ICAR – Central Coastal Agricultural Research Institute, Goa

PROJECT INFORMATION

Building Capacity for Climate Adaptation in Smallholder Fish Farming

PROJECT OVERVIEW

Funding Agency	ADB
Total Outlay	₹ 74.87 LAKHS
Duration	2
Single / Multi-Institutional	Multi-Institutional
Lead Centre if Multi-Institutional	TERI, Delhi
Cooperating Centre(s)	ICAR-CCARI
Principal Investigator	Shri Trivesh S. Mayekar
Co-Investigators	Dr. Sreekanth G.B., Dr. Paramesha V., Dr. Shripad Bhat

RATIONALE

India is the world's second-largest aquaculture producer, yet over 90% of production comes from smallholders operating below 2 ha, who hold the least capacity to absorb climate shocks. Coastal and inland fish farmers across the 13 target states (Maharashtra, Andhra Pradesh, Kerala, Karnataka, Tamil Nadu, Odisha, West Bengal, Telangana, Uttar Pradesh, Chhattisgarh, Jammu & Kashmir, Assam, Bihar) face rising water temperature, erratic monsoon and salinity swings, cyclone and flood damage to ponds and cages, and disease and low-oxygen events — each translating directly into crop loss and debt. Climate-resilient aquaculture technologies already exist in the research system (species diversification, aeration and water-quality management, improved feeds, resilient pond/cage design, IMTA and polyculture), but adoption at farm level remains low because they reach farmers as generic recommendations rather than as locally calibrated, economically justified practices. Technical training alone does not change behaviour: adaptation requires capital, and smallholders lack the financial literacy, budgeting ability and credit access to evaluate and finance a resilient investment. Technical and financial capacity must be built together. Women contribute substantially to post-harvest, feeding, nursery and marketing operations but are largely invisible in extension rosters and credit systems; a deliberate 1,200-women target is needed to correct this, not an incidental outcome. ICAR-CCARI's mandate covers research and extension across India's 82 coastal districts, and TERI's coastal division brings a decade of community-based aquaculture, aquaponics, cage culture, mussel

and crab farming and livelihood-diversification work — the partnership matches the research-to-farm gap the project addresses. The TA complements ADB's investment in a micro fish-feed plant: without farmer capacity to use higher-efficiency feeds and resilient practices, the hardware investment will not convert into productivity, income or reduced effluent load. Evidence generated (farmer database, vulnerability profiles, training modules) feeds directly into state and national policy, giving the investment a life beyond the project period.

RESEARCH GAPS

Vulnerability is undocumented at farm scale. Climate-risk assessments for Indian aquaculture exist at regional/basin scale; there is no farm-level, georeferenced baseline of exposure, sensitivity and adaptive capacity for smallholder fish farmers across agro-climatic zones. No validated smallholder-specific climate-vulnerability index for aquaculture that integrates biophysical (water quality, salinity, flood/cyclone exposure), production (species, system, stocking, feed) and socio-economic (assets, credit, gender, literacy) dimensions. Knowledge and practice gaps are unmapped. What farmers actually know versus what they practise — and why the gap persists — has not been systematically profiled, so extension content remains supply-driven. Weak evidence on the economics of adaptation. Cost–benefit, payback period and risk-adjusted return of climate-resilient investments (aerators, liners, deeper ponds, cage reinforcement, better feeds, species switching) at smallholder scale are largely unquantified, leaving farmers and lenders without a basis for decision. No gender-disaggregated evidence base on women's roles, decision authority, training access and technology preferences in Indian smallholder aquaculture — training is designed as if farmers are homogeneous. Training material gap. Climate-smart aquaculture modules in regional languages, pitched to low-literacy audiences and combined with functional financial literacy, are essentially absent; existing material is technical, English-dominant and not locally calibrated. Adoption pathways untested. The determinants of adoption and sustained use of climate-resilient practices after training ends — and the relative effect of training alone versus training plus credit plus input access — have not been tested experimentally. No impact-assessment framework for capacity-building in aquaculture that links training to measurable changes in practice, productivity, income and resilience; most programmes report outputs (numbers trained), not outcomes. Fragmented data systems. No consolidated, updatable database of smallholder fish farmers usable for targeting, advisories or scheme convergence. Broken knowledge–market interface. Mechanisms linking farmer learning platforms with input suppliers, credit institutions and buyers remain untested for smallholder aquaculture.

OBJECTIVES

To conduct a comprehensive needs assessment characterising the climate vulnerabilities, adaptive capacity and knowledge gaps of small-scale fish farming communities across the target states. To develop and deliver targeted training programmes and materials on climate-smart fish farming practices and functional financial literacy, tailored to local context and gender-specific needs. To promote the adoption of climate-resilient technologies, inputs and infrastructure among smallholder fish farmers. To establish a knowledge-sharing platform facilitating market linkages, continued learning and multi-stakeholder collaboration.

ACTIVITIES

Objective 1 — Needs assessment and baseline

Design and pre-test a structured vulnerability and knowledge-attitude-practice (KAP) survey instrument; obtain ethical/administrative clearances. Stratified sampling and selection of clusters across the 13 states covering coastal, brackishwater, estuarine and inland freshwater systems. Field surveys, focus group discussions and key-informant interviews with farmers, SHGs, FFPOs, traders and line departments. Collect production, water-quality, input-use, credit and loss-event data; record gender-disaggregated roles and constraints. Build a georeferenced database of participating fish farmers. Analyse data to construct a smallholder climate-vulnerability profile and rank priority training needs by zone and gender. Publish a baseline needs-assessment report.

Objective 2 — Training programmes and materials

Develop a modular climate-smart aquaculture curriculum (species and system selection, water and soil quality, aeration and oxygen management, feed and feeding efficiency, health and biosecurity, pond/cage design for extreme events, harvest and post-harvest handling). Develop a parallel functional financial-literacy module (farm budgeting and record-keeping, costing a crop cycle, savings, credit appraisal and repayment, insurance, economics of climate-resilient capital investment). Translate and adapt modules into regional languages; produce low-literacy-friendly print, audio and audio-visual material. Train master trainers and field facilitators; establish state-level training teams. Conduct structured training of 6,000+ smallholder fish farmers, with at least 1,200 women, through batch-wise programmes. Run exposure visits to model fish farms and demonstration units showcasing best management practices. Administer pre- and post-training assessments to measure knowledge gain; refine modules iteratively.

Objective 3 — Adoption of climate-resilient technologies

Establish on-farm demonstration units for climate-resilient practices (cage culture, polyculture/diversified species, aquaponics, improved feed use, water-management and aeration systems) at representative sites. Facilitate access to quality seed, high-efficiency feed, equipment and credit for entrepreneurship development. Work with banks, NABARD and state schemes to link trained farmers to credit, subsidy and insurance products. Monitor demonstration units for growth, survival, FCR, water quality, cost of production and returns. Compile adoption case studies and cost–benefit analyses of each promoted technology. Track adoption rates and identify barriers through follow-up rounds.

Objective 4 — Knowledge-sharing platform and linkages

Design and launch a digital knowledge-sharing platform (with offline/mobile-friendly and regional-language access) hosting modules, advisories and the farmer database. Establish farmer interest groups / peer-learning networks and WhatsApp-based advisory channels at cluster level. Organise multi-stakeholder workshops with State Fisheries Departments, NFDB, NABARD, NGOs, SHG federations, input suppliers and buyers. Facilitate market linkages for trained farmers, including value

addition and quality-improvement pathways. Conduct national-level dissemination workshops; hand over training materials, database and lessons to government agencies.

EXPERIMENTAL DETAILS

Treatment:	NA
Fertilizer Doses	NA
Variety	NA
Replications:	NA
Observations:	A. Baseline / Needs Assessment Observations (Objective 1) Farm and farmer identification Farmer name, GPS coordinates of farm, village/block/district/state, agro-climatic zone Age, education level, years in aquaculture, primary vs. secondary occupation Household size, dependents, landholding (owned/leased), water body ownership status Membership in SHG / FFPO / cooperative / fisheries society Farming system characteristics Culture system type (pond, cage, pen, tank, RAS, aquaponics, khazan/brackishwater, paddy-cum-fish) Water body area (ha), depth (m), number of units, dyke condition, inlet/outlet structure Water source (rain-fed, canal, borewell, estuarine tidal, river) and reliability Species cultured, stocking density (no./ha), seed source and size at stocking Crop cycles per year, culture duration (days), stocking and harvest calendar Production and input parameters Survival rate (%), average body weight at harvest (g), total yield (kg/ha/crop) Feed type, quantity used (kg/crop), feeding frequency, FCR Fertilizer, lime, probiotic, therapeutant use (type, dose, frequency) Energy use (aerator hours/day, pumping hours, diesel/electricity units) Labour deployed (man-days/crop, family vs. hired, male vs. female) Water and environmental parameters (seasonal — pre-monsoon, monsoon, post-monsoon) Temperature (°C), dissolved oxygen (mg/L), pH, salinity (ppt), transparency (cm) Total alkalinity, total hardness, ammonia-N, nitrite-N, nitrate-N, phosphate (mg/L) Soil pH, organic carbon, available N and P of pond bottom Plankton abundance and composition (where demonstration units are established) Climate exposure and loss history (last 5 years, recall-based) Frequency and severity of flood, cyclone, drought, heat-wave, unseasonal rain, salinity intrusion events Crop loss per event (kg and ₹), infrastructure damage (₹), mortality events and suspected cause Disease outbreak frequency, species affected, mortality (%) Days of production lost, number of crops abandoned Knowledge, Attitude and Practice (KAP) Awareness score on climate

change impacts on aquaculture (structured scale) Knowledge score on each climate-smart practice (pre-training baseline) Practices currently adopted vs. known-but-not-adopted, with stated reason for non-adoption Information sources used (extension officer, dealer, peer, media, mobile) Risk perception and willingness to invest in adaptation Financial and economic parameters Cost of production (₹/kg), gross return, net return, B:C ratio per crop Farm-gate price realized (₹/kg) by species and season Credit status: source (bank/SHG/moneylender/dealer), amount, interest rate, repayment status Existence of farm records/budgeting practice (yes/no, type) Insurance coverage (aquaculture, crop, life), subsidy/scheme benefits availed Financial literacy score (baseline, structured instrument) Indebtedness and savings behaviour (categorical, non-intrusive) Gender-disaggregated observations Activity-wise participation of women (feeding, nursery, harvest, processing, marketing, record-keeping) — time spent (hrs/day) Decision-making authority (stocking, sale, credit, expenditure) by gender Access to training, credit, markets and assets by gender Constraints reported by women (mobility, time, ownership, literacy) B. Training and Capacity-Building Observations

(Objective 2)

Number of training programmes conducted, by state, district and theme Number of participants trained — total, male, female, youth (<35 yrs), SC/ST, disaggregated by batch Attendance and completion rate per batch (%) Pre-training and post-training knowledge scores (same instrument); knowledge gain (%) Pre- and post-training financial literacy scores; gain (%) Skill demonstration/practical assessment score per participant Training material developed: number of modules, languages, print copies, audio-visual units produced Participant feedback: relevance, clarity, trainer effectiveness, duration adequacy (rated scale) Number of master trainers/facilitators trained and retained Exposure visits conducted, participants covered, sites visited Cost per farmer trained (₹) Retention of knowledge at 3 and 6 months post-training (follow-up recall test) C. Technology Demonstration and Adoption Observations

(Objective 3)

Demonstration unit performance Species, stocking density, seed size, survival (%), growth rate (g/day), SGR Harvest yield (kg/unit and kg/ha), FCR, feed cost (₹/kg fish) Water quality parameters (as listed above), monitored at fixed intervals Disease incidence, mortality events, corrective measures applied Structural performance of the unit during extreme events (damage/no damage, repair cost) Cost of establishment, operating cost, gross and net return, B:C ratio, payback period Adoption tracking Number

	and percentage of trained farmers adopting each promoted practice (at 6, 12, 18, 24 months) Extent of adoption (full / partial / discontinued) and reason for discontinuation Quantum of investment made by farmer in resilient inputs/infrastructure (₹) Number of farmers accessing credit, subsidy or insurance post-training; amount sanctioned (₹) Number of farmers accessing quality seed, improved feed and equipment through project linkages Change in species diversity (number of species cultured per farm, pre vs. post) Change in yield (kg/ha), cost of production (₹/kg) and net income (₹/ha) — baseline vs. endline Number of new enterprises/start-ups initiated by trained farmers and youth Employment generated (man-days, disaggregated by gender) D. Knowledge Platform and Linkage Observations (Objective 4) Number of farmers registered on the knowledge-sharing platform; active-user rate Number of advisories/content items issued; reach and open/response rate Number of farmer interest groups / peer-learning networks formed and functional Number of multi-stakeholder workshops held; institutions and participants engaged Number of market linkages established (buyers, input suppliers, credit institutions) Change in price realization (₹/kg) among linked farmers vs. non-linked Number of MoUs, convergences or scheme linkages facilitated Number of government agencies receiving training materials and lessons E. Outcome and Impact Observations (Cross-cutting) Composite Climate Vulnerability Index score per farm — baseline vs. endline Adaptive Capacity Index score — baseline vs. endline Change in household income from aquaculture (₹/annum) and share of total household income (%) Change in number of crop losses/failures per year Change in women's participation and decision-making scores Nutritional indicator: household fish consumption frequency and quantity Number of publications, bulletins, manuals, case studies and policy briefs produced Deviation of physical and financial progress from the approved work plan, with reasons
GPS Coordinates:	NA

EXPECTED OUTPUT

Georeferenced database of smallholder fish farmers across 13 states, with baseline vulnerability and KAP profiles. Needs-assessment report identifying climate vulnerabilities, knowledge gaps and priority training needs. Climate-smart aquaculture training modules and functional financial-literacy modules in regional languages, with manuals and audio-visual materials. 6,000+ smallholder fish farmers trained, including at least 1,200 women, in climate-resilient practices and financial literacy. Pool of trained master trainers and field facilitators in each participating state. On-farm demonstration units of climate-resilient technologies, with performance data and cost–benefit

analyses. Functional knowledge-sharing platform hosting modules, advisories and farmer database. Farmer groups, market, input and credit linkages established. Technical bulletins, case studies, publications and policy briefs; training materials handed over to government agencies.

EXPECTED OUTCOME

Enhanced resilience of smallholder fish farmers to climate shocks, with reduced crop loss and improved recovery capacity. Wider adoption of climate-resilient aquaculture practices, inputs and infrastructure. Increased fish production, species diversification, improved quality and value addition, strengthening nutritional food security. Lower cost of production and higher net income from aquaculture. Improved financial literacy, better farm budgeting and increased access to institutional credit and insurance. Entrepreneurship and livelihood generation in coastal and inland communities, attracting youth and women to fish farming. Greater participation of women in decision-making, credit access and enterprise ownership, advancing gender equality. Strengthened extension capacity of ICAR-CCARI and a replicable capacity-building model for India's 82 coastal districts. Evidence base and policy recommendations for climate adaptation in smallholder aquaculture; complementarity with ADB's fish-feed investment realised.

FIELD INFORMATION

When the field was developed:	NA
What are crops being cultivated season-wise:	NA
Soil type:	NA
Soil pH, EC, OC:	NA
Soil depth:	NA
Soil NPK and Micronutrient status:	NA
Common pests and diseases:	NA