CLOC Knowledge2Action

Promoting SDGs in South Asia in the fields of ecological sustainability and social well-being

Co-produced interventions in inland fishing experimentation

Kumirmari, Sundarbans




Route Map

1. From knowledge to action and the other way round

2. The pre-implementation phase: analysis, design, and development

    - Validation space(s)
    - Knowledge mobilization and exchange on implementation
    - Micro-detailed template on implementation logistics
    - Shifted timelines

3. The implementation phase: coproduced interventions in experimentation

    - On-site workshop and release of fish: March 24-26

4. Knowledge outputs – production and dissemination

5. Momentum, viability and expanding K2A partnerships

1. From knowledge to action and the other way round

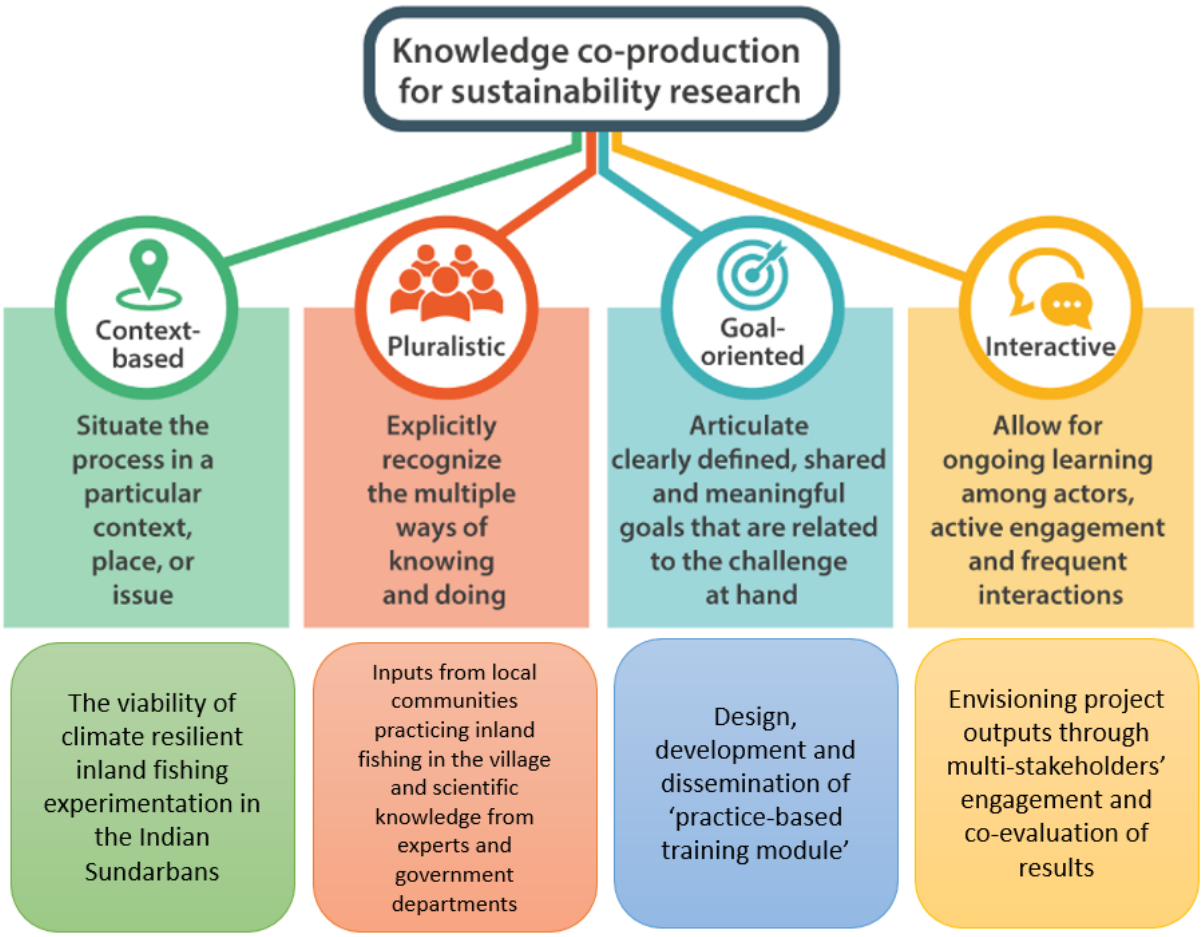
What is knowledge? How can knowledge be gathered and generated – by whom and for what purpose? What are the ideal ways of communicating and disseminating knowledge? Are these 'ways' universal or place-based? Whom does this knowledge cater to, for how long?

Contemporary socio-ecological research is being flooded with these questions – 'knowledge coproduction' gaining limelight to address (perennial) invisibilities and dismantle dogmas around mainstream/sacrosanct knowledge (produced by statecraft and international donor agencies and 'experts') to bring into its fold multiple ways of knowing, and hence, approaching the world. With a larger agenda and rationale to breakdown knowledge hierarchies, knowledge coproduction for sustainability research adheres to the four following principles:

Context-based	Understanding how a challenge emerged, how it is affected by its particular social, economic, and ecological contexts, and the different beliefs and needs of those affected by it
Pluralistic	Recognizing a range of perspectives, knowledge, and expertise and consider gender, ethnicity and age in developing the project
Goal-oriented	Articulating clearly defined, shared, and meaningful goals that are related to the challenge at hand
Interactive	Allowing for ongoing learning among actors, active engagement, and frequent interactions

Source: https://futureearth.org/2020/01/21/principles-for-successful-knowledge-co-production-for-sustainability-research/

Our interdisciplinary, cross-sectoral team was formed through the first small-scale grant (hereafter SSG 1) to develop a practice-based training module, specifically targeted to conduct inland fishing in the Kumirmari Village of the Gosaba Block, Indian Sundarbans. As the community lacked exposure to scientific and technical know-how in optimizing fish farming as one of the resilient livelihoods strategies in the cyclone-prone and flood-affected village, the IIT team acted as the liaison by compiling inputs from community and scientific experts (government departments and institutes on fisheries), generated across multi-stakeholders' engagement workshops, complying to the inclusive principles of knowledge coproduction (Picture 1).

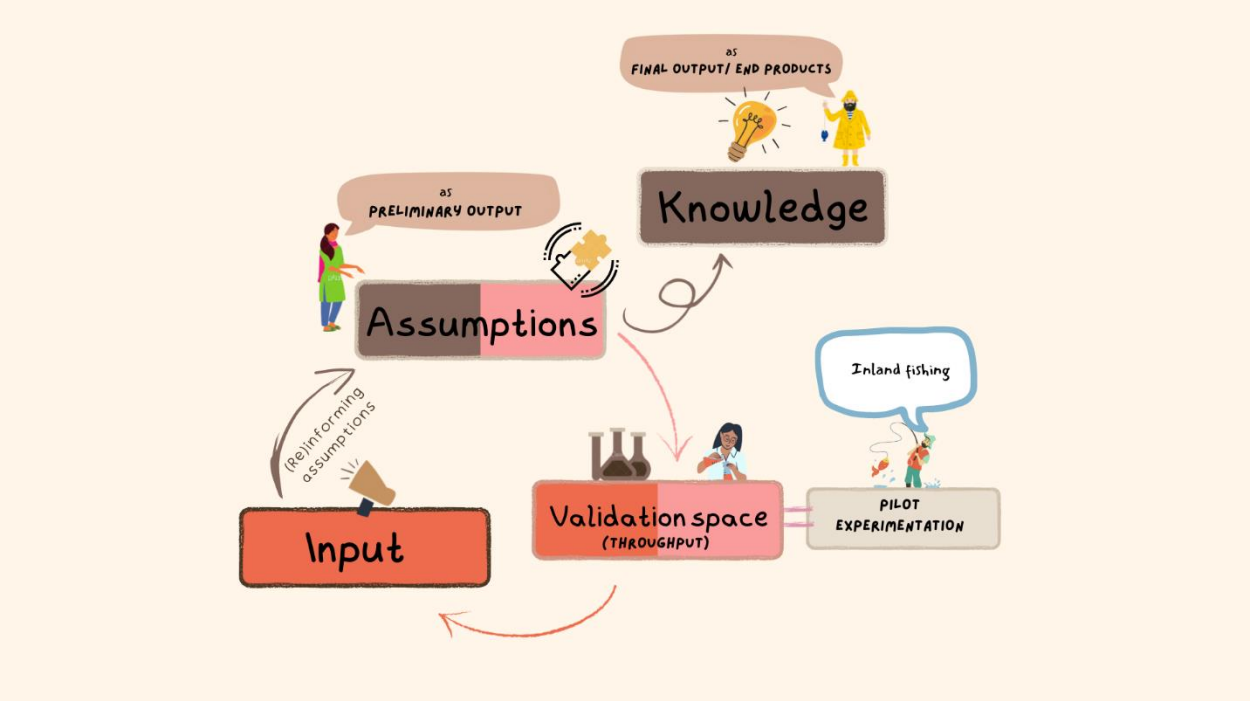


Picture 1: Knowledge coproduction principles in K2A SSG 1

Source: Adapted from https://futureearth.org/2020/01/21/principles-for-successful-knowledge-co-production-for-sustainability-research/. The last row demonstrates the K2A SSG 1 empirics.

When the IIT team was prepared to develop the module on the basis of compiled and coproduced knowledge gathered across series of on-site and virtual workshops and qualitative interviews, the community brought to the fore the inadequacy in this specific methodological design of translating knowledge to actions/outputs crafted by the academic team. What was perceived as 'knowledge' by academia and scientific experts at the fag end of SSG 1, was considered to be (mere) 'assumptions' by community as it awaited validation from on-ground implementation and findings. The local community was vocal that the training module would be considered effective once incorporated guidelines and principles on the basis of tested and validated facts and information. Thus, only through (at least a one-time) implementation of inputs (gathered through the workshops) in a validation space (an identified pond/water body), assumptions (perceived knowledge) had the possibility to get translated into (actual) knowledge – to be then communicated and disseminated at scales (Picture 2). Thus, through SSG 1, we could critically interrogate the linear pathway from knowledge to action and radically internalize its

mutual-reciprocal-cyclical interconnections. SSG 2 was an outcome of this critical transition to knowledge from actions across the tangible trajectory of implementation of inland fishing experimentation along coproduced interventions involving and engaging the cross-sectoral team at the different stages and components of project execution.



Picture 2: The knowledge-action feedback loop

2. The pre-implementation phase: analysis, design and development

During the pre-implementation phase, the project team pursued the analysis (A), design (D) and development (D) goals towards a tangible transition in the K2A pathway – charting out the action route in the latest SSG from knowledge coproduced during the earlier SSG. The following three major tasks and activities were co-conducted:

- Identification of validation space(s)
- Designing and finalization of tasks and timeline template
- Development of micro-detailed template on implementation logistics

Validation space(s)

A 30 ft. x 40 ft. pond at the SJSM premise was identified and selected for the experimentation (Picture 3).

Picture 3: The experimentation pond at the SJSM premise

To more appropriately assess the outcomes of this experimentation, the community suggested deployment of a comparative methodology, documenting details of step-by-step activities and results in two water bodies: the SJSM pond – as the site of coproduced knowledge interventions and co-involved actions, and another nearby pond (25 ft. x 30 ft.), personally owned by an active society member) – implementing fish farming using the locally pursued conventional method (Picture 4).

Picture 4: The personally owned pond following the conventional fish farming method

Knowledge mobilization and exchange on implementation

Considering practicalities in terms of reaping optimal results from the experimentation, the implementation activities were scheduled to be initiated in October 2022 after the offset of monsoons. A joint decision was taken that the experimentation will be conducted in the SJSM pond from scratch – i.e., the existing water would be channelized, the bed and bank would be cleaned and cleared, and the bed would be dried under the sun – the elaborate pond preparation being the most crucial component to scientifically initiate fish farming practices.

The IIT team got an additional window to probe into further micro-details as part of this experimentation exercise between July and September 2022 – conducting meetings with the Principal Scientist, qualitative interviews with the community, and secondary review of best practices of inland fishing in coastal-tropical-deltaic landscapes. Data was gathered relating to (Picture 5):

- The physical dimensions of the pond
- Pond preparation apparatuses and arrangements
- Details on quantity, quality, and access of fishlings to be used for composite aquaculture
- Optimum conditions for rearing
- Guidelines on production size and post-production preservation mechanisms
- Disaster preparedness and (back-up) strategies to deal with unexpected events
- Market linkages
- Profit sharing and distribution (among community directly involved in the experimentation)

1. Size of the pond
(composite inland aquaculture এর জন্য পুকুরের পরিমাপ)

2. Pond preparation
(একটা নির্দিষ্ট আয়তনের পুকুরকে কীভাবে মাছ চাষের জন্য তৈরী করতে নিতে পারবো)
- Pondbed scrubbing (পুকুর ছেঁচানো)
- Which ingredients (chemical/bio) are required
- In what amount
- How long / Duration of preparation (কতদিন ধরে, কোন কোন পদ্ধতিতে, বিভিন্ন উপাদান দ্বারা তৈরী করতে হবে)

3. Fishlings / Spawns
- Species (কোন কোন প্রজাতির মাছ ব্যবহৃত হবে)
- Their brooder size
- How to access/collect those

(If hatching is conducted then how to perform - detail)
- Ratio / Proportion for composite ~~[illegible]~~ aquaculture

4. Optimum condition for rearing
- What are the necessary moves to be performed for preparing the ambience of the pond conducive to growth of the fishes.
- Plankton boom
- Fishfeed

(What are the optimum ~~[illegible]~~/ideal fishfeed?
From where to access?
How to apply / in what proportion?
How to utilise traditionally available feeds?)
- Maintenance of O_2

(Which methods to be followed?
How to implement?
Traditional traits)

- Fish disease

(which type of chemoprophylaxis to be follow
~~locally practiced / traditional traits~~
How to access those or from where?
How to apply?
Locally practiced / ~~traits~~ traditional trait)

- ~~Maintaining optimum~~ Sun in the pond
- Maintaining optimum waterflow in the pond
- Maintaining the water quality of the pond
- Application of pumpset
  (Power (HP), ~~[illegible]~~ Procedure of application)

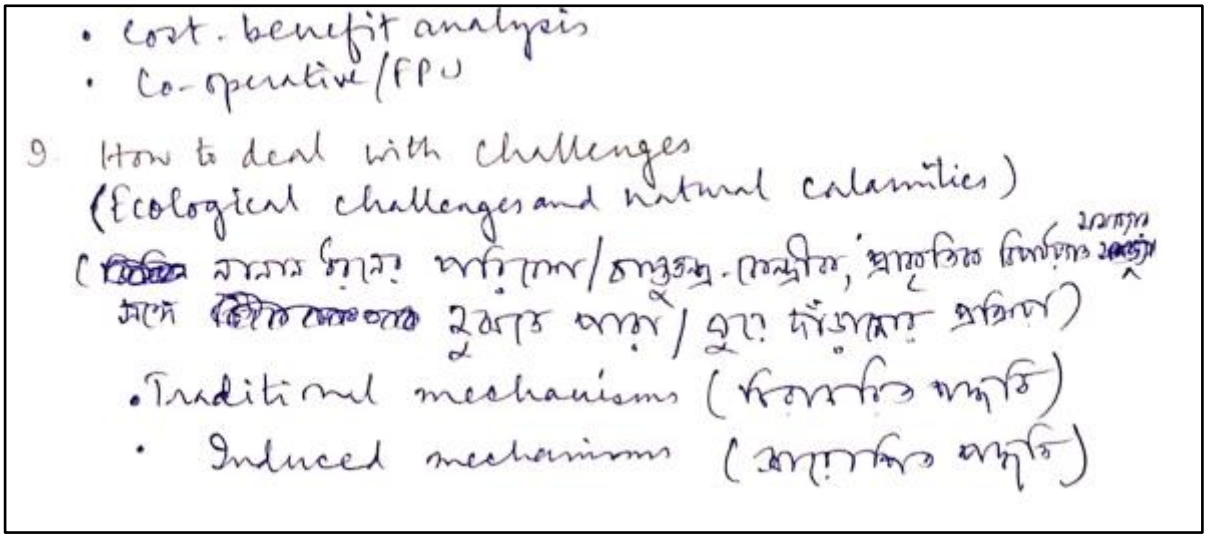
5. Technological apparatus
   (Aerator)

6. Production
   - Optimum production growth/size
   - Mechanism for preservation

7. Access to market
   - Connecting nodes with ~~the~~ which types of desired ~~a~~ markets / whosaler / online retailers ~~[illegible]~~ and franchisers.
   - Mechanism for preservation ~~to~~ while dispatching
     (~~[illegible]~~ Fundamental requirements and modes of application / [illegible])

~~[illegible]~~

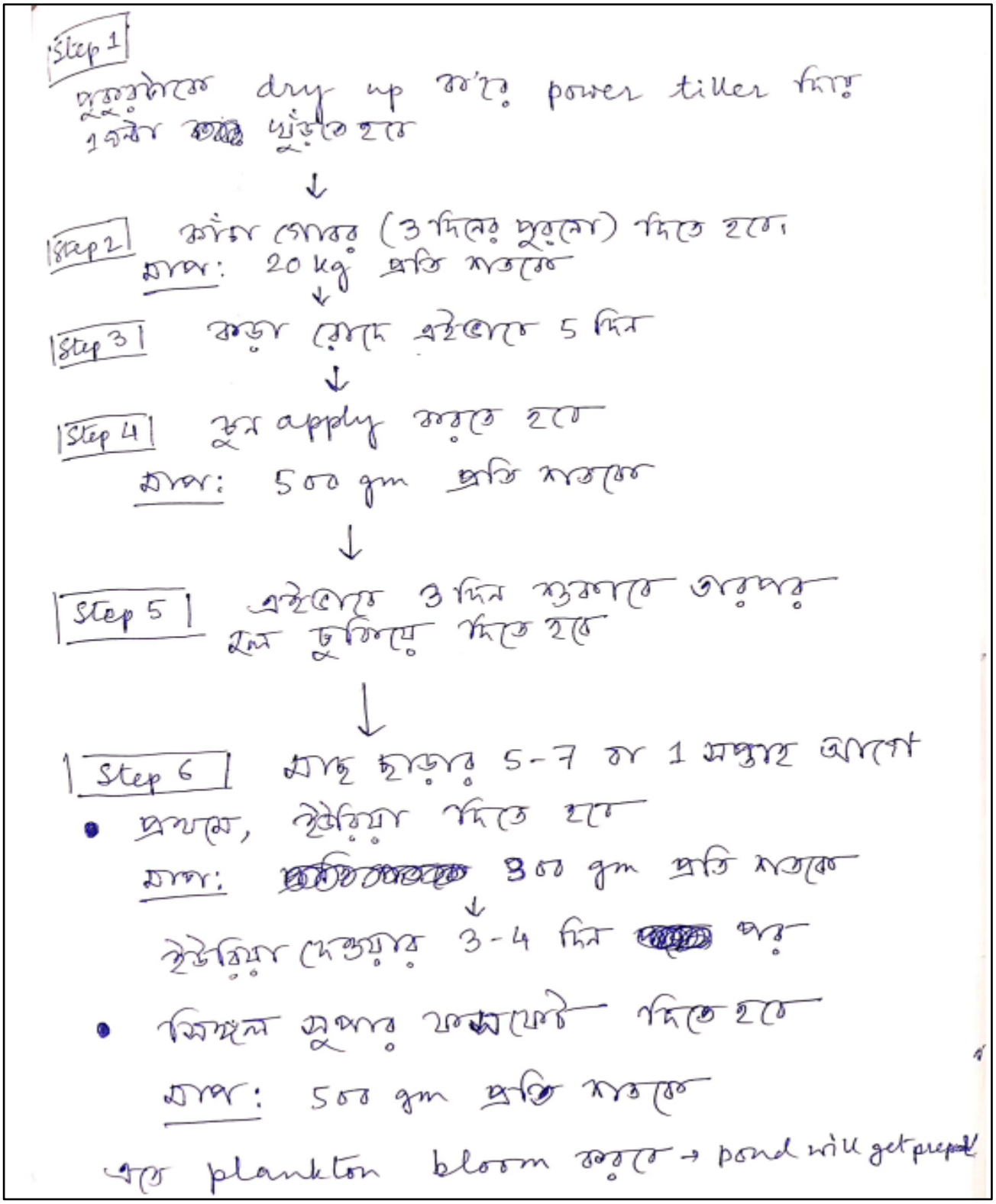
8. Sustainable profit sharing
   (How to ~~[illegible]~~ implement → where to utilize the benefit → how to sustain for future purpose)
   (~~[illegible]~~ [illegible])



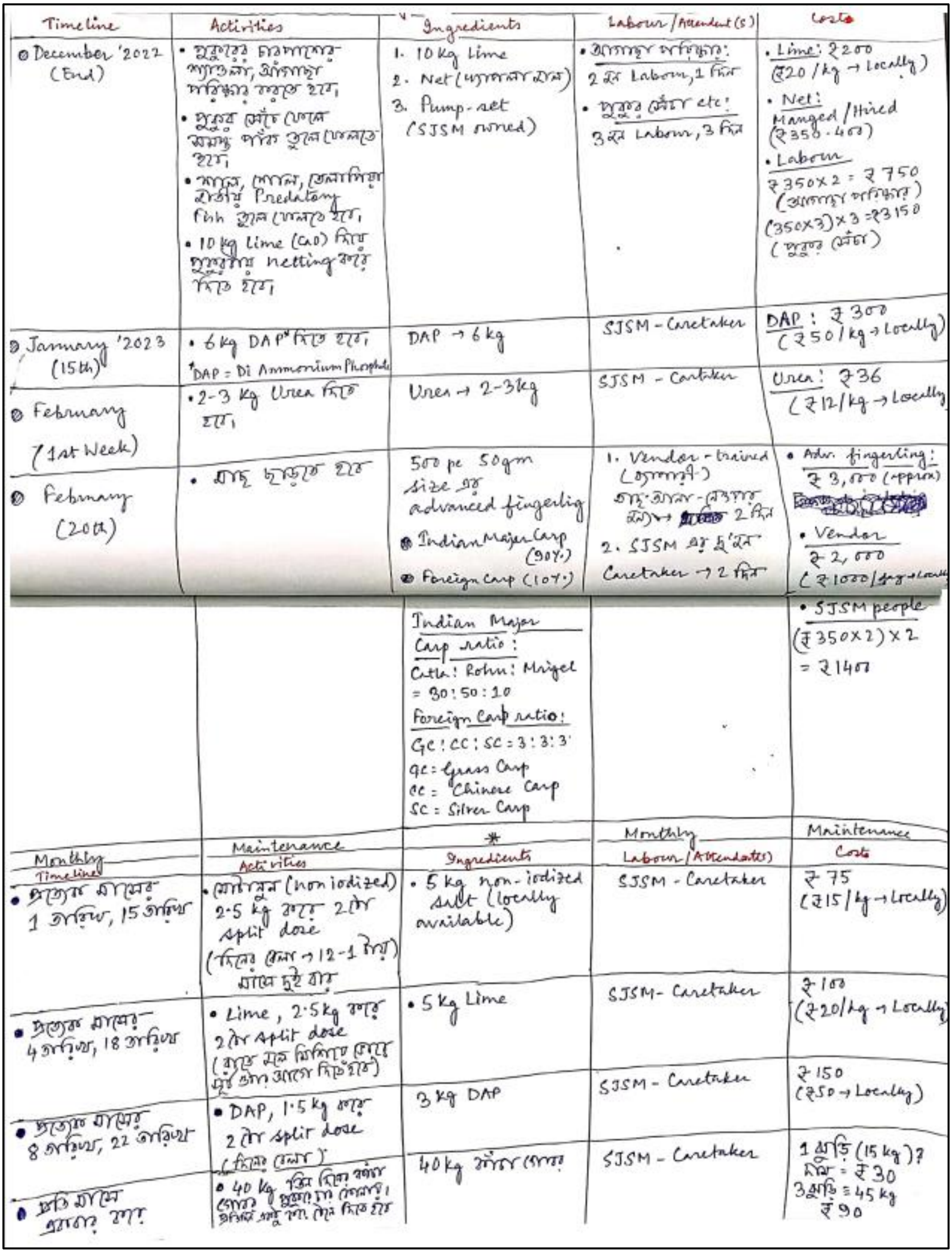
Picture 5: Questions, key pointers during the data collection-collation stage

Micro-detailed template on implementation logistics

Step-by-step knowledge of pond preparation was further mobilized and documented (Picture 6). The next major activity being the collation of inputs from primary interviews and secondary research and its dissemination among the internal project team in the vernacular language – the template serving as the guiding document during the implementation phase. It included details of tasks against stipulated timelines, range of ingredients and apparatuses, involvement of implementing actors to perform the various components of the experimentation in the validation space, and budget (Picture 7).



Picture 6: Pond preparation mechanisms



Timeline	Activities	Ingredients	Labour / Attendant(s)	Costs
December '2022 (End)	• পুকুরের চারপাশের আগাছা, জঙ্গল পরিষ্কার করতে হবে। • পুকুর সেঁচে সেখান সমস্ত পাঁক তুলে ফেলতে হবে। • সাপ, শোল, ল্যাটা ইত্যাদি Predatory fish তুলে ফেলতে হবে। • 10 kg Lime (CaO) দিয়ে পুকুরটায় netting করে দিতে হবে।	1. 10 kg Lime 2. Net ([illegible]) 3. Pump-set (SJSM owned)	• আগাছার পরিষ্কার: 2 জন Labour, 1 দিন • পুকুর সেঁচা etc: 3 জন Labour, 3 দিন	• Lime: ₹200 (₹20 / kg → Locally) • Net: Manged / Hired (₹350-400) • Labour ₹350×2 = ₹750 (আগাছার পরিষ্কার) (350×3)×3 = ₹3150 (পুকুর সেঁচা)
January '2023 (15th)	• 6 kg DAP* দিতে হবে। *DAP = Di Ammonium Phosphate	DAP → 6 kg	SJSM - Caretaker	DAP: ₹300 (₹50 / kg → Locally)
February (1st Week)	• 2-3 kg Urea দিতে হবে।	Urea → 2-3 kg	SJSM - Caretaker	Urea: ₹36 (₹12 / kg → Locally)
February (20th)	• মাছ ছাড়তে হবে	500 pc 50gm size এর advanced fingerling • Indian Major Carp (90%) • Foreign Carp (10%) Indian Major Carp ratio: Catla : Rohu : Mrigel = 30 : 50 : 10 Foreign Carp ratio: GC : CC : SC = 3 : 3 : 3 GC = Grass Carp CC = Chinese Carp SC = Silver Carp	1. Vendor - trained (ব্যবসায়ী) মাছ-ধরার-জেলের দল → 2 দিন 2. SJSM এর দু'জন Caretaker → 2 দিন	• Adv. fingerling: ₹3,000 (approx) • Vendor ₹2,000 (₹1000 / day → Locally) • SJSM people (₹350×2)×2 = ₹1400
Monthly Timeline	Maintenance Activities	* Ingredients	Monthly Labour / Attendant(s)	Maintenance Costs
• প্রত্যেক মাসের 1 তারিখ, 15 তারিখ	• সাধারণ নুন (non iodized) 2.5 kg করে 2টো split dose (দিনের বেলা → 12-1 টায়) মাসে দুই বার	• 5 kg non-iodized salt (locally available)	SJSM - Caretaker	₹75 (₹15 / kg → Locally)
• প্রত্যেক মাসের 4 তারিখ, 18 তারিখ	• Lime, 2.5 kg করে 2টো split dose (নুন এর দিন থেকে তিন দিন পরে দিতে হবে)	• 5 kg Lime	SJSM - Caretaker	₹100 (₹20 / kg → Locally)
• প্রত্যেক মাসের 8 তারিখ, 22 তারিখ	• DAP, 1.5 kg করে 2টো split dose (দিনের বেলা)	3 kg DAP	SJSM - Caretaker	₹150 (₹50 → Locally)
• প্রতি মাসে খাবার জন্য	• 40 kg [illegible]	40 kg সর্ষের খোল	SJSM - Caretaker	1 ঝুড়ি (15 kg) দাম = ₹30 3 ঝুড়ি = 45 kg ₹90

Picture 7: The guiding template

Shifted timelines

Physical settings and scenarios at the ground were key variables to push the initiation of experimentation further behind two months. It was clear that pond preparation could not be planned in October and before December 2022, the pond bed could not be dried. The process of draining of existing water from the pond and keeping it fallow under the sun entailed one-month duration. The community convinced the other project team members that as October overlapped with autumnal harvests of paddy (locally called the *Aman* variety), there were high chances of water from the encircling paddy fields getting infiltrated in the pond through gravity. The other pond following the conventional fishing method was already overflowing with water from the agricultural farms. It was jointly decided that the experimentation will start during the end of December 2022 (also reflected in the (revised) template – Picture 7). During this time, further 'queries and responses' rounds were conducted between the scientist and the community with IIT facilitating the exchange and documenting these discussions (Box 1).

Box 1: Some specific questions and responses before and towards actual implementation

Q: What will be the duration for the drying up of the pond bed before refilling it with water again?

R: Around 15 days

Q: What will be the optimal depth of the pond water during the application of soaked lime?

R: A minimum depth of 3 feet

Q: What will be the optimal duration of netting once soaked lime is applied?

R: At least 3 days

Q: What will be the optimal depth of the pond water while applying Di Ammonium Phosphate (DAP)?

R: A minimum depth of 3.5 feet to 4 feet

Q: What will be the optimal depth of the pond water while applying Urea?

R: A minimum depth of 3.5 feet to 4 feet

3. The implementation phase: coproduced interventions in experimentation

The implementation phase was initiated in January 2023 with multiple activities on the SJSM pond. This phase has been earmarked between January and November 2023 – with planned activities (completed, ongoing and forthcoming) across different stages from pond preparation to release of fish varieties to maturation of fish species and pond maintenance (pond bank activities) to fish growth and harvest. This phase includes the implementation of coproduced knowledge interventions along the co-involvement and engagement of the multi-stakeholders' CLOC K2A team – designed on the basis of role, expertise and enthusiasm of actors.

JANUARY 2023	
Activity	Details
Cleaning and scrubbing of the pond bed and bank	• Grasses and shrubs from the bank removed with the support of three-four locals (chosen by SJSM) working for five days. • The water was released from the pond with the use of SJSM pump working for 24 hours at a stretch (Picture 8). • The pond bed was cleaned (Picture 9). • Predatory fish varieties (such as Shol and Tilapia) that were growing in the pond (after entering in it from nearby canals) were caught, consumed and distributed among the locals (Picture 10). • The pond bed was dried under the sun. • Fresh water was channelized into the pond from the nearby canal. The canal owner allowed this as reduction in water level in the canal was important for him to sublet stretch of this canal to leaseholders for fishing and irrigation (Picture 11).

Picture 8: Pond water evacuation

Picture 9: Cleaning of the pond bed

Picture 10: Predatory fish species removed

Picture 11: The canal that supplied fresh water

FEBRUARY 2023	
Activity	Details
Application of soaked lime and subsequent netting	• Once the pond contained 4 feet of water, soaked lime was applied during the daytime (Box 2) (Picture 12). • To deal with a thick layer of calcium during the post-application period, the society members pulled a net (locally known as *Khyapla Jaal*). • Di Ammonium Phosphate (DAP) was added in the water (Picture 13). This led to plankton boom in the water surface (Picture 14). Plankton is one of the key elementary food for fish.
IIT team visit and qualitative interviews and feedback	• Interviews were conducted with the locals and society members involved in the activities. • The interviews were documented, audio-recorded and transcribed. • Feedback from the society members were taken and shared with the Principal Scientist, CIFRI. One important discussion was on the uncertainties surrounding the application of Urea (Box 3).

Box 2: The logic of lime application

According to the traditional method, soaked lime is applied to the pond anytime during the day, especially around midday. This technique triggers the alkaline effect of soaked lime, which is detrimental to fish. The scientific approach, however, suggests mixing lime with freshwater the night before and applying it before sunrise. But there is another twist! Lime could be applied anytime during pond preparation – although, not for the harvest boom – as the pond does not contain fish during the preparation phase.

Box 3: Uncertainties relating to urea application

Urea is supposed to be applied in the post-DAP (Di-Ammonium Phosphate) application phase. Some fishers mentioned that they had never used Urea while preparing the pond they consider Urea as a chemical fertilizer. While some villagers are doubtful about the edibility of fish harvested if Urea is applied, the scientific approach instructs that Urea and DAP get decomposed and contribute significantly to plankton bloom. On the other hand, a section of the community has taken a gradual turn towards practicing organic farming by using organic fertilizer. Since there is doubt about whether Urea contributes to organic fish food, its application has been put to questions from every angle.

In this case, as the experimentation pond has already met the optimal status of plankton bloom, the subsequent phase of applying Urea has been skipped at it may trigger an excess of plankton into the pond.

Picture 12: Application of soaked lime

Picture 13: Application of DAP

Picture 14: Plankton boom

MARCH 2023	
Activity	Details
Meetings with the Principal Scientist (and iterative rounds with SJSM members virtually)	• Identification and listing of fish varieties to be released in the pond, ensuring optimal returns on investments • Identification of the wholesaler and vendors from whom fingerlings would be purchased and transported in Kumirmari • Listing of equipment to be purchased and used against as identified by the society along with budget estimation
During this phase, community members asked some technical questions to the Scientist with the IIT team acting as liaison to facilitate knowledge coproduction and exchange through the 'queries and responses' rounds (Box 4). **The Kumirmari onsite workshop was held between March 24 and 26 – converging with the release of selected fish species in the pond. A co-participatory approach was followed to co-assess phase-wise activities already conducted and the forthcoming ones in the subsequent months.**	

Box 4: Queries and responses: Local Community and the Principal Scientist

Q: What will be the depth of the water level in the pond while releasing the fingerlings?

R: 4.5 feet to 6-8 feet.

Q: How would fish feed be applied during the first five days?

R: A mixture of mustard oil cake (locally called *Shorsher Khol*) fermented for one-and-half day and rice crumbs in 50: 50 ratio along with Agrimin Forte (1 Kg in 100 kg) should be applied and mixed with fresh water.

Q: What would be the interval of applying fish feed?

R: One-day alternate method i.e., at least three days containing a gap of one day in a week.

Q: After four days (as the Scientist had mentioned), fish feed should be served in a proportion of 4% of the total body weight of the fish in the experimentation pond; what would be the interval to check the weight?

R: At an interval of every one month.

Q: If this experimentation design is implemented, could other household activities such as bathing, cleaning of utensils, washing clothes, etc. be performed in the pond (as many of the villagers do not have a separate pond)?

R: Fortunately yes! These activities could be performed as the use of soap or detergent would increase the phosphate component in the pond which would be instrumental in plankton bloom and inland aqua-harvesting.

On-site workshop and release of fish: March 24-26

Trained local fishers with expertise in fetching fish from the market and releasing it to the pond (locally known as *Byaparis*) were given the task to transport the fish from the Naihati market. Fishlings of an average size of 120 gm including all three Indian Major Carps (*Mrigal* (*Cirrhinus cirrhosus*), *Rohu* (*Labeo rohita*), and *Catla* (*Catla catla*)) were procured. The *byaparis* did not intend to include the foreign carps against the apprehension that they would consume the fingerlings. Instead *Bata* (*Labeo bata*) was introduced. The carps were brought in large cooking pots, their mouths closed with nets. The *Byaparis* kept stirring the water manually to increase the flow and supply of oxygen in the pot water. The water also had to be changed to ensure survival of the carps four times (at Banshtala, Mahabirtala, Basirhat, and Nazat) in the eight hour journey between Naihati and Kumirmari (three hours on road and five hours on boat).

Fishes were released in the pond and the team members participated in this activity with enthusiasm (Picture 15). The academic team interviewed vendors, the Scientist and the locals on the spot, documenting their perspectives and understandings of the process and involvement in this experimentation. Some fishes were reserved in the breeding Hapa net, prepared by the society members (Picture 16). The fishes were to be released in the pond the next morning after some rituals being offered in the name of *Makal Thakur*, *Satya Narayan* and *Satya Pir* ensuring good harvest (Picture 17).

Picture 15: Interviews and exchanges during fish release

Following the release of fish, the team members participated in an interactive discussion moderated by the IIT group – assessing the activities conducted so far, sharing experiences, and planning forthcoming activities, using a task and timeline template (Picture 18). One prolonged discussion was on the use of fish feed (Box 5).

Picture 16: Hapa net

Picture 17: Rituals

Picture 18: Interactions – evaluations and planning the next steps in experimentation

Box 5: Knowledge coproduction on fish feed

- According to the previous guideline for the fish feed, mustard oil cake (locally called *Shorsher Khol*), fermented for one and half days and rice crumb in 50: 50 ratio along with Agrimin Forte (1 Kg in 100 kg) needs to be applied after mixing them into fresh water. As the size of the fishlings varied from pre-set estimation, the stakeholders were involved in knowledge exchanges on redesigning the fish feed composition.
- Fish feed weighing 6% of the total body weight (3kg 600gm) of the fishlings is the immediate need for the fishlings as they are not accustomed to the natural feed like plankton.
- A mound of 40% mustard oil cake, 30% nut cake and 30% rice bran along with Agrimin Forte needs to be prepared and 1% of the total weight of the food must be hung through polythene bags at four corners of the experimentation pond for next 15 days after the fingerlings are released.
- Both the mustard oil cake and the nut cake will dissolve in water throughout two days and afterwards, they will be mixed up with rice bran and Agrimin Forte in a standard proportion to be served as mounds. The mounds need to be hung through porous polythene bags or sacks which need to be fixed with projecting sticks at the four corners of the pond. This process needs to initiate by the morning and finished as soon as dusk arrives as this variety of fish does not take food at night. This mode of application should continue daily for the first 15 days.
- After 15 days when the fish will gradually get accustomed to consuming phytoplankton, the fish feed will be applied on the alternative days. Next month onwards, the amount of fish feed will be reduced to 5% of the total body weight. Consecutively, it will get reduced to 4%, 3%...etc., following a 1% reduction in the amount of fish feed applied after each of the months passed. As the biomass of the fish will increase proportionately over time, the gross amount of fish feed will increase after each of the months. The fishers will check the biomass of the fish once a month by pulling the net.

The next phase of implementation activities between **April and November 2023** include:

- Maintenance of pond, facilitating growth of fish varieties
- Application of fish feed (as per coproduced scientific and application-oriented logic)
- Interactive-iterative rounds between the different actors of the team to optimize fish growth and production and rule out challenges and impediments to a great extent
- On-site workshops
- Fish harvest
- A brief report on community method-induced fishing in the other pond and comparison between the outputs in the SJSM pond that had undergone coproduced interventions and the former.

4. Knowledge outputs – production and dissemination

The tangible knowledge products are:

- Coproduced and validated training module on inland fishing in Kumirmari
- Production of a video-documentary capturing the process of knowledge coproduction and actions in Kumirmari

Knowledge product	Description	Dissemination
Coproduced and validated training module on inland fishing (in and for Kumirmari)	It will capture the step-by-step methodology in inland fishing experimentation and practices in the delta. Stories, visuals, and interactive infographics will be extensively used so that the differently educated village community (including women) can rely on the module as a guiding manual in fish farming.	The physical formats will be distributed among households in Kumirmari. Posters demonstrating key steps and highlights of fishing will be distributed in local institutional centres, SJSM hub, etc. The digital format will be submitted to K2A targeting wider dissemination. It will also be uploaded in the ENGAGE website – to be developed as part of SOR4D.
A video documentary (Small steps, big dreams – Action research in Kumirmari)	Based on real life project components and events – from inception to implementation, deviations and possibilities, and (dis)agreements among multiple actors, this 25 mins (approx.) film will unleash and archive unforgettable moments of transdisciplinary research in dynamic socio-ecological landscapes – the challenges involved and the opportunities (to be) harnessed towards more just and resilient trajectories	The ENGAGE website and (most likely) other existing project platforms Dissemination channels will be identified in consultation with research communities using videography techniques in socio-ecological research
Trailer available at: https://drive.google.com/file/d/1_jBB-a9t84ObRKJpJvrcYWO83F7NS3Rl/view?usp=share_link		

5. Momentum, viability and expanding K2A partnerships

CLOC K2A SSG 1 and 2 have given our interdisciplinary, cross-sectoral team an edge to continue action research in the Sundarbans. With some experience in inland fishing experimentation, mobilizing and coproducing knowledge along participation of multiple stakeholders – academia, NGO, government institutions (local and national), and community, our team applied for the 'Solution-oriented Research for Development' (SOR4D) programme which is a joint funding instrument between the Swiss Agency for Development and Cooperation (SDC) and the Swiss National Science Foundation (SNSF) – building on experiences and lessons learnt in previous joint programmes. The successful bid has now offered us the opportunity to diversify and up-scale K2A outputs (Box 6) and also expand network partnerships with Bangladesh by extending the spatial breadth of the project to include transboundary Sundarbans.

Box 6: Diversification and up-scaling of K2A outputs in the SOR4D (2023-26/27) research plan

- Practice-oriented training module and experimentation on inland fishing as alternative livelihoods strategy
- Ancillary development interventions to up-scale inland fisheries, crafting transition from self-sufficient consumption mode to surplus and local exports; development of cold storage facilities, laying out effective market linkages through detailed research on value chain analysis
- Gender empowerment by involving women in fisheries and related enterprises (manufacturing and sale of fish pickles, fish balls, products made of fish scales, etc.)
- Development of forecasting station in the project site, generating disaster warnings
- Sustained support, training and fund mobilization initiatives from the SOR4D transdisciplinary consortium on the Sundarbans Delta

The K2A project – especially the process through which the project components could co-evolve, leading to ontological ruptures in knowledge, action and their possible intersections, has drawn some attention of researchers and consultants at the national and global levels. In collaboration with IIT Bombay, IIT Kharagpur will be developing the roadmap to establish a pilot living lab in Kumirmari as part of CGIAR's 'Securing the Food Systems of the Asian Mega-Deltas for Climate and Livelihood Resilience (AMD)

Initiative' that aims to support governments, NGOs, private sector and local communities in selected deltascapes of Asia.

The K2A SSGs have been instrumental in gathering empirical insights to advance the theoretical-conceptual traction of 'social resilience' in the Sundarbans delta. It has been the stepping stone to forge transdisciplinary collaboration to argue for and enact locally appropriate solution strategies to deal with socio-ecological volatilities dotting this deltascape. The final outputs envisioned from this project will also showcase the significance of the application of multi-modal methodologies towards more desirable and effective knowledge communication, mobilization, and dissemination among local communities and other stakeholders engaged in climate change and livelihoods resilience research and actions in vulnerable geographies.