	WATER FOR IRRIGATION
	WATER FOR LIVESTOCK WASHING
	WATER FOR COMMERCIAL WASHING
	MEDICINAL HERBS
REGULATING SERVICES	CONTROLLING LOCAL CHIMATE AND AIR
	CARBON SEQUESTATION
	MODERATION OF EXTREME EVENTS
	EROSION PREVENTION & SOIL FERTILITY
	POLLINATION
	BIOLOGICAL CONTROL
HABITAT & SUPPORTING SERVICES	HABITAT FOR SPECIES
	MAINTENANCE OF GENETIC DIVERSIY
CULTURAL SERVICES	RECREATIONAL ACTIVITIES
	TOURISM
	AESTHETIC ASPIRATION
	SPIRITUAL EXPERIENCE

• **Provisioning services:**

EKW is a unique example of wise use of wetland ecosystem. Urban waste water which is discharged in the wetland is used for fish cultivation and agriculture. The integrated resource recovery at EKW started in mid nineteenth century when the land areas around the waste dumping ground within the EKW started to be used for vegetable production. Wastewater fish cultivation in traditional way within EKW started in 1929. Four prominent provisioning services of EKW are garbage farming for cultivation of vegetables, waste water fed fish cultivation, paddy cultivation using fish pond effluent and sewage fed brackish water aquaculture (outside EKW region). EKW contains 272 fish farms with various dimensions spreading over 4,000 hectares. About 10,500 tons of fishes are cultivated in traditional way in the setting ponds which provide livelihood support to thousands of local people. Lands around the wetland are also used as grazing land for the livestock.



EKW produces 10,500 tons of fish per year

Besides providing livelihood supports, it also provides resources which are used by the local community to maintain daily life. A large number of people collect medicinal herbs, minor food products, fire wood, raw material for construction etc. Many people use the water from the wetlands for domestic use. Though these services do not produce direct revenue, they supplement the basic resource demand of the local people.

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• **Regulating Services:**

Every day 980 million liters of raw urban sewage is discharged in the EKW and about 3500 tons of solid wastes are dumped in the waste dumping ground within EKW. City's waste water flowing through a network of drainage canals reach the setting ponds (Bheries) where through the natural process BOD, pathogen content, heavy metal content is reduced, photosynthetic oxygen is added and organic wastes are degraded. Thus the overall water quality improves.

Besides the wetland plays very important role in controlling the local climate through carbon sequestration and absorption of heat. It also acts a huge sponge which absorbs the flood water of the surrounding basin area and saves the whole region from flood. It plays very important role in recharging the ground water.



Raw urban sewage canal interconnected with shallow water ponds at EKW

• **Habitat and Supporting Services:**

EKW provide a wide variety of habitat for a wide range of biodiversity which include about 104 plant species, about 20 mammalian species, more than 40 bird species including both local and migratory types, about 52 endemic fish types, various reptile species and a huge number of diverse microbial populations.

- **Cultural Services:**

The cultural value of the wetland is immense which is still less recognized. The wetland has huge potential in developing eco-tourism which can supplement income of the local people. The aesthetic beauty of the wetland is of immense value to the people living in and around it. It provides better habitat and working environment to the community living within the area of EKW compared to the areas outside it.

2.2. Participatory SWOT analysis with the community for validating the assessment and categorization for developing a priority list of ESs

EVENT: FGD, SWOT with the fishing community members at Sukantanagar, Kolkata on 22nd September 2015

Focused Group Discussion and participatory SWOT have been organized on 22nd September 2015 with thirty-five community members from various Fisher's Cooperatives at Sukantanagar. The programme aimed at sensitizing the fisher community member towards better understanding of the ecosystem and the Ecosystem Services provided by the East Kolkata Wetland. The programme was totally participatory and interactive in nature.

Methodology followed:

Different methodologies were developed for FGD, SWOT and awareness programme to ensure the participatory nature of the events.

FGD methodology:

FGD aimed at sensitizing the community members towards better understanding of the ecosystem services provided by the East Kolkata Wetland (EKW) as well as validating and categorizing the present ecosystem services. The FGD also aimed at evaluating the degree of the impact of the drivers which influence the provisioning ecosystem services adversely. Following steps were followed to conduct the FGD:

1. At the very beginning the scientific team from SAFE thanked all the community members to allow SAFE and EarthWatch to work at Sukantanagar fishing cooperative and also for presence of the community members at the programme.
2. It was followed by a short introductory address on the importance of ecosystem services and the ecosystem services provided by the EKW.
3. The community members were then asked to share their perception regarding the ecosystem services they enjoy from the surrounding wetlands.
4. On the basis of the response a list of ecosystem services were prepared.
5. Each of the listed ecosystem services were discussed individually and the community members were asked to rank the ecosystem services according to the level of benefits they get from the particular ecosystem service.
6. To get better feedback, an interactive tool was prepared. A five point scale was conceived indicating



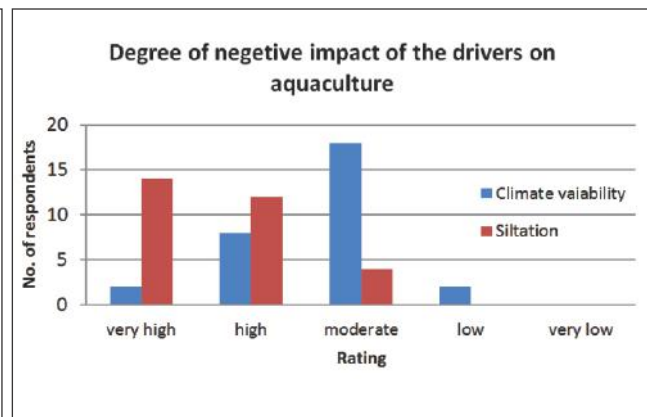
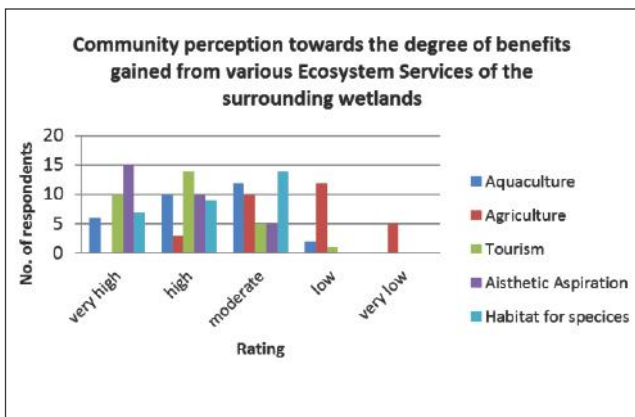
Ongoing Focus Group Discussion, FGD at EKW

very high, high, moderate, low and very low benefit from the ecosystem services. Five sheets of papers were taken and each of the scale divisions was written on each of the five papers. The papers were then placed on the ground according to the order. The individual community members were then given single pebbles collected from the surroundings and were requested to place the pebbles on the sheets paper indicating the scale which would convey the rating.

7. As all the participants finished the rating procedure, the pebbles accumulated on each of the sheet of papers were counted which showed the cumulative rating of the particular ecosystem service. The result was conveyed to the community members.
8. The same procedure was followed to evaluate the importance of the ecosystem services as perceived by the community members.
9. On the basis of the rating given by the community members a priority list of the ecosystem services were prepared.
10. The same procedure was also followed to assess the degree of the impact of the drivers which influence the provisioning ecosystem services adversely.

Results and discussions :

- The FGD revealed a clear idea regarding the community's perception towards the importance of ecosystem services. Aquaculture, Agriculture, tourism, aesthetic aspiration, and habitat for species are the prominent ecosystem services as perceived by the fishing community members. Of the two main provisioning services namely aquaculture and agriculture, aquaculture is of very high to moderate importance as the livelihood of the fishing community depends on it. Whereas agriculture has moderate to very low importance to them as in spite of having scopes to develop kitchen gardens, agriculture is not regularly practiced by the community due to the lack of infrastructure. Tourism is of very high to moderate importance as ecotourism is the supplementary livelihood support for the community. The community members were also aware of the aesthetic aspiration of the wetland and they themselves also enjoy the environment where they work. Importance of the species specially the biota of the surrounding wetland were of very high to moderate importance to the community as they are supplementary source for food and medicine.



- The focused group discussion with the community reveals that there are two major drivers namely climate variability and constant siltation in the wetland which have their negative influence on aquaculture, the main provisioning service. Of these two drivers, siltation has high to very high impact on the production of the fishes. Constant siltation leads to constant reduction in the water depth of the fishing tanks for last five to seven years which has its adverse effects on fish production. The fishing community has adopted various coping strategy to increase the resilience. Climatic variability has high to moderate impact on the aquaculture practice. The effect of the climate variability is inconsistent, short-lived, drastic and unpredictable in nature. As a result the community still could not come across any coping strategy to increase the resilience towards climate variability.

Participatory SWOT analysis :

Participatory SWOT analysis aimed at understanding of community's attitude towards the scope of providing aids for conservation and compensation, which are the two important components of bio-rights.

Methodology followed:

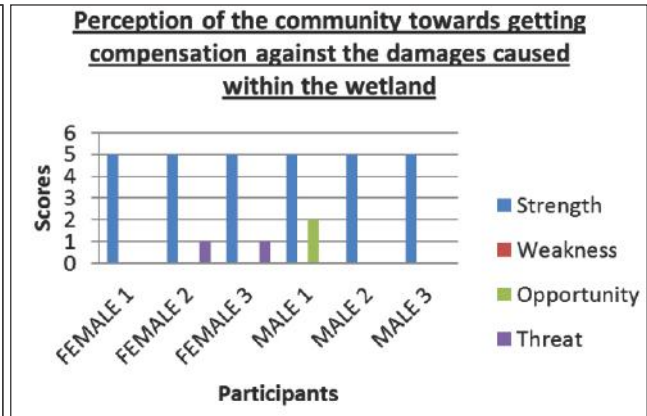
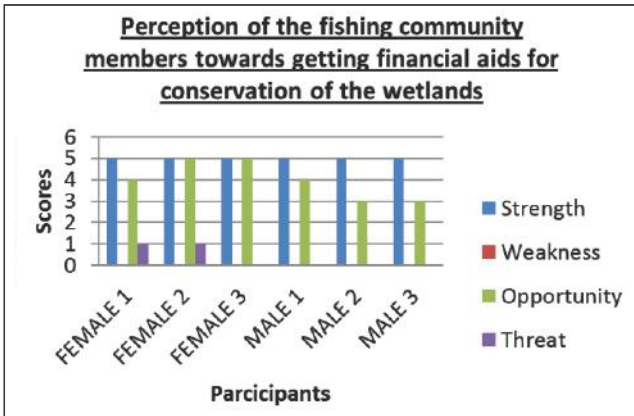
1. Two questions were asked to the community members on which they were asked to express their opinion.
 - Q-1. Whether it will be a strength or weakness or opportunity or threat if the community is given some financial aid for conservation of the wetland?
 - Q-2. Whether it will be a strength or weakness or opportunity or threat if the community is given the compensation against any damage caused in the wetland?
2. Another interactive tool has been prepared to get the SWOT result.
3. Four chart papers with different colours were taken where four statements were written indicating strength, weakness, opportunity and threat.
 - *Statement 1:* The financial aid will strengthen the aquaculture.
 - *Statement 2:* The financial aid will weaken the aquaculture practice.
 - *Statement 3:* The financial aid will bring various opportunities to the community.
 - *Statement 4:* The financial help will be a threat for the aquaculture.
4. The chart papers were placed on the ground and the community members were asked put weightage to the four segments by placing coins of rupee. The weightage would have to range between zero to five.
5. Three men and three women participants were selected who were asked the two questions and requested to express their opinion by putting coins to the four segments.
6. The scores at each segments very clearly expressed their opinion.



SAFE team conducting participatory SWOT at Sukantanagar bheri.

Results and Discussion:

It is very clear from the SWOT analysis that according to the fishing community members any financial aid for the conservation of the wetlands would strengthen the aquaculture as they could spend the money for better maintenance of the wetland. If they would have received such financial helps they could combat the problem of continuous siltation by periodic dredging. Besides such aids would also bring some opportunities such as enhancing the supporting livelihood opportunities such as eco- tourism, agriculture etc. The women community members gave more weightage to the opportunity segment. While no male community members could perceive any threat related to such aids, some of the women members believe that there may arise some problems if the money comes from any external source. The community members also believe that if they would receive any compensation against the damages often caused in the aquaculture, it would strengthen the system. While it would bring less opportunity as the community members would like to spend the money only to compensate the damage.



3. Develop practice modules on relevant ecological stature of wetland and mapping of ESs for participatory conservation planning

3.1. Preparation of rapid field testing module for common ecological aspects in wetlands using simple testing kits for soil & water

Analyses for many important physical, chemical and microbiological variables can be carried out in the field using apparatus made specifically for field use. A significant advantage of field analysis is that tests are carried out on fresh samples whose characteristics have not been contaminated or otherwise changed as a result of storage in a container. Also the intention was to formulate test modules that would be affordable and convenient in places where there are no laboratories within a reasonable distance.

Simple Rapid field testing kit:

- *Alkalinity/ Acidity of Soil*
 - Collect one cup of soil
 - Put 2 spoonfuls each in 2 separate containers
 - Add ½ cup vinegar to one of the containers. If it fizzes the soil is alkaline
 - If it doesn't fizz then add a little distilled water to the other container and add 2 spoonful baking soda. If it fizzes the soil is acidic
 - If there is no fizz at all the soil is neutral

- *pH of water*
 - pH paper or Litmus Paper is used
 - Take the water in a clean glass or beaker
 - Wet the both the blue litmus paper and red litmus paper in water
 - Blue litmus paper turns red under acidic conditions and red litmus paper turns blue under basic or alkaline conditions



SAFE team demonstrating pH, turbidity tests to fishers community at EKW

- *Turbidity*
 - Turbidity can be measured by using a home-made secchi disk. The disc is mounted on a pole or line, and lowered slowly down in the water. The depth at which the disk is no longer visible is taken as a measure of the transparency of the water.

Calculation of Trophic State Index (TSI) as a parameter in conservation of EKW bheries/tanks

A frequently used biomass related Trophic State Index (TSI) is that of Carlson and Simpson (1977). This requires minimum data and is generally easy to understand. It retains the expression of diverse aspects of trophic state found in multi-parameter indices yet still has the simplicity of a single parameter index. A single trophic criterion e.g. algal, biomass, nutrient concentration etc could be the basis for an index from which other trophic criteria could be estimated or predicted by means of the established relationships. The Trophic state index (TSI) uses the TSI of phosphorus, TSI of secchi disk depth and TSI of chlorophyll-a to arrive at a single index. Sakamoto (1966) and Dillon and Rigler (1974) have shown a relationship between phosphorus concentration and algal biomass, measured as chlorophyll-a concentration.



Collecting water sample from core area of EKW

The East Kolkata wetlands consist of an intricate network of canals delivering sewage to water bodies or fish tanks(bheries) which act as fodder for the fish as well as nutrient for phyto-plankton growth. However there has been no empirical

study on the trophic state of the water in the bheries, both individually and comparatively. The reason behind using TSI method is that the data used can be minimal or extensive, depending on the level of accuracy desired and the resources available. Secchi disk values alone can give a trophic state classification, information that can be collected by even nonscientists in public participation programme. If the survey is more extensive data on chlorophyll and phosphorus can provide supplementary or alternative index values. The index gives both the public and the scientist a reasonable accurate impression of a water-bodies' water quality. For the layman the number may have little meaning at first, but it can readily be transformed into secchi transparency, which is easily understood.

The index has been used as a predictive tool in water bodies' management programs. A trophic state index is not the same as a water quality index. The term quality is subjective and it is best kept separate from the concept of trophic state. For example the term eutrophic is often equated with poor water quality. Excellent or poor, water quality depends on the use of that water and the local needs of the people. In the case of EKW the entry of sewage into the water bodies is necessary for the aquaculture purposes. The TSI forms a framework within which various evaluations of water quality can be made. The results obtained could be a more complete and dynamic picture of how the different parameters relate to one another and to the EKW water bodies as a whole.

Methodology

Study Site

The study site encompasses 4 water bodies of East Kolkata Wetlands. The study sites are Sukantonagar bheri (22.559386°N, 88.419986°E), 4 No. bheri (22.55629°N, 88.42390°E), NatarBheri (22.55887°N, 88.44725°E), Bantala (22.53430°N, 88.41806°E). Water sample for the analysis of phosphorus and chlorophyll 'a' were collected from the four water bodies using subsampling method to form one composite sample from each site. 4 subsamples of 500ml each were transferred in a churn spitter and the composite sample was transferred to 2 litre sampling bottle. The bottles were previously cleaned with detergent devoid of phosphorus, washed with acid and rinsed vigorously thrice with distilled water (APHA, 1995; USGS, 2006).

For phosphorus sampling the water sample was subjected to perferate digestion followed by ascorbic acid method, 4500E (APHA, 1995). Chlorophyll 'a' was estimated by acetone method. This was analyzed in spectrophotometer. Absorbance was marked at 630 nm (APHA, 1995). The units for both Chlorophyll a and phosphorus is microgram/litre.

The equations for TSI are as follows:

$$\begin{aligned} \text{TSI(SD)} &= 60 - 14.41 \ln(\text{SD}) \\ \text{TSI(CHL)} &= 9.81 \ln(\text{CHL}) + 30.6 \\ \text{TSI(TP)} &= 14.42 \ln(\text{TP}) + 4.15 \end{aligned}$$

TSI is Carlson Trophic State Index, SD is Secchi Disk, CHL is Chlorophyll and TP is Total Phosphorus.



Ongoing water health test in EKW

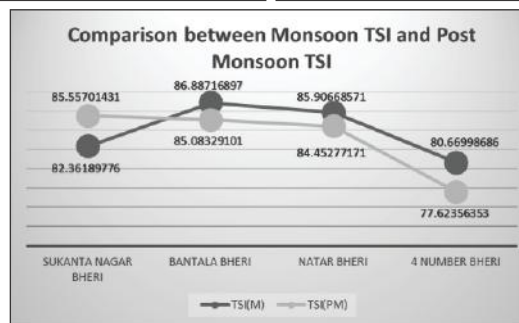
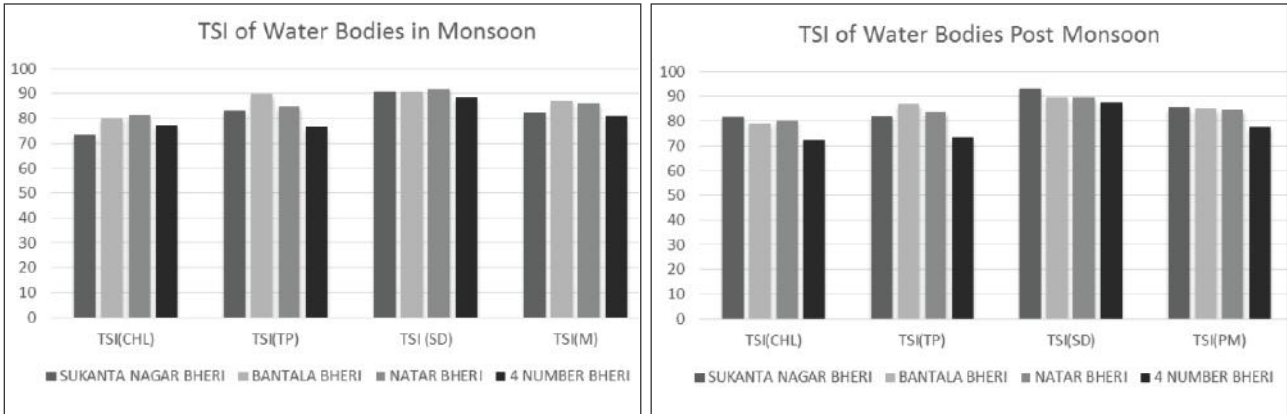
Result

The difference between monsoon and pre-monsoon TSI (Chlorophyll) is remarkable in SukantonagarBheri. As a result the eutrophication level in Sukantonagar during the post monsoon period surpasses that of monsoon period. In the cases of the other bheries (fish tank) this phenomenon is reversed and the monsoon TSI is higher than the post monsoon TSI. This unique phenomenon in the case of Sukantonagarbheri can be traced back to the clogged canal system which serves as both the outlet and inlet for this particular bheri. The flow of water in and out of the water body is hampered. This in turn results in increase of algal mass and phytoplankton growth at a rate not discerned in the other water bodies being studied. The post monsoon TSI levels are lower than the monsoon TSI level showing betterment in the health of the trophic status of the water bodies since the diluted nutrients as well as the excess water level from the monsoon period adds to lesser productivity leading to lower levels of algal mass and phytoplankton growth.

The TSI of the 4 <u>Bheris</u> in Monsoon				
SAMPLE LOCATION	TSI(CHL)	TSI(TP)	TSI (SD)	TSI
SUKANTA NAGAR BHERI	73.35188246	83.18081327	90.55299756	82.36189776
BANTALA BHERI	80.30123988	89.80726946	90.55299756	86.88716897
NATAR BHERI	81.03398097	84.87924465	91.8068315	85.90668571
4 NUMBER BHERI	77.27491339	76.40336094	88.33168626	80.66998686
The TSI of the 4 <u>Bheris</u> Post Monsoon				
SAMPLE LOCATION	TSI(CHL)	TSI(TP)	TSI(SD)	TSI
SUKANTA NAGAR BHERI	81.56468252	81.9261092	93.18025	85.55701431
BANTALA BHERI	78.97891837	86.8713725	89.39958	85.08329101
NATAR BHERI	80.18926657	83.7694664	89.39958	84.45277171
4 NUMBER BHERI	72.34756068	73.1856309	87.3375	77.62356353

The TSI levels of all the water bodies are quite high in both the monsoon and post monsoon period (> 80). This leads to the inference that all the water bodies are hypereutrophic which suggests a high production capacity as a result of excessive nutrients with visibility less than 15 cm on a Secchi Disk. This leads to excessive algal scum, predatory fish species and prevent life from functioning at lower depths creating dead zones beneath the surface. The exception

was the 4 No. bheri which is borderline eutrophic showing a relatively low Post Monsoon TSI which reveals a lower production level than the other bheries and a low chance of fish kill as well as extensive algal bloom.



Water Bodies	Trophic Class (Monsoon)	Trophic Class (Post Monsoon)
SUKANTA NAGAR BHERI	Hypereutrophic	Hypereutrophic
BANTALA BHERI	Hypereutrophic	Hypereutrophic
NATAR BHERI	Hypereutrophic	Hypereutrophic
4 NUMBER BHERI	Eutrophic	Eutrophic

Preparation of Floral Inventory

Methodology for conducting a floral survey

- Plant quadrats was the main techniques for surveying vegetation.
- Quadrats were located randomly.
- To ensure that a survey includes plants from different growing conditions (e.g. rocky areas, drainage lines), a stratified, random sampling technique was used.
- Quadrats of 1 m x 1 m size were used since the study site is wetlands.

BOTANICAL NAME USED PARTS USED AS / USED IN	BOTANICAL NAME USED PARTS USED AS / USED IN	BOTANICAL NAME USED PARTS USED AS / USED IN
1) <i>Aeschynomeneaspera</i> L.	Root	Jaundice.
2) <i>Bacopamonnieri</i> (L.) Pennell	Leaf / whole plant	Nerve tonic, Epilepsy, Bronchitis, Skindisease, Bilioussness, Dyspepsia, Flatulence, Diuretic, Asthma, Rheumatism, Cardio- <u>tonic</u> .
3) <i>Canna indica</i> L.	Root, Rhizome & Scape leaf	Diaphoretic, diuretic, <u>dimulcent</u> , Stimulant, Dropsy, Fever.
4) <i>Centellaasiatica</i> (L)	Leaf	Antidysenteric, Mouth and throat ulcers, Appetizer, Leprosy, Eczyma, Psoriasis, Cervicites etc.
5) <i>Ceratophyllumdemersum</i> L	Whole plant(Plant paste)	Antidote to Scorpion sting.
6) <i>Colocasiaesculenta</i> (L.) Scott	Petiole	Styptic, Astringent.
7) <i>Commelinabenghalensis</i> L.	Whole plant	Leprosy, Demulcent, Refrigerent, Laxative, Dropsy.
8) <i>Commelinadiffusa</i> Burm.	Whole plant	Burns, Itches & Boils.
9) <i>Cyperusrotundus</i> L.	Tuber	Cooling agent.
10) <i>Dentellarepens</i> (L.) J.R.et.J.G.A.Forster	Whole plant	Poulticing agent.
11) <i>Ecliptaprostrata</i> (L.) L	Leaf & Whole plant	Jaundice, Hair-tonic, Antiinflammatory.
12) <i>Eaichhorniacrassipes</i> (Mart) Solms. Laubach.	Plant juice, Root	Toothache, Goitre.
13) <i>Enhydrafluctuans</i> Lour.	Leaf	Laxative, Antibilious, Demulcent, Cutaneous&Nervous affection.
14) <i>Grangeamaderaspatana</i> L. Poiret	Leaf	Antispasmodic, Stomachic, deobstruent, Menstrual disorder, Ear-ache.

The wetland floral diversity shows several economically important wetland plant resources of which the numbers of species are in use of medicine, paper pulp, thatching materials, vegetables, food for water fowl, as green manure and compost, water purifies and fodder etc. Floristic component along the bank of any aquatic system have very significant role for their existence and sustenance through checking erosion and rapid eutrophication, supplying essential nutrients and harboring innumerable biodiversity. Most of the helophytic plants are integrated with bank flora. Other than helophytes a number of herbaceous flora found in EKW give a confident stability to its banks.

Preparation of Faunal Inventor

Methodology for conducting a faunal survey

- For Faunal Survey random belt transect method of sampling was employed
- Measuring tapes and plastic pipes were used to form the lines
- The transect line was laid out for 5 metres.
- Ocular survey was carried out for spotting avian species.

The wetland areas offer suitable habitat to mammals for diversity of different niches – water body for aquatic mammals and grassland, scrubs and orchards for others EKW is no exception. Wetland dependent mammal species that were observed were Mongoose and bandicoot, other carnivores and rats and mice prefer grassland and scrubs around the wetland. One mammalian species is endemic to EKW i.e. Marsh Mongoose. The EKW system offers suitable habitat for amphibian species – as they prefer impounded water for breeding, water body with submerged vegetation for development of young and cover on the bank vegetation to hide and feed. On an average 15 species of birds were spotted regularly.

	Family	Common Name	Scientific Name
Amphibia	Dicroglossidae	Indian Skipper frog	<i>Euphlyctiscyanophlyctis</i>
	Dicroglossidae	Jerdon's Bullfrog	<i>Hoplobatrachuscrassus</i>
Reptilia	Colubridae	Checkered Keelback	<i>Xenochrophispiscator</i>
	Colubridae	Indian Rat Snake	<i>Ptyasmucosus</i>
Aves	Ardeidae	Cattle Egret	<i>Bubulcus ibis</i>
	Ciconiidae	Asian Openbill Stork	<i>Anastomusoscitans</i>
	Cisticolidae	Plain Prinia	<i>Priniainornata</i>
	Corvidae	House Crow	<i>Corvissplendens</i>
	Passeridae	House Sparrow	<i>Passer domesticus</i>
	Coraciiformes	White throated kingfisher	<i>Halcyon smyrnensis</i>
	Alcedinidae	Common Kingfisher	<i>Alcedoatthis</i>
	Phalacrocoracidae	Little Cormorant	<i>Microcarboniger</i>
	Sturnidae	Common Myna	<i>Acridotherestrtris</i>
	Sturnidae	Jungle myna	<i>Acridotheresfuscus</i>
	Sturnidae	Asian Pied Starling	<i>Graupica contra</i>
	Acciptridae	Paria Kite	<i>Milvusmigrans</i>
	Raliidae	White breasted waterhen	<i>Amauornisphoenicurus</i>
	Ploceidae	Baya Weaver	<i>Ploceusphilippinus</i>
Mammalia	Herpestidae	Small Asian Mongoose	<i>Herpestesjavanicus</i>
		Bandicoot	<i>Bandicotaindica</i>
Lepidoptera	Papilionidae	Common Mormone	<i>Papiliopolytes</i>
	Pieridae	Common Emigrant	<i>Catopsiliapomona</i>
	Pieridae	Psyche	<i>Catospillapomona</i>
	Pieridae	Common Indian Crow	<i>Euploea core</i>
	Nymphalidae	Grey Pansy	<i>Junoniaatlites</i>
	Lycaenidae	Dark Grass Blue	<i>Zizeeriakarsandra</i>
	Lycaenidae	Lime Blue	<i>Chiladeslarius</i>

3.2. Capacity building of the primary beneficiaries on the use of such ecological modules in the context of conserving ESs towards sustainable livelihood

The capacity building of the primary beneficiaries was carried out through awareness generation programmes and participatory workshops. The beneficiaries were fishermen and farmers whose livelihoods were dependent on the wetlands

1. To accomplish this, colourful visuals of flora and fauna of wetlands were prepared and shown to the beneficiaries.
2. Most of the photographs containing the animals found in EKW were identified in vernacular names by participants.
3. Participants were able to identify locally vulnerable fauna like Purple Moorhen, Baya weaver etc. A couple

of causes for deterioration of species diversity were efficiently discussed with them like removal of swamp, increased level of pollutants, lack of proper habitats for foraging and feeding etc. This shows the attachment of local folks to nature.

4. Importance of insects as natural pollinators and pros and cons of the use of chemical insecticides were explained.
5. Photo plates containing local herbs of medicinal importance were shown of which a few were found to be used by the localites themselves. The community was aware of plants of medicinal importance often used by them in case of cuts and bruises.
6. Overall, they are well aware of the present status of their surrounding environment and thus about the changes happening at spatiotemporal scale.
7. The awareness program also consisted of Rapid Ecological Assessment through tools like secchi disk, pH papers and Litmus papers. The tools were used to make the community aware of easy and correct ways to test parameters of water and soil by themselves.
8. The Secchi disk is used to measure turbidity of water. The depth of the disk helps to assess the entry of sewage into the aquaculture ponds.
9. The pH papers are used to measure the approximate pH of water and soil. They are to be utilised every two months to check the pH of the aquaculture ponds as well as before the introduction of fries or fishlings into the tanks. The pH papers can also be used to measure the pH of soil which would provide the knowledge necessary to determine the type of vegetables to be grown on a soil of a particular pH.
10. The litmus papers were used to test the alkalinity and acidity of water. It is a cheap, rapid and fairly accurate test for analysing whether the water is acidic or basic.



Meeting with Agricultural farmers of East Kolkata Wetlands

4. Develop participatory methods to enhance ecosystem service delivery

4.1. Documentation of TEK (Traditional Ecological Knowledge) in enhancing ES components:

As the project aimed at constructing a roadmap for enhancing ecosystem services of the wetlands towards sustainable food production and poverty alleviation through a interacting process engaging the primary stakeholders, understanding of the traditional ecological knowledge of the local wetland users was rudimentary for developing the action plans.

The multifunctional wetland, the East Kolkata Wetland, functions as an excellent resource recovery system where fishes and vegetables are grown using the waste water. The study reveals that the production of fishes and the vegetables in the area is totally based on the traditional knowledge of the local people. Knowledge regarding the mechanism of these traditional practices was necessary for understanding the present ecological status of the wetland.

Following is the traditional method which is practiced in the EKW resource recovery system:

- i. The water bodies have distinct type of architecture which helps in purification of waste and integrated resource recovery. The traditional knowledge associated with the age old practices carried out in Bheries has sound scientific basis.

- ii. The shallow basins allow full vertical circulation of water to the surface and allow penetration of sunlight up to the bottom of the ponds thereby allowing photosynthesis even at the bottom of the ponds which in turn allows the growth of algae. This algal growth results in generation of oxygen which helps in purification of the waste water.
- iii. The alkalinity due to lime addition during pond preparation results in pathogen content reduction.
- iv. Bheries also causes detoxification of waste water by reducing heavy metals and maintaining the biological oxygen demand. Growth of water hyacinth causes active reduction in amount of heavy metals by trapping them in different parts of the plant body.
- v. The high alkalinity helps in growth of phytoplanktons which provides food to the fishes grown in the Bheries.
- vi. Enough oxygen is added to the Bheries due to stirring of water due to shallow depth and huge growth of planktons, algae, water hyacinth etc.
- vii. Plankton play a very important role in degradation of organic matter, metal accumulation, and degradation of several aromatic hydrocarbons, herbicides and insecticides.
- viii. BOD is reduced through a symbiosis between algae and bacteria. This helps in reduction of coliform bacteria prone to be pathogenic.
- ix. Water hyacinth is associated with rhizofiltration in addition to providing shade to the fishes during summer and prevention of erosion of bank.
- x. Most of the fish ponds range in size between two to ten hectares. Three types of ponds are required according to the stage of production: the nursery pond, the rearing pond, and the stocking pond. Each needs a proper inlet-outlet management of sewage. The main requirement for maintaining the fish productivity is the proper supply of nutrient rich waste water. Lack in nutrient in the waste water specially in the monsoon months are supplemented by the external supply of food.
- xi. The flow of water is mostly directed by gravity but in some areas diesel-powered pumps are used.
- xii. *Fish are raised in five major stages* : Pond preparation (done in the coolest months when the ponds are drained, and maintenance and repairs of dikes are carried out), Primary fertilization (initial introduction of waste water into the pond and allowed to undergo natural purification, and stirring of the pond in order to reduce anaerobic conditions in the sediments), Fish stocking (where farmers stock a small number of fishes to taste the water quality, subsequently stocking up for four times) Secondary fertilization



Different types of fish production in EKW



Daily life of East Kolkata Wetlands

(periodic introduction of waste water into the ponds throughout the growth cycle), and finally fish harvesting (taken at different times according to species).

- xiii. Bout twelve different types of fishes are raised which occupy various ecological niches of the pond ecosystem, including Indian major, minor and exotic carp, varieties of non-native tilapia, mourala etc.
- xiv. Ponds are periodically dredged and used to strengthen pond dykes. Ponds are drained before the monsoon season for various reasons like to free up some of the nutrients in the sediments, to kill some the parasites which reduce fish production.
- xv. The water and effluent generated from the Bheries are used for cultivation of vegetables.

4.2. Skill building in ecosystem management of the beneficiaries through workshops

EVENT: Awareness programme with the fishing community members at Sukantanagar, Kolkata on 22nd September 2015:

Awareness generation program was conducted among the local beneficiaries about ecosystem, biodiversity and importance of East Kolkata Wetland. To accomplish this, colourful visuals were prepared and shown to the participants. The programme was totally participatory and interactive in nature.

- Most of the photographs containing the animals found in EKW were identified in vernacular names by participants.
- Participants were able to identify locally vulnerable fauna like Purple Moorhen, Baya weaver etc. A couple of causes for deterioration of species diversity were efficiently discussed with them like removal of swamp, increased level of pollutants, lack of proper habitats for foraging and feeding etc. This shows the attachment of local folks to nature.
- Importance of insects as natural pollinators and pros and cons of the use of chemical insecticides were explained.
- Photo plates containing local herbs of medicinal importance were shown of which a few were found to be used by the localities themselves. They showed us another plant of medicinal importance often used by them in case of cuts and bruises.
- Overall, they are well aware of the present status of their surrounding environment and thus about the changes happening at spatiotemporal scale.



Awareness programme with fishermen at Sukantanagar Bheri, EKW

The awareness program also consisted of Rapid Ecological Assessment through tools like secchi disk, pH papers and Litmus papers. The tools were used to make the community aware of easy and correct ways to test parameters of water and soil by themselves.

- The Secchi disk is used to measure turbidity of water. The depth of the disk helps to assess the entry of sewage into the aquaculture ponds.
- The pH papers are used to measure the approximate pH of water and soil. They are to be utilized every two months to check the pH of the aquaculture ponds as well as before the introduction of fries or fishlings into the tanks. The pH papers can also be used to measure the pH of soil which would provide the knowledge necessary to determine the type of vegetables to be grown on a soil of a particular pH.
- The litmus papers were used to test the alkalinity and acidity of water. It is a cheap, rapid and fairly accurate test for analysing whether the water is acidic or basic.

4.3. Intensification of Sustainable Agriculture in Peri-urban Wetlands through workshops

EVENT: Stakeholder Meeting at Science City Auditorium in Kolkata on 26th September 2015

The Stakeholder Meeting: Phase II on introducing the concept of Ecosystem Services (ESs) towards sustainable intensification of agriculture in Peri urban Wetlands was held at Science City in Kolkata, West Bengal on 26th September 2015. The sessions were moderated by Dr Dipayan Dey, Chairman, SAFE and Dr Priyani Amarsinghe, IWMI. The meeting organized by SAFE, IWMI and EarthWatch Institute was attended by researchers, policymakers and scholars whose recommendations led to the development of a framework for wise use and conservation of wetlands with special attention to the concept of ecosystem services in per-urban wetlands. The importance of all the four categories of Ecosystem services, i.e. provisioning, regulating, habitat or supporting, and cultural services as provided in the TEEB(The economics of Ecosystems and Biodiversity) framework in the context of wetlands was the recurring theme of the discourse.



Stakeholder Meeting at Science City Auditorium in Kolkata

The first session was a deliberation on the expected outcomes of the meeting and a discussion on different strategies to mend the gaps present in wetland conservation

The recommendations made are as follows:

1. Instead of so many different rules and regulations there needs to be a single umbrella act covering all the aspects of wetlands use and conservation. There needs to be a single board of authority with independent charge to oversee the wetland conservation
2. There is a need for intervention by media, international pressure groups and activists to help generate awareness among public about the importance of wetlands.
3. The data collected through surveys and studies on wetland should be compiled into a database which should be an open repository of information on the public domain.
4. An efficient capacity building through volunteered citizen monitoring programs, creation of a science-society interface, community assessment recording and formation of Urban Local Bodies (ULB) and/or Rural Local Bodies (RLB).
5. There is an urgent need to focus attention on peri urban wetlands by conducting appropriate studies and surveys.
6. Ecological audits and Environment Impact Assessment (EIA) should be made compulsory along with FPIC (Free, Prior and Informed Consent) before undertaking any kind of developmental and commercial activity on the wetlands.
7. Modeling different wetland ecosystems for sustainable usage through rigorous biodiversity assessment, estimation of carrying capacity of wetlands, geospatial profiling and other such studies. The modeling will ensure the development of appropriate conservation strategies and facilitate valuation of wetlands and its ESs, involving ENCAP and other such initiatives.
8. Due to the current conditions of climate stress it is necessary that climate adaptive strategies are formulated along with documentation of Traditional Ecological Knowledge (TEK).

Event : Workshop with the farmers of East Kolkata Wetland on 30th July, 2016

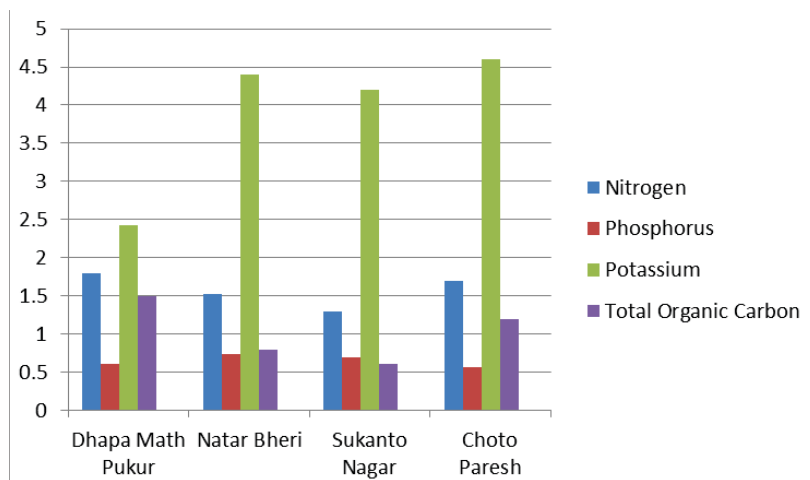
The workshop for farmers of East Kolkata Wetlands was organised on 30th July, 2016 at DhapaMathpukur in Kolkata. The programme conducted by scientific team of SAFE saw the participation of 30 farmers from the area. This particular area was chosen since this has a few peri urban wetlands as well as being close to the famous dumping ground of the city ,'Dhapa'. The farmers are involved in vegetable farming and had little knowhow about the condition of their soils, what kind of crops to grow on their soil and about the pitfalls of using chemical fertilizers. The existence of these farms is directly interlinked with the wetlands as well as the refuge in the dumping grounds.

Workshop Methodology

- At the very beginning the scientific team from SAFE thanked all the farmers to allow SAFE and EarthWatch to work at Dhapa, Mathpukur and also for presence of the farmer community at the programme.
- It was followed by a short introductory address on the importance of ecosystem services and the ecosystem services provided by the EKW.
- The farmers were then asked to share their perception regarding the ecosystem services they enjoy from the surrounding wetlands.
- On the basis of the soil analysis report of the site they were informed of the soil condition, importance of the soil nutrients and parameters and in which parameters the soil was lacking.
- They were informed of the vegetables most suitable for growing on the soil as well as instructions were provided for vermin-composting and organic farming.



On field agricultural workshop for farmers of East Kolkata Wetlands



Comparison of soil parameters among 4 sites of East Kolkata Wetlands

Consisted of Rapid Ecological Assessment through tools like, pH papers, baking soda and vinegar and Litmus papers. The tools were used to make the community aware of easy and correct ways to test parameters of water and soil by themselves.

- The pH papers are used to measure the approximate pH of water and soil. They are to be utilised every two months to check the pH of the aquaculture ponds as well as before the introduction of fries or fishlings into the tanks. The pH papers can also be used to measure the pH of soil which would provide the knowledge necessary to determine the type of vegetables to be grown on a soil of a particular pH.
- The litmus papers were used to test the alkalinity and acidity of water. It is a cheap, rapid and fairly accurate test for analysing whether the water is acidic or basic.
- Alkalinity/ Acidity of Soil was also analysed by a simple experiment
 - Collection of one cup of soil
 - Putting 2 spoonfuls each in 2 separate containers.

- Adding ½ cup vinegar to one of the containers. If it fizzes the soil is alkaline.
- If it doesn't fizz then adding a little distilled water to the other container and adding 2 spoonful baking soda. If it fizzes the soil is acidic. If there is no fizz at all the soil is neutral.

Results and Discussion

- The onfield demonstration suggested that the soil was acidic. The community was instructed to grow carrot, cauliflower, cucumber, dill, corn as these crops grow well in condition between 5.5-7 pH
- The soil is deficient in potassium and the farmers were sensitised on the importance of potassium. The importance of proper fertilizer management was discussed. Potassium triggers activation of enzymes and is essential for production of Adenosine Triphosphate (ATP). ATP is an important energy source for many chemical processes taking place in plant issues. Potassium plays a major role in the regulation of water in plants (osmo-regulation). Both uptake of water through plant roots and its loss through the stomata are affected by potassium. It is also known to improve drought resistance.
- The problem of growing exotic crops were discussed which led to the conclusion that to avoid theft and human damage to the crops a co-operative for the farmers need to be formed urgently.
- Since one of the primary crop is maize and the husk of maize is used as an organic manure the farmers are interested in vermicomposting and sought full scale demonstration.
- The response was overwhelming and the community discussed the need and importance of educational and technical workshops.

5. Create general awareness amongst the beneficiaries in retaining the crucial ES of EKW

5.1. Awareness campaigns in the area through audiovisual displays and interactive sessions engaging school children

EVENT : World Habitat Day Celebration: School awareness program

On World Habitat Day a School Children Awareness Program was organised at NatarBheri (East Kolkata Wetlands) in Kolkata, West Bengal on 5th October 2015. The different events of the day were overseen by scientific team of SAFE. The entire event was photo documented. The schools which participated were Modern High School for Girls and Sarat Chandra Paul girls' high school. The intent of the program was to enlighten the bright young minds of the 50 participating school kids about the importance of wetlands and their ecosystem services. The purpose of the program was to inspire these young people to help save the environment and become the green warriors of tomorrow.

The program started with registration of the school children and distribution of the World Habitat Day Stickers for their uniforms. The kits which had a number of items ranging from pen, scissors, origami to datasheets for ecological survey were distributed. These kits were designed so that the items inside could be used in the different activities organized throughout the day. The participants were gathered under the shades of the big pippal trees at the eco-tourism picnic spots of the Bheri for the various events. The introductory speech was



World Habitat Day 2015 : Student awareness programme on wetlands

made by Amrita Chatterjee who emphasized on the meaning and significance of the World Habitat Day. Habitat is not only for sheltering human beings but also for the survival of plants and animals. The conservation of their habitat is the responsibility of mankind. The East Kolkata Wetland is one such example of a unique habitat where human beings and animals and plants co-exist side by side symbiotically. She also stressed on the danger to this unique biodiversity owing to indiscriminate urban development.

The importance of wetlands and how they are so important for our everyday existence was addressed. Wetlands are areas where standing water covers the soil or an area where the ground is very wet. She talked about the different types of wetlands in the world. Unlike estuaries, freshwater wetlands are not connected to the ocean. They can be found along the boundaries of streams, lakes, ponds or even in large shallow holes that fill up with rainwater. Freshwater wetlands may stay wet all year long, or the water may evaporate during the dry season.

The scientific team talked about the East Kolkata Wetland (EKW) and how the subject of EKW was still neglected even though it is a crucial part of Kolkata's very own ecosystem. The school children were made aware of the Ramsar Convention and how it is related to EKW. The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty which provides the outline for national action and international cooperation for the conservation and wise use of wetlands and their resources. The East Calcutta Wetlands were designated a "wetland of international importance" under the Ramsar Convention on August 19, 2002. Colourful handouts of birds, animals and insects were distributed so that the participants could simultaneously learn about and enjoy the biodiversity of EKW.

The significance of soil and water in an ecosystem especially in the context of wetlands was tackled. The children were made aware of the necessity to check the different parameters like acidity, alkalinity and turbidity of water. Some ingenious yet simple techniques like secchi disk, litmus, vinegar and baking soda tests were discussed and the different tools were passed around so that they could inspect themselves.

The next activity was teaching the school kids how to make origami. The kits which were distributed already had four different kind of origami; a bird, a snake, a fish and a frog. These animals represent the most important members of the animal community of a wetland. The participants were shown how to make origami frogs out of the piece of paper provided in their kits. They enjoyed the exercise and everybody succeeded in making a frog origami.

Now it was time for the segment of the program called Know Your Nature. This involved a nature walk through the wilderness of the wetland and at the same time learning about the ecosystem, the different birds and animals and taking part in fun activities and experiments to know about the environment. The participants were briefed on the list of activities to be done on the walk. They were divided into three teams formed of students from both the schools led by the team leaders. The walk started from the gathering spot and the three teams moved towards three different directions. The walk was divided into 4 main activities.

- They were shown the basics of quadrat



World Habitat Day : Student awareness programme on wetlands : water testing



World Habitat Day : Student awareness programme on wetlands : Identification of floras

sampling. The importance of quadrat sampling in ecological studies was explained. In quadrat sampling small areas of known size were marked off within a larger area (usually, quadrats are placed randomly within the larger area) and then the organisms within the quadrat were surveyed. The average of the information from all the quadrats is used to represent the larger population. The information gathered while sampling was noted down on the flora and fauna inventory data sheets. The participants were shown how to collect vegetation carefully while sampling. Since ground truthing is an integral part of quadrat sampling the participants were given a demo on how to use a GPS instrument.

- They were also given instructions on how to prepare a herbarium sheet and as an example they had been provided with herbarium sheets in their kits.
- The turbidity of water in the wetland water bodies was measured using the Do-It-Yourself Secchi Disk. They were also given instructions on how to build a secchi disk themselves at home. They were shown to test pH test of water using pH papers and Litmus papers.
- A rapid on-field soil pH test using baking soda and vinegar was performed. This is a very easy test to analyse soil acidity or alkalinity and can be easily performed in the backyard or garden.

After the completion of the walk they were gathered at the start point for relaxation and feedback. The response was overwhelming. They had all learnt new and exciting activities. It would not only enhance their knowledge and help their current curriculum but also imbibe curiosity and a thirst for changing the world. The program ended with distribution of lunch packets and a hope for better, secure and a safe habitat for tomorrow.

EVENT : Interactive Workshop on Wetlands Conservation Awareness for students in Kolkata, School Awareness Programme on 1st September, 2016

The School awareness program on Peri Urban Wetlands was organized on 1st September at Sukantonagar High School, East Kolkata Wetlands. The programme was conducted by scientific team of SAFE and saw the participation of 70 students of Standard 7 and 8.

The programme was conducted indoor and over a period of 2 hours. The Sukantanagar Vidyaniketan High School of East Kolkata Wetlands was chosen for its unique socio-ecological setting; for being a school situated within the Peri Urban Wetlands area as well as embracing students from families directly or indirectly dependent on wetland ecosystem services. The lives of these children are interwoven into the very fabric of these invaluable wetlands. The programme aimed at providing them with the knowledge and knowhow to champion the cause of protection of these wetlands which are their home.

Activities

- The importance of wetlands and how they are so important for our everyday existence was addressed. Wetlands are areas where standing water covers the soil or an area where the ground is very wet. The different types of wetlands in the world were discussed. Unlike estuaries, freshwater wetlands are not connected to the ocean. They can be found along the boundaries of streams, lakes, ponds or even in large shallow holes that fill up with rainwater. Freshwater wetlands may stay wet all year long, or the water may evaporate during the dry season. The school children were made aware of the Ramsar Convention and how it is related to EKW. The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty which provides the outline for national action and international cooperation for the conservation and wise use of wetlands and their resources.
- The event comprised of colourful visual representation of birds and animals, i.e. biodiversity of wetlands.



Interactive Workshop on Wetlands Conservation Awareness for students in Kolkata

Different species of amphibians, reptiles, birds and mammals were showcased through colourful leaflets.

- Participants were able to identify locally vulnerable fauna like Purple Moorhen, Baya weaver etc. A couple of causes for deterioration of species diversity were efficiently discussed with them like removal of swamp, increased level of pollutants, lack of proper habitats for foraging and feeding etc. This shows the attachment of local folks to nature.
- Importance of insects as natural pollinators and pros and cons of the use of chemical insecticides were explained.
- Overall, they are well aware of the present status of their surrounding environment and thus about the changes happening at spatiotemporal scale.



Interactive Workshop on Wetlands Conservation Awareness for students in Kolkata

- The significance of water and soil, the two essential components of any ecosystem especially that of wetlands was showcased through some very interesting and simple experiments with scientific equipment's for students to learn from as well to as replicate.
- There was rapid testing of acidity, alkalinity, pH, turbidity as well as demonstrating the surging importance of GPS technology and instruments in wetland conservation.
- The children were made aware of the necessity to check the different parameters like acidity, alkalinity and turbidity of water. Some ingenious yet simple techniques like secchi disk, litmus, vinegar and baking soda tests were discussed and the different tools were passed around so that they could inspect themselves. The tools were used to make the children aware of easy and correct ways to test parameters of water and soil by themselves.
- The Secchi disk is used to measure turbidity of water. The depth of the disk helps to assess the entry of sewage into the aquaculture ponds.
- The pH papers are used to measure the approximate pH of water and soil. They are to be utilised every two months to check the pH of the aquaculture ponds as well as before the introduction of fries or fishlings into the tanks. The pH papers can also be used to measure the pH of soil which would provide the knowledge necessary to determine the type of vegetables to be grown on a soil of a particular pH.
- The litmus papers were used to test the alkalinity and acidity of water. It is a cheap, rapid and fairly accurate test for analysing whether the water is acidic or basic.

Result

After the demonstrations ended the children were asked for feedback. They had all learnt new and exciting activities. It would not only enhance their knowledge and help their current curriculum but also imbibe curiosity and a thirst for changing the world. The program was completed with distribution of lunch packets and a hope for better, secure and a safe habitat for tomorrow.

Appendix: 1

Table 2: LVI Calculation Matrix: Index Method

Major Components	Sub-components	Units	Value	Max value	Min Value	Index Value	Major Component Value	LVI
1. Socio-Demographic profile	1. % of female headed households	Percent	37.68	100	0	0.3768	0.48225	0.45699
	2. Dependency ratio	Ratio	0.54	12	0	0.045		
	3. Percent of Households where head of the household has not attended school	Percent	73.91	100	0	0.7391		
	4. Percent of households where none of the family members have any formal skill	Percent	76.81	100	0	0.7681		
2. Livelihood Strategy	1. Percent of households with family members working in a different community	Percent	89	100	0	0.89	0.48996	
	2. Average livelihood Diversification Index	1/#livelihoods	0.28	1	0.1	0.2		
	3. Percent of households depend primarily on agriculture for a source of income	Percent	70.76	100	0	0.7076		
	4. Percent of family members not having bank account	Percent	18.84	100	0	0.1884		
	5. Percent of households having atleast one person who had no work for atleast one month in last year	Percent	46.38	100	0	0.4638		
3. Health	1. Average time to reach health centre	Minutes	80	150	0	0.5333	0.33802	
	2. Percent of households having family members with chronic illness	Percent	48.37	100	0	0.4837		
	3. Percent of households not having toilet facilities at home	Percent	13.04	100	0	0.1304		
	4. Percentage of households with family members suffering from water borne diseases	Percent	49.27	100	0	0.4927		
	5. Percentage of households with family members suffering from vector borne diseases	Percent	5	100	0	0.05		
4. Social network	1. Percent of households who have neither received nor helped and neighbors in last 12 months	Percent	18.84	100	0	0.1884	0.33333	
	2. Percent of households who have neither borrowed from nor lent money to neighbors in last 12 months	Percent	33.33	100	0	0.3333		
	3. Percent of households that have not gone to their local government for assistance in the past 12 months	Percent	47.83	100	0	0.4783		
5. Food	1. Percentage of households depend on family farm for food	Percent	14.49	100	0	0.1449	0.52175	
	2. Percentage of households that do not save food crops	Percent	89.86	100	0	0.8986		
6. Water	1. Percentage of households reporting water conflict	Percent	81.16	100	0	0.8116	0.37565	
	2. Average time to reach water source	Minutes	15	45	0	0.3333		
	3. Percentage of households that do not have a consistent water supply	Percent	33.33	100	0	0.3333		
	4. Inverse of average number of liters stored per households	1/liters	0.04	1	0.016	0.0244		
7. Natural disasters and climate Vulnerability	1. Average number of flood, drought, and cyclone events in the past 6 years	Count	3	5	0	0.6	0.75556	
	2. Percent of households that did not receive a warning about the pending natural disasters	Percent	94.2	100	0	0.942		
	3. Percent of who's livelihood has been affected by climatic abnormalities	Percent	72.46	100	0	0.7246		

Table3 : LVI Calculation Matrix: IPCC Method

Contributing factors	Major components	Major component values	Number of sub-components per major components	Contributing factor values	LVI-IPCC
Adaptive capacity	Socio-demographic Profile	0.48225	4	0.448	0.118
	Livelihood strategies	0.48996	5		
	Social networks	0.33333	3		
Sensitivity	Health	0.33802	5	0.385	
	Food	0.52175	2		
	water	0.37565	4		
Exposure	Natural disaster and climate vulnerability	0.75556	3	0.75556	

Appendix: 2 Questionnaire Schedule for Calculating Livelihood Vulnerability Index and Assessment of Livelihood Dependency of the Community on Ecosystem Services in East Kolkata Wetlands Ramser Site:

Questionnaire: Category 'A'

Survey Number: _____ Place: _____

Date: _____

Name of the respondent: _____ Male: Female:

A. Socio-demographic profile:

1. Total number of family members: Male: Female:

2. **Head of the family:** Male: Female:

3. Age categories of family members:

Age groups	<15 yrs:		15-35 yrs:		35-60yrs:		>60 yrs:	
	Male	Female	Male	Female	Male	Female	Male	Female
No. of family members:								
Worker								
Non-worker								
Practice Agriculture								

4. Literacy level of the family:

Literacy level	Literate	Illiterate
Male		
Female		

5. **Literacy level of head of the family:** Literate: _____ Illiterate: _____

6. Do any of your family members have any formal skill?

Sex	Number of family members
Male	
Female	

B. Livelihood strategy:

7. Family members working in different community:

Community	Give a Tick (✓) mark On the traditional occupation	Family members have moved away from the traditional occupation:	
		Male	Female
Agriculture			
Aquaculture			
Garbage Farming			
other			

8. What are the sources of income of the family members (livelihood diversification)? What is the primary source of income?

Sl. No.	Source of income	Tick	Tick on the primary occupation of the family	Number of family members involved	
				male	Female
1	Agriculture				
2	Aquaculture				
3	Livestock grazing				
4	Agricultural labours				
5	Collect natural resources				
6	Industrial labours				
7	Business				

8	Manufacturing				
9	Service				
10					
11					

Total number of agricultural livelihood:

Total number of livelihoods:

9. **Does your family depend solely on agriculture?** Yes No

10. ****Do you save money in any bank or in any cooperative?** Yes: No:

Please specify the nature of your savings:

Organization	Nature of savings
Bank/post office	
Insurance	
Local cooperative	
Any other unorganized sector	
other	

11. ****How many months in the last year any member in your family had no works?**

Sector of economy the family member attached to	Number of months without work	Number of family members
Agriculture(all sectors of agriculture)		
<u>Agricultural labour</u>		
<u>Industrial labour</u>		
Business		
Manufacturing		
Service		
other		

C. Health:

12. **Average time to health facility:**

Nature of health facility	Time taken to reach
Government Hospital	
Private nursing home	
Private medical consultant	

13. **Any chronic disease in your family:**

Name of the disease	Number of persons suffering

14. **Do you have toilet in your home?** Yes No

15. **Had any body of your family malaria last year?** Yes No

16. **Had any body of your family water borne disease last year?** Yes No

17. **Do you drink boiled/filtered water?** Yes: No:

D. Natural Capital:

18. **Do you own land?** Yes No

If yes, then how much land do you have? _____

19. **Do you have fertile land?** Yes No

20. If yes, then how much land does you have? _____

E. Community network:

21. **In the past month, did your family received any help or helped any friends / relatives/ neighbors?**

Nature of help	Received help	Helped
Medical care/ medicine		
<u>Voluntary labour</u>		
Take care of children		

22. **Do you borrow money from relatives or friends? Did you lend money to relatives or friends in the past month?**

Number of times borrowed money	Number of time lent money

23. **In the past 12 months, have you or someone in your family gone to your community leader for help?** Yes: No:

F. Food:

24. Where does your family get most of its food?

Nature of food	Own agricultural field	Purchase from market
Staple food (for e.g. Rice)		
Vegetables		
Other ingredients		

26. How many months a year do your family trouble getting enough food?

Number of months:

25. Does your family save some of the crops to eat during a different time of year? Yes: No:

27. Water:

26. In the past year, have you heard about any conflicts over water in your community? Yes: No:

27. Which is your primary drinking water source?

Source of water	Amount withdrawn/ day	Primary source	Time to reach the source
Tube wells			
Municipality supply purchase			

28. Is this water available every day? Yes: No:

29. How much water do you store?

Number of storage containers	Capacity of containers (in liters)	Total water stored

30. Natural disaster and climate variability:

30. How many times has this area been affected by a flood/drought/cyclone in 2008-2014?

Natural disaster	Number of times
Flood	
Drought	
Cyclone	

31. Did you receive a warning about the flood/ cyclone/drought before it happened?

Natural disaster	Received alert	Alert not received
Flood		
Drought		
Cyclone		

31. **Did any climatic abnormality affect your livelihood in past 6 years? Yes: No:

Questionnaire: category 'B'

1. What is your approximate monthly household income (in INR)?

<3000	3000-10000	10000-20000	20000-30000	30000-40000	>40000

2. (for aqua cultural community) For what purpose does your family use the wetland and its vicinity for? (Write 'P' for previous uses)

	Use	Tick		Use	Tick
1	Drinking water		10	Water for Bathing & washing	
2	Fishing		11	Livestock Drinking & washing	
3	Hunting		12	Plants for traditional medicines/food	
4	Livestock Grazing		13	Land for Agriculture	
5	Livestock Fodder		14	Recreational activities	
6	Firewood		15	Religious activities	
7	Material for craft		16	Constructional activities	
8	Irrigation		17	Cooking Fuel	
9	Commercial Washing		18	other	

3. (for aqua cultural community) How long have you been using this wetland?

4. (for aqua cultural community) Who in your family predominantly use the wetland? Men: Women:

5. Do you cultivate fish in your land? Yes: No:

If yes please answer the question No. 9-14)

6. Which fishes do you cultivate in the wetland?

1	4	7
2	5	8
3	6	9

7. How much fishes do you catch annually?

Number of harvesting seasons	
Number of harvesting days in a season	
Number of harvesting days in a year	
Average fishes caught/ day (in Kg)	
Average fishes caught annually (in Kg)	

8. Have you noticed changes in the daily fish catch over the years? If yes what trend has it shown?

Yield trend (increased/ decreased)	
Daily yield at present	
Daily yield before	
How many years back?	
Cause	

9. Has the degradation of wetland affected your livelihood? If yes, how?

10. What you think has triggered the degradation of the wetland? (most important cause)

11. Rank the contribution of the wetland to your livelihood/ income?

High		Moderate		Low	
------	--	----------	--	-----	--

12. Do you cultivate any crop in your land? Yes No:
If yes, please answer **question No. 16- 21)**

13. (For farmer communities) How long are you practicing agriculture?

14. For which purposes do you use your agricultural land?(to assess the agricultural diversification)

Purposes	
Paddy farming	
Vegetable farming	
Livestock rearing	
Collecting food from natural habitat	
Other	

15. (For agricultural communities) What are the commonly grown crops in your field?

	Crop name	Season	Area under cultivation	Average yield/acre	Market Rate	Quantity of crops sold at market (in Kg)
1						
2						
3						
4						
5						

16. (For farmer communities) Have you noticed changes in the crop yields over the years? If yes, what trend has it shown? And, what was the yield before?

	Crop Name	Yield trend (increased/ decreased)	Yield before (quintals/acre)	How many years back?	If overall yield decreased, what are the reason?
1					
2					

17. (For agricultural communities) How much water do you withdraw for cultivation?

BHP of motor used	Duration for which motor is run (hours)	Frequency of withdrawal	Month of withdrawal (number of months)

18. (For agricultural communities) What are the alternate sources of water for irrigation?

Collected Rain water	Pond	Tube well	Other(specify)

19. Do you have livestock? Yes: No:

If yes, how many livestock do you have?

Types	Cow	Goat	Pig	Goat	Duck
Number					

20. Where from do you get the fodder for the livestock? Surrounding wetland areas: **Purchase:**

Appendix: 3



SAFE

South Asian Forum for Environment

PARIS 2015

UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

Our partners:



Getting innovations on the road...SAFE at COP21 “Life changing climate actions for Global South”



As we look ahead to the COP21, climate negotiations in Paris at the end of this year, nations, cities and individuals are looking for ways to ensure a decision of the future. We at SAFE and our partner network prepare to get the innovations to address two crucial challenges - climate change and poverty right, on the track of COP21, we are looking to help all urban and rural areas accelerate their progress towards cutting emissions and leverage resources to transcend innovations for a sustainable climate lifestyle for all, and ones breathing below the poverty line in the global south.

Energy, Water, Sanitation; highlight at COP 21 side event

The side event on the third day of COP21 was jointly hosted by SAFE, with GHERUSH92 and COBASE ECOSOC, held on the theme, “Electrical cities, common goods (Energy, Water & Sanitation) and Agro-ecological parks against climate change” at Paris, Le Bourget Room-8, on 2nd December 2015.

The sessions addressed; “Designing human settlements, restoring natural ecosystems with the high efficiency electricity, bio circular economy and interventions on energy, water and sanitation for the urban poor.

Dr. Dipayan Dey, Chair, SAFE presented outcomes of community based innovations in the face of changing





economy of developing country like India, the contribution of innovations to climate change adaptation and mitigation. He said, "With or without negotiations, lets join efforts to decide our future". Among the other panelists present were Massimo Pieri, Valentina Sereni, Delfina Piu, Mario Agostinelli, and Stefano Mannacio. The climate scientists, economists, architect, highlighted the need to develop readiness within and enhance the partnership network to reach ecosystem restoration strategy and sustainable solutions for poor. They joined hands to pledge for life changing climate actions with special focus on the developing global south.

Make 'wetlands' count at COP21

On 3rd Dec; Prioritizing wetlands in practices, SAFE formally released a documentary on ecosystem services of peri-urban wetlands and heritage water bodies of Kolkata at 'Nature Solutions' Pavilion coordinated by the Ramsar Secretariat & IUCN-France at COP21. The documentary titled, "United voices Sustainable Solutions", is jointly produced by International Water Management Institute, Hyderabad, India and South Asian Forum for Environment. Viewers appreciated the effort and more so acknowledged the relevance of the theme in the milieu of climate change and its impact on periurban wetlands. The Ramsar representatives have expressed their eagerness to circulate the documentary and disseminate it globally through their own network. We gratefully acknowledge the Med Wet and Ramsar Secretariat for the support extended towards the launch of this documentary.



How to better integrate Climate smart Agriculture & REDD+



5th December ; Release of e-book; SAFE released a compendium on "Sustainable Agro-farming initiatives in North eastern Agro-ecological zone of India", under the aegis of NABARD, regional office in Kolkata. The CD-ROM of the book launched at India Pavilion by Deputy Managing Director, NABARD, Mr.R.Amalorpavanathan. The mass migration of humans into urban areas happening due to failing crops, and developing countries will lead to more people on the poverty grid than off it. Sustainable agro-farming is community innovation in the present challenge and actions at local level strengthens community resilience, and ensures contribution of community to climate change mitigation and adaptation. This publication documented information on farmer's response to the new farming

techniques, guidance on applied methods, outcomes and achievements, enabling techniques and building capacities in the agro-ecological zone.

SAFE Exhibit at COP 21 “Empower Biorights of commons”

The climate action exhibit area happened to be a dedicated place for SAFE that gave an opportunity to share platform with business, civil society groups, development agencies and others to reveal transformational examples that became momentum for change at national and sub-national level. SAFE showcased its most acclaimed WASH-US project, solar run integrated water, sanitation and energy for urban poor, both in Kolkata and North-East, India supported by HSBC Water Programme and World Bank. SAFE exhibited its range of rural and urban interventions including forest fire management, sustainable agriculture and waste management program Resolve Trash2Cash, which received UNFCCC Momentum for Change, Lighthouse activity Award last year at Lima COP 20.



SAFE's observations for COP21 negotiations

1. **The promises pledged by the countries are over ambitious and need more of a participatory approach in achieving the same. Civil society involvement and participation of community based organizations seems limited in the commitments and also in the national agenda of action.**
2. **Corporate sector has been extensively allowed to partner climate initiatives at cross sectoral level to defend economic development and as well facilitate partnership in climate action, however the environmental regulations are yet not standardized, neither the economic impacts assessed on the global south for this. Business monopolies in the name of 'green businesses' are apprehended and pollution norms may have threats in meeting lofty emission reduction targets. This could be a welcome effort only with adequate safeguards on the green fronts.**
3. **Rights of marginal communities and indigenous people and compensating the climate costs for them have not been addressed, other than general national schemes of development. This may have a 'Kick-back' effect and several sensitive ecosystems like mountains and wetlands may get coarsely affected.**

The India Impact factors:

Logically what India pledges in the carbon negotiation table seems valid, though differential impacts of emission on urban hubs, especially 'Heat island Effects' and pressure on natural resources in promoting economic development through 'Make in India' is undermined. Heavily populated metropolis and rapidly urbanizing cities like Guwahati and



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Patna will be the worst hit. As suggested in INDC, technology interventions would definitely curtail the emission factors, but how would it percolate to the bottom of the economic pyramid that sustains the primary production sector is unclear. Will not this keep aside the poor from the carbon finance benefits? Further, in the absence of vital national strategies like fresh water and wetland conservation, REDDplus implications, indigenous people and commons rights to nature capital and participation of civil societies in climate action etc it is obvious to apprehend that national commitments do not have a fail-safe immunity.



“Resolve Trash2Cash is an inspiring example of Climate action towards low carbon and resilient future.”
- UNFCCC Executive Secretary,Christiana Figures.

“Climate decisions made in Paris have to reach the local homes of commons, because finally the bottom of the pyramid has to understand, decide and take actions, either to mitigate or to adapt.”
- Dr. Dipayan Dey, Chair, SAFE.



SAFE team at COP21, Paris 2015, third from left Pushpa Sen from HSBC Water Programme