BEFORE THE NATIONAL GREEN TRIBUNAL

SOUTHERN ZONE, CHENNAI

Original Application No. 152 of 2023(SZ)

In the matter of:

Kumaresan sooluran. … Applicant(s)

Versus

The Tamil Nadu Coastal Zone Management Authority

and ors …Respondent(s)

ADDITIONAL TYPESET FILED BY THE 4TH RESPONDENT-

THE TAMILNADU STATE WETLAND AUTHORITY

INDEX

S. No.	Date	Description	Page No.
1	-	Annexure -5	1-16

(**Note**: The page numbers are at the top centre of every page)

Through

Dr. D. Shanmuganathan

Standing Counsel for Government of Tamil Nadu

National Green Tribunal

Southern Zone, Chennai

DATE:19.08.2025

Annexure -5

Interim Progress Report

Value addition of Invasive Charru Mussel from Ennore Creek as Biofertilizer and Mineral mix

Tamil Nadu State Wetland Authority, Chennai

Submitted By

Dr MGR. Fisheries College and Research Institute
Tamil Nadu Dr. J. Jayalalithaa Fisheries University
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Value addition of Invasive Charru Mussel from Ennore Creek as Biofertilizer and Mineral mix

1. Project details:

- Project Duration: One year
- Total Budget: ₹ 11.11 lakh
- Budget released so far: ₹ 8.45 lakh
- Start Date: 01.05.2025
- End Date (Expected): 28.02.2026
- Date of Administrative Sanction: 15.04.2025

2. Progress report (As of July 25, 2025)

2.1. Introduction

This project aims to convert the ecologically invasive Charru mussel (*Mytella strigata*) from Ennore Creek into value-added products—specifically, organic biofertilizers and mineral mixes—for agricultural and aquaculture applications. The work is motivated by both the need for sustainable bioresource utilization and the ecological necessity of managing invasive species.

2.2. Nutritional analysis and characterization

Profile of charru mussel: Commonly shell contains 60.7% and meat contains 39.25% in the total body weight (wet weight). The size of mussels were found to be much smaller in the size. Average size of charru mussels was length 4.24 cm, breadth 2.2. cm, body weight 4.05 g.

Biochemical composition of Charru mussel meat: The moisture present is little high 84%. The protein content is 9.2% and carbohydrate content is 4.2%. The mineral presence is 1.8% and the fat is negligible in the mussel meat.

Component	Value (%)
Moisture	84.206 ± 0.13
Protein	9.258 ± 0.53
Carbohydrate	4.2 ± 0.31
Fat	0.952 ± 0.12
Ash	1.795 ± 0.41
Fiber	0.18 ± 0.12

Table. 1. Proximate composition of the mussel meat

Fertilizer nutritional composition in mussel meat: Analyzed the bio-nutritional potential of various components of the invasive Charru mussel. Mussel meat powder exhibited a high organic matter content of 82.73%, total nitrogen at 10.88%, and beneficial levels of phosphate (3.26%), potash, manganese, and magnesium. In addition, C/N ratio of 5.4:1 in mussel meat indicates high nitrogen content. So, it requires external carbon addition during biofertilizer formulation for agriculture application.

Sl. No	Parameters	Result
1.	pH	6.78
2.	Total Ash content (%)	9.79
3.	Total Organic Matter (%)	82.73
4.	Total Nitrogen (%)	10.88
5.	Total Phosphate (PO_4) (%)	3.26
6.	Total Potash (K_2O) (%)	0.18
7.	C/N Ratio	47.98/10.88
8.	Manganese (Mn) ppm	310
9.	Magnesium (Mg) ppm	3445

Table. 2. Nutritional composition of charru mussel meat

1. **Mineral composition in mussel shell:** The shell powder analysis showed high calcium content (26.37%), along with phosphorus (3.68%) and magnesium (638 ppm). Trace minerals such as selenium, zinc, copper, sodium,

and manganese were also present in the sample. These results confirm the feasibility of converting this invasive biomass into a sustainable mineral mix for aquaculture applications.

Sl. No	Parameters	Result
1.	Calcium (Ca) (%)	26.37
2.	Magnesium (Mg) ppm	638
3.	Phosphorous (P) %	3.68
4.	Manganese (Mn) ppm	33
5.	Zinc (Zn) ppm	BDL
6.	Sodium (Na) (%)	0.98

Table 3. Mineral composition of mussel shell

2. **Heavy metal and mineral concentration in mussel meat and shell**:

- Heavy Metals (Arsenic, Lead, Chromium, Nickel): heavy metals, including arsenic, lead, nickel, and chromium, is within acceptable limits in both the meat and shell as per the FCO Order, 1985.
- High Aluminium Concentration: Notably high in EN-MP (3178.75 ppm) and PU-MP (1285.46 ppm) - likely due to environmental accumulation.
- Zinc and Copper: Found in biologically relevant concentrations, especially in meat samples (PU-MP: Zn 63.33 ppm, Cu 22.94 ppm; EN-MP: Zn 76.98 ppm, Cu 16.82 ppm).
- Strontium: strontium levels are exceptionally high in the mussel shell (Pulicat shell: 1437.43 ppm; Ennore shell: 1335.15 ppm). Strontium is generally regarded as having low toxicity in its common forms. Therefore, its presence is not expected to negatively impact the aquaculture ecosystem when the shell powder is converted into a mineral mix.
- Micronutrients (Selenium, Molybdenum, Lithium): Present in trace but beneficial levels. Lithium notably higher in EN-MP (5.59 ppm).

S. No	Parameters	PU-MP	PU-SP	EN-MP	EN-SP
1	Arsenic (ppm)	15.16	0.0	4.08	1.11
2	Aluminium (ppm)	1285.46	146.35	3178.75	780.69
3	Lead (ppm)	3.94	2.93	6.0	1.9
4	Selenium (ppm)	4.28	1.27	2.02	1.33
5	Zinc (ppm)	63.33	10.13	76.98	12.94
6	Nickel (ppm)	10.1	1.67	9.51	1.96
7	Chromium (ppm)	44.05	16.11	33.46	6.35
8	Copper (ppm)	22.94	7.42	16.82	7.19
9	Molybdenum (ppm)	0.76	0.28	0.6	0.3
10	Lithium (ppm)	2.45	0.65	5.59	1.24
11	Strontium (ppm)	90.57	1437.43	225.43	1335.15
12	Silver (ppm)	0.98	0.61	0.72	0.71

Table 4. Heavy metal concentration of mussel meat and shell of Ennore and Pulicat

Note: PU-MP: Pulicat Mussel Meat, PU-SP: Pulicat Shell Powder, EN-MP: Ennore Mussel Meat, EN-SP: Ennore Shell Powder

3. Challenges and Mitigation Measures

Challenge	Mitigation Strategy
High nitrogen content in mussel meat (low C/N ratio)	Integration with carbon-rich compost to stabilize nitrogen levels.
Shell powder lacks certain micro-minerals (Zn, Cu, K)	External supplementation planned during mineral mix formulation.
Logistical coordination for field and shrimp trials	Timelines staggered; field preparation and lab batching initiated early.
Strontium content in shell	Literature and toxicity assessment confirmed safety for aquaculture use.

4. Plan of Action

Mussel-Based Organic Fertilizer: The mussel meat, being nitrogen-rich with a low carbon-to-nitrogen ratio, will serve as the core ingredient for organic fertilizer production. To balance the high nitrogen content and adjust the C:N ratio to a suitable range for agricultural application, carbon-rich compost will be blended with the mussel meat powder. Clay will be incorporated to improve the physical texture and facilitate the formation of granules. This mixture will then be processed to form granules or pellets, which will be dried and cured to ensure stability and ease of application. The prepared fertilizer will undergo field trials at the agricultural demonstration plots of TNAU-KVK, Tiruvallur. These trials will evaluate the performance of the fertilizer in terms of plant growth promotion, yield enhancement, and soil nutrient improvement. Based on field trial outcomes, the fertilizer formulation will be optimized, and the most effective blend of mussel meat, compost, and clay will be standardized. Upon finalization, standard operating procedures (SOPs) will be developed.

Mineral Mix for Aquaculture Application: The mussel shells, which are rich in calcium and phosphorus, will be processed into fine powder for use as a base material in the mineral mix formulation. Since the shell powder lacks certain essential micro-minerals like zinc, potassium, and copper, these will be supplemented externally to develop a balanced mineral mix suitable for aquaculture, particularly shrimp farming. Various formulations will be prepared using different inclusion levels of micro-minerals. This mineral mix will then be incorporated into shrimp feed at different dosages. Controlled shrimp feeding trials will be conducted at the TNJFU farm facility in Madhavaram to evaluate the impact of the mineral-supplemented feed on shrimp growth, survival rate, shell hardness, and overall health.

Technology Transfer and Livelihood Promotion: Following standardization and successful validation of both products, the developed technologies will be transferred to local user groups in the Ennore region. If the mussel biomass gains a market value of Rs. 5–10 per kilogram, fishermen will be incentivized to collect it from the water.

7

5. Timeline for the Proposed Plan of Action (July 2025 Onward)

Sl. No.	Plan of Work	Jul 25	Aug' 25	Sep' 25	Oct' 25	Nov' 25	Dec' 25	Jan' 26	Feb' 26
1.	Mineral Mix Development for Aquaculture: Processing of mussel shells; formulation with added micro-minerals (Zn, K, Cu, Mn); pilot mixing trials.								
2.	Shrimp Feeding Trials with Mineral Mix: Feeding trials at TNJFU farm, Madhavaram; assessment of shrimp growth, survival, and SOP preparation.								
3.	Mussel-Based Organic Fertilizer Development: Preparation of nitrogen-rich mussel meat powder; blending with compost and clay; granule formation.								
4.	Field Trials for Fertilizer: Application of fertilizer granules in TNAU-KVK, Tiruvallur demonstration plots; monitoring plant growth, yield, and soil health.								
5.	Optimization of Fertilizer Formulation & SOP preparation: Data analysis from field trials; Prepare Standard Operating Procedures (SOPs) for mussel-based fertilizer and production								
6.	Report submission: Compilation of trial results, and socio-economic outcomes into a comprehensive project report for submission to the TNSWA.								

6. Key points from the project

- Nutrient-Rich Mussel Meat: Mussel meat is rich in essential nutrients like Zinc, Copper, and Aluminium, making it ideal for use in biofertilizer formulations.
- Shell Powder as Mineral Mix: The mussel shells, particularly from Ennore and Pulicat, are high in Calcium, Strontium, and Phosphorus, making them excellent for mineral mix applications, especially in aquaculture.
- No Toxic Heavy Metals Detected: Heavy metals such as Arsenic, Lead, Nickel, and Chromium are within the permissible limits, ensuring environmental safety for agricultural and aquaculture applications.
- Aluminium & Strontium Levels: The project identifies high levels of Aluminium and Strontium, but these do not pose known hazards at the concentrations found, though monitoring is advised.
- Optimization and Technology Transfer: Field and aquaculture trials will help optimize formulations. The technology developed will be transferred to local user groups, aiming to increase livelihoods by converting invasive mussels into valuable products.
- Sustainability and Ecological Control: The project focuses on sustainable bioresource utilization by addressing the invasive species issue and converting it into products that benefit both the environment and local communities.

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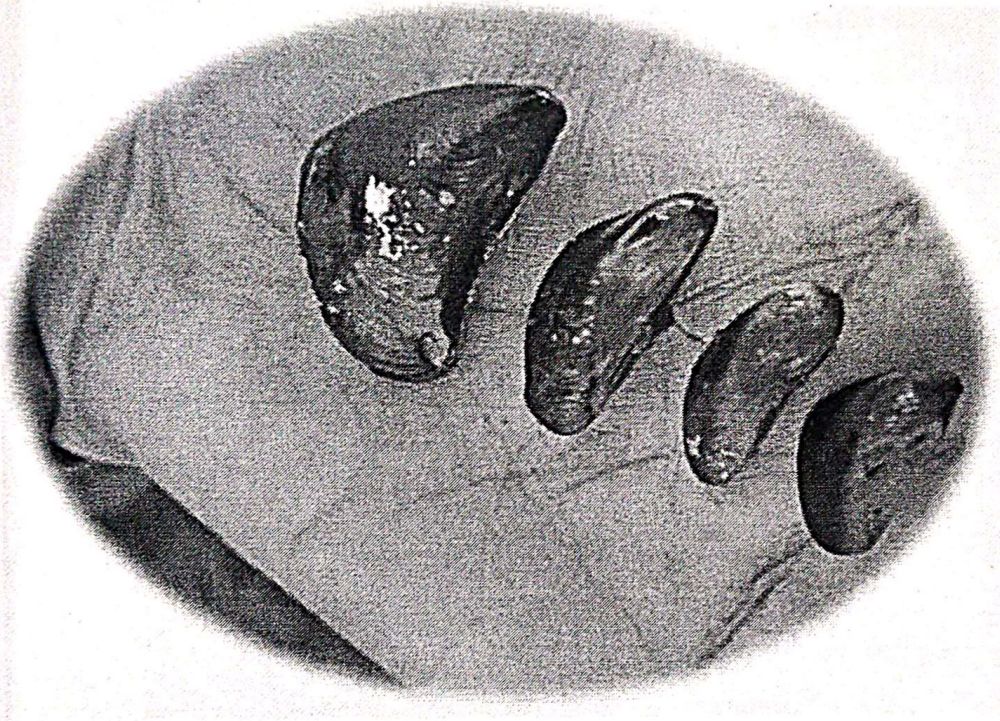
Interim Progress Report

A Pilot Study on Controlling the spread of Invasive Mussel, Mytella strigata (Hanley, 1843) in Dredged Areas of Ennore Creek, Chennai through Recurrence assessment, Eradication strategies and Ecosystem restoration



Tamil Nadu State Wetland Authority, Chennai

Submitted by

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July 2025

A Pilot Study on Controlling the spread of Invasive Mussel, Mytella strigata (Hanley, 1843) in Dredged Areas of Ennore Creek, Chennai through Recurrence assessment, Eradication strategies and Ecosystem restoration

1. Project Details:

- **Project Duration** : Six Months
- **Total Budget** : Rs. 22.63 Lakhs
- **Budget Released** : Rs. 10.61 Lakhs
- **Project Start Date** : 01.05.2025
- **Project Closure** (Expected) : 01.01.2026
- **Date of Administrative Sanction:** 15.04.2025

2. Progress Report (As of July 25, 2025)

2.1 Introduction

The Ennore Creek in Chennai, a vital estuarine ecosystem along the Coromandel Coast of India, has recently witnessed the rapid proliferation of an invasive bivalve species, *Mytella strigata* (Hanley, 1843), commonly known as the Charru mussel. Originally native to Central and South America, this species has established a stronghold in the dredged and disturbed zones of the creek, threatening native biodiversity, altering sediment dynamics, and disrupting traditional fisheries. Its aggressive colonization is particularly concerning in the context of ongoing industrial activities, reduced freshwater inflow, and habitat degradation in the Ennore region.

This pilot project aims to develop a comprehensive strategy to control the spread of *Mytella strigata* in the dredged areas of Ennore Creek through a three-pronged approach: recurrence assessment, eradication strategies, and ecosystem restoration. The recurrence assessment component focuses on current extent and patterns of infestation to understand the ecological triggers behind the species' success. The eradication strategies will evaluate feasible mechanical, biological, and community-led removal methods suitable for localized control without causing harm to native species.

Simultaneously, the project will explore nature-based solutions for ecosystem restoration, aiming to improve the overall resilience of the estuarine system. By

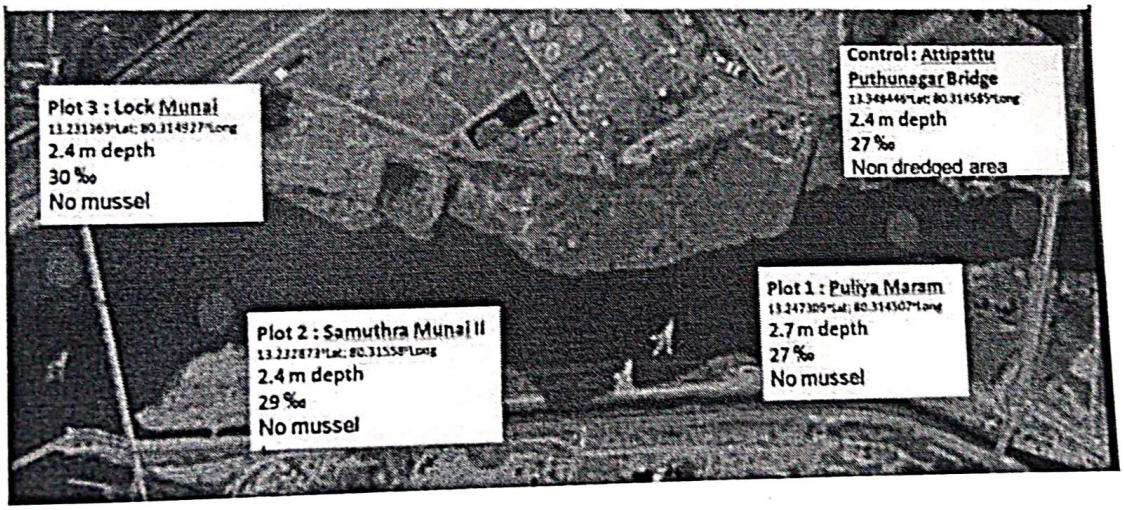
integrating scientific monitoring, experimental interventions, and participatory approaches, this study seeks to lay the groundwork for long-term management of invasive species in coastal wetland systems and provide policy-relevant insights for environmental governance in coastal zones.

2.2. Details of Field Visit made to Ennore creek for sample collection

S.No.	Date of Field Visit	Water Sample	Soil Sample	Plankton Sample	Mussel Sample
1.	13.03.2025	✓	-	✓	✓
2.	16.03.2025	-	✓	✓	✓
3.	25.04.2025	✓	✓	✓	✓
4.	17.05.2025	✓	✓	✓	✓
5.	06.06.2025	✓	-	✓	✓
6.	18.06.2025	-	✓	✓	✓

2.3. Site Selection for Monitoring:

Three sampling plots (1- PuliyaMaram; 2- Samuthra Munai II; 3 – Lock Munai) and **one control plot** (Attipattu Puthunagar Bridge) were investigated for the plot deployment.



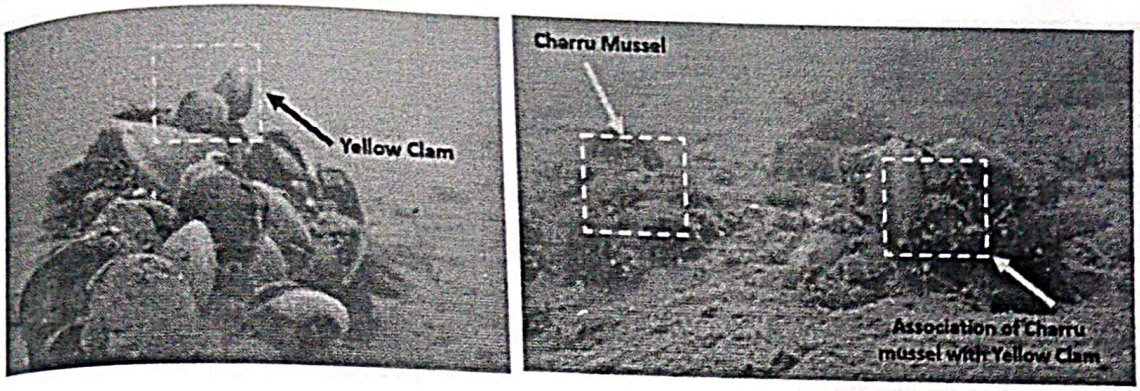
2.4. Charru Mussel Density Study:

The pilot study was conducted from March, 2025 to July, 2025 to observe the mussel density by using quadrants (25 X 25 cm) along the random sites of Ennore creek region. The infestation of invasive Charru mussels was found attached in a wide range of substratum including clams, gastropod egg mass, and concrete structures along the Ennore creek region. It was also observed that the mussels present on the

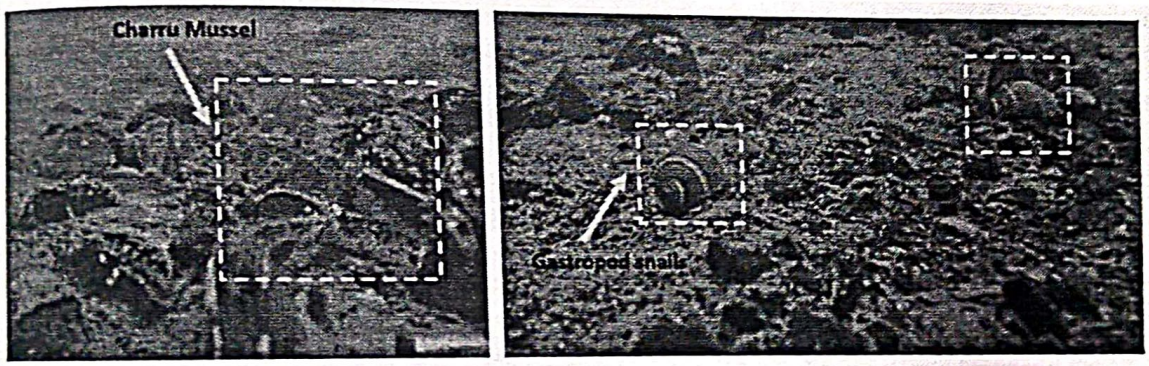
surface layer were in live condition and in the bottom layer were in dead condition. The occurrence of the mussels was recorded and tabulated below,

S. No.	Latitude	Longitude	Mussel Density (in 25 X 25 cm)	No. of Live Mussels	No. of Dead Mussels
1	13°20.045"N	80°19.712"E	20	16	4
2	13°19.897"N	80°19.660"E	15	10	5
3	13°19.788"N	80°19.563"E	12	8	4
4	13°19.451"N	80°19.082"E	45	35	10
5	13°19.146"N	80°18.747"E	54	48	6
6	13°18.775"N	80°19.101"E	78	52	26
7	13°18.651"N	80°19.419"E	120	79	41
8	13°18.402"N	80°19.600"E	145	128	17
9	13°18.112"N	80°19.694"E	98	52	46
10	13°17.832"N	80°19.740"E	84	16	68
11	13°17.469"N	80°19.770"E	123	46	77
12	13°17.203"N	80°19.754"E	52	22	30
13	13°13.860"N	80°19.072"E	65	49	16
14	13°15.552"N	80°19.110"E	52	29	23
15	13°14.258"N	80°18.960"E	46	12	34
16	13°15.018"N	80°18.865°E	89	56	33
17	13°14.936"N	80°18.861"E	85	42	43
18	13°14.132"N	80°18.959"E	75	19	56
19	13°13.871"N	80°19.018"E	20	12	8
20	13°15.261"N	80°18.926"E	13	5	8
21	13°14.747"N	80°18.887'E	46	16	30
22	13°14.588"N	80°18.936"E	52	34	18
23	13°16.045"N	80°19.255"E	78	56	22
24	13°13.993"N	80°18.947"E	98	84	14
25	13°15.901"N	80°19.265"E	52	45	7
26	13°14.464"N	80°18.961"E	22	11	11
27	13°14.025"N	80°19.562"E	12	8	4
28	13°13.464"N	80°19.135"E	17	12	5
29	13°13.549"N	80°19.187"E	15	10	5
30	13°13.738"N	80°19.368"E	42	29	13
31	13°13.844"N	80°19.521"E	30	24	6

✓ **Clusters of invasive mussels** were found in **association with yellow mussels** in control plots.



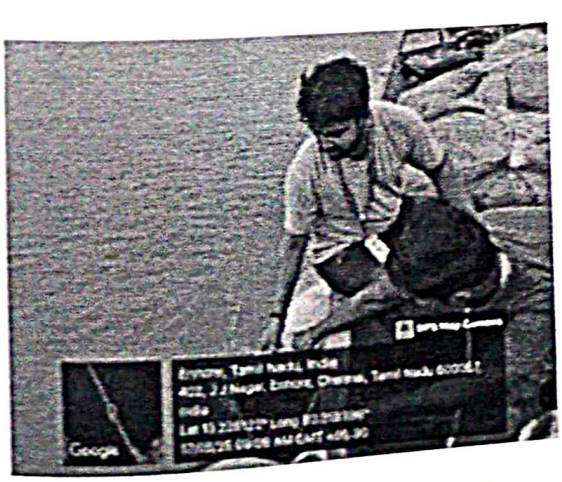
✓ **Bioindicator species** such as *Nerita sp.* and **fish larvae** were observed across dredged plots.

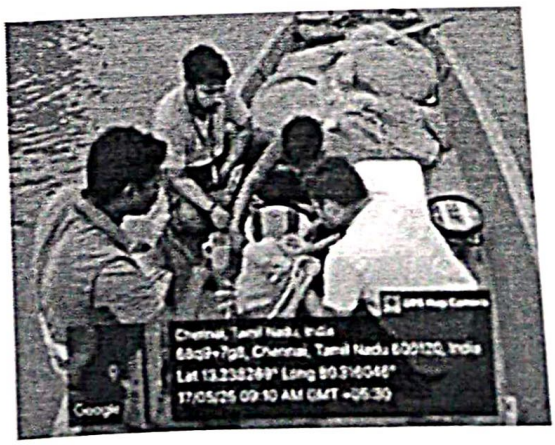


2.6. Environmental Parameter Analysis

✓ No significant difference was detected in water and sediment quality parameters between dredged and control plots.

✓ Salinity ranged from 30 ppt to 36 ppt, with the highest salinity at Lock Munai and lower salinity in deeper zones, suggesting freshwater mixing.





2.7. Experimental study on survival of Charru mussel in different salinities

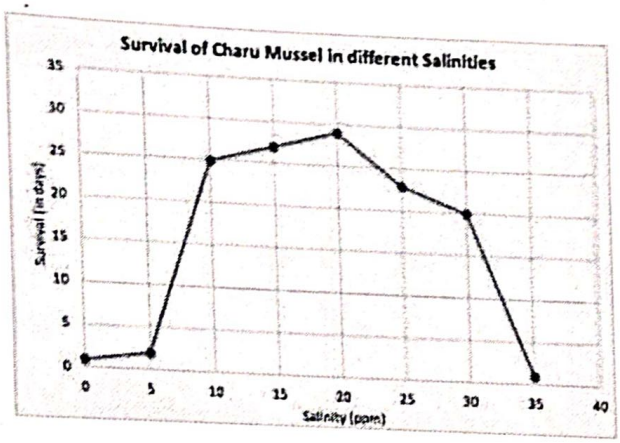
Charru mussels were grown invitro in different salinities in Pulicat Research Farm Facility of our campus; and examined for their survival.

Tank capacity: 100 L

Total No. of tank: 8

Stocking density: 30 Nos per tank

Sl. No.	Salinity	Mortality after
1.	0 ppt	1 day
2.	5 ppt	2 days
3.	10 ppt	25 days
4.	15 ppt	27 days
5.	20 ppt	29 days
6.	25 ppt	23 days
7.	30 ppt	20 days
8.	35 ppt	1 days



According to the study, mortality of charru mussel occurred below 10 ppt and at 35 ppt. T**he optimum salinity required for their growth ranged from 10 to 30 ppt.** However, higher growth is noticed at lower salinity range (10 to 20 ppt).

2.7. Equipment Purchase: Equipment purchase was initiated in GeM portal for the project

2.8. Species Translocation and Plot Trials: Spots will be identified along the Ennore creek for the collection of native species such as yellow clam, green mussel, mud crab and white shrimp for species translocation into plot enclosures with different species combinations

3. Timeline for the proposed Plan of Action (July, 2025 Onwards)

S.No.	Plan of Work	Jul 25	Aug' 25	Sep' 25	Oct' 25	Nov' 25	Dec' 25	Jan' 26
1.	**Enclosure set up for sampling plots:** Establish boundary fencing using wooden poles (10m x 10m x 4m) and polyethylene webbing in all four sampling plots							
2.	**Species Translocation and Plot Trials:** Collection of native species such as green mussel, mud crab and white shrimp, followed by translocation into pen culture enclosures using different species combinations.							
3.	**Environmental parameters monitoring:** Regular monitoring of hydrodynamic parameters, Water and Sediment Quality Parameters							
4.	**Biodiversity and Biological Sampling:** Routine sampling to assess plankton including larvae and species diversity in each sampling plot followed by observation of mussel bed formation across various substrates, with documentation of reoccurrence and spread patterns							
5.	**Protocol Development:** Formulation of a standardized protocol for eradication strategies specific to *Mytella strigata*							
6.	**Documentation:** Preparation of a comprehensive Standard Operating Procedure (SOP). Compilation of findings and submission of technical reports to Wetland Authority.							

4. key points from the Project

- Site Selection for Monitoring: One control plot and Three sampling plots were identified for the continuous monitoring of recurrence of the Charru mussel in Ennore creek
- Charru Mussel Density Study: The density study reveals that the spread of mussel is confirmed throughout the system and suggests the mechanical removal in highly spread area, physical removal in the bridges and nearby tower lines and biological control in low spread area of Charru mussel along the Ennore creek
- Larval and Associated Species Diversity: The native larval forms of other than charru mussel were observed in the dredged areas revealed the natural rejuvenation of species in the Ennore creek suggests that scientific removal of the Charru mussel species could have the minimal impact on the ecosystem
- Experimental study on survival of Charru mussel in different salinities: The optimum salinity required for their growth ranged from 10 to 30 ppt. Hence, the Charru mussel could be removed before the onset of monsoon
- Environmental Parameter Analysis: No significant difference was detected in water and sediment quality parameters between dredged and control plots
- Species Translocation and Plot Trials: Spots will be identified along the Ennore creek for the collection of native species such as yellow clam, green mussel, mud crab and white shrimp for species translocation into plot enclosures with different species combinations

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