# Workshop on Co-developing an Experiential Learning Game for Invasive Species Management and Landscape Restoration

## Foundation for Ecological Security and International Food Policy Research Institute

Mayfair Lagoon, Bhubaneswar, Odisha, India, 31st August – 1st September 2026

### Background

Foundation for Ecological Security (FES) and International Food Policy Research Institute (IFPRI) have been collaborating for over a decade to co-develop and apply games and other experiential learning approaches to strengthen collective action for managing land and water commons. The ongoing collaboration seeks to co-design and test experiential games that can stimulate conversations, enable collective learning, and foster collective action for improving the health and sustainability of forests and other landscapes.

As part of this collaboration, FES and IFPRI are developing an experiential learning game focused on invasive species management, with particular emphasis on lantana removal and restoration aftercare. The game seeks to enable participants to explore the social, economic, ecological, and governance dimensions of invasive species management and the collective-action challenges associated with sustaining restoration outcomes after removal.

A prototype of the game has been developed and field tested with communities in Mandla, Madhya Pradesh in India. The feedback and observations from the pilot have been consolidated and inform further refinement of the game. In parallel, we have developed a cost-benefit analysis of lantana removal and aftercare to better understand the economic dimensions of restoration and the costs and benefits associated with sustained aftercare.

### Objectives

The two-day co-development workshop aimed to:

1. Collaboratively refine and strengthen an experiential learning game for invasive species management and restoration aftercare.

2. Develop strategies for piloting, adapting and scaling its use across FES and partner landscapes.

**The Challenge of Lantana Camara**

*Lantana camara* is among the most widespread and ecologically disruptive invasive species in India. Introduced originally as an ornamental plant, it has spread extensively across forests, commons, agricultural margins, and protected areas, forming dense thickets that suppress native vegetation, alter habitat structure and hinder natural regeneration.

In the Kanha landscape of central India, ecological studies show that areas with higher lantana infestation support significantly fewer non-timber forest product (NTFP) species: roughly 60% of the observed variation in NTFP richness can be statistically associated with lantana cover. Infestation has also been linked to greater crop losses, reduced grazing, higher fire risk, and changed wildlife movement patterns.

For forest-fringe communities, commons continue to provide fodder, fuelwood, seasonal foods, NTFPs, and grazing. Lantana affects not only the availability of these resources but also their accessibility, increasing the time, effort and risk of collection. Dense thickets provide cover for wildlife such as wild pigs and native deer, contributing to crop raiding, in some areas reported to cause 80-90% paddy yield losses, and to livestock predation and poisoning from the plant's toxins. Communities also report reduced mobility, greater labor burden, and heightened fear of moving through infested areas.

The scale of the response reflects the scale of the problem: by 2020, communities across 111 villages in the Kanha landscape had collectively restored approximately 6,078 hectares of lantana-infested commons and agricultural uplands. Assessments of these efforts documented improvements in fodder availability, access to major NTFPs such as mahua (*Madhuca longifolia*) and tendu (*Diospyros melanoxylon*), biodiversity indicators, and reduced crop depredation. However, these benefits do not appear immediately: different ecosystem services recover at different rates after removal, and restored land will reinfest with lantana regrowing from seed unless aftercare continues. This makes the economics of restoration, and specifically of aftercare, central to whether these gains are sustained.

## The Economics of Restoration and Aftercare

To understand these economics, FES and IFPRI developed a community-informed cost-benefit analysis of lantana removal and restoration in the forest commons of Mandla district, Madhya Pradesh, drawing on focus group discussions and participatory recovery-trajectory exercises in four villages. Rather than assuming

that ecosystem-service benefits return immediately after removal, the study modelled restoration as a phased recovery process: provisioning services such as fodder and fuelwood recover comparatively quickly, while regulating and supporting services recover over longer horizons. Ecosystem-service values were drawn from published valuation literature and combined with these community-perceived recovery trajectories.

Restoration costs are concentrated in the first two years, while incremental benefits accumulate progressively over the following years as ecosystem services recover. Discounting this stream of costs and benefits over a five-year horizon, at three social discount rates representing low, moderate, and conservative assumptions about how future benefits are valued, produces the following results:

| Discount Rate | Discounted Benefits (₹/ha) | Discounted Costs (₹/ha) | Net Present Value (₹/ha) | Benefit-Cost Ratio |
|---|---|---|---|---|
| 3% | 67,358 | 18,324 | 49,033 | 3.68 |
| 5% | 62,811 | 17,966 | 44,845 | 3.50 |
| 8% | 56,761 | 17,477 | 39,284 | 3.25 |

*Table 1: Benefit-cost ratio for three scenarios*

Even under the most conservative (8%) discounting assumption, the discounted benefits of restoration are more than three times its costs. Provisioning services, fodder and grazing, fuelwood, food resources, and NTFPs account for the largest share of these benefits, reflecting how central the commons remain to local livelihoods. Notably, several co-benefits identified during fieldwork, reduced labor burden, improved mobility, reduced fear, biodiversity gains, and lower fire and wildlife-conflict risk, could not be reliably monetized and were excluded from the analysis. The results should therefore be read as a conservative estimate: restoration and aftercare make clear economic sense in the long run, and quite possibly more so than these figures suggest.

## Invasive Species as a Governance Challenge

If restoration is thus worthwhile economically, the natural question is why it does not happen more readily, and why aftercare in particular is so hard to sustain once land has been cleared. The answer lies less in ecology than in governance.

Most of the ecosystem services generated by restored commons behave as public goods or common-pool resources. They are only weakly excludable: a household that contributes nothing to clearing and maintaining the land still benefits from the fodder, fuelwood, and NTFPs it produces. Where the resource is also subtractable (one household's use reduces what is available to others), this

combination creates a persistent incentive to free-ride on others' labor rather than contribute one's own.

The cost-benefit analysis highlights a further complication: the costs of aftercare are immediate and private (a day spent clearing saplings is a day not spent on wage labor), while the benefits are delayed, shared, and collective. This temporal and spatial mismatch between who bears the cost and when, and who receives the benefit and when, is precisely the structure of a collective-action problem. Individually, it is often rational to prioritize private wage labor over commons aftercare; but if every household reasons the same way, the land reinfests and everyone loses more than they would have gained; a prisoner's dilemma played out at the scale of the village commons.

Overcoming this problem requires strong local institutions capable of making, monitoring, and enforcing rules: agreeing how labor and benefits will be shared, sanctioning free-riding, and adapting rules as circumstances change. Without such institutions, the favorable economics shown above remain theoretical, benefits that could be realized, but are not, because no individual has the incentive to invest first.

It is this gap, between what restoration could deliver and what unaided individual behavior will deliver, that positions experiential games as a useful tool. By letting participants feel the tension between private and common benefit for themselves, in a low-stakes setting, a game such as this can help communities recognize the collective-action problem they face and begin to discuss and design the rules and institutions needed to address it.

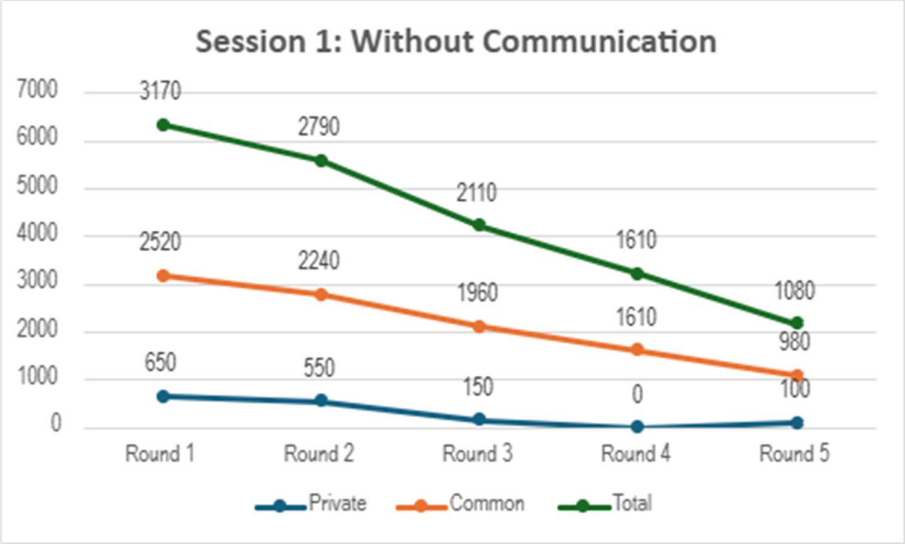
## Gameplay with Workshop Participants

Workshop participants played the current prototype of the game in two sessions, each of five rounds, using the same seven-player group and starting board from the Mandla pilot. In the non-communication session, players made labor-allocation decisions independently and in silence, as in the game's first session. In the communication session, players could discuss and coordinate between rounds, as in the game's second session.

### Non-communication session

The board began with 14 saplings on a grid of 36 quadrants. Players contributed between 0 and 2–3 labor tokens (stones) per round to clearing, which was not enough to keep pace with regrowth: by round 2 the board carried 7 mature plants and 11 saplings, and by round 5 the entire grid was almost covered in mature lantana or saplings. Common earnings fell steadily as a result, from 360 play rupees in round 1 to 320, 280, 230 and finally 140 per player by round 5, while private earnings also declined as fewer players chose to hold back labor.

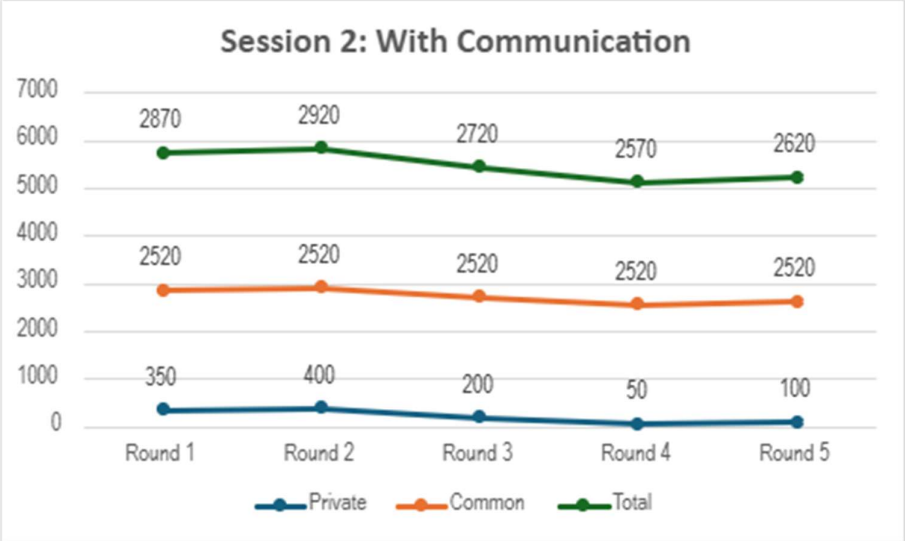
The pattern that emerged showed players watched what others contributed and adjusted their own effort accordingly; that commons benefits are shared equally even when effort is not; and that voluntary contributions increased only in later rounds, once the extent of the degradation was visible, by which point it was very difficult to reverse. Participants observed that once the problem crosses a certain threshold, even a shift toward collective effort cannot fully recover the commons: households must give up wage income for a reduced return.




*Graph 1: Income trend for without communication session.*

**Communication session**

With discussion allowed, common earnings held steady at 360 play rupees for the first three rounds and rose to 420 by round 5, as the group came far closer to clearing the board. One player, taking the role of an older villager who wanted to retain some lantana for fuelwood, resisted full clearance. In round 4 the group agreed a rule withholding common benefits from anyone who did not contribute to clearing labor, and the player affected ended up with the lowest total earnings of the group, despite the fact that he would have earned among the most had the rule not been adopted.




*Graph 2: Income trend for communication session.*

Discussion in the debriefing after game play drew out several further points: that rules were only made once a problem was already visible, in round 4, rather than being agreed from the outset, and that earlier, consistent rule-making would likely have produced a better outcome; that fairness was understood by participants not as equal contribution but as contribution and benefit proportionate to ability; that even with discussion allowed, players did not share labor easily at first and some further degradation occurred before behavior shifted; and that leadership played a visible role in moving the group toward a rule, and would need ongoing monitoring to hold.



*Image 1: Gameplay in progress*

## Suggestions for Game Design and Facilitation

Building on the gameplay and debrief, participants worked in small groups to identify what the game and its manual should change, add, or remove, and discussed these game experts on a call. The resulting suggestions are grouped below.

### Game structure and materials

- Make the number of rounds flexible rather than fixed. A default of five rounds is enough for most groups to reach the point where individual decision-making is visibly worsening the collective problem; facilitators can then add up to two further rounds if useful, rather than always playing the full ten.
- Introduce more randomness into lantana regrowth, for example by rolling a die to determine the number of new saplings at a random round, rather than a fixed rule. This better reflects the real uncertainty of invasion.
- Rename the 'labor tokens' or 'labor stones' to a more locally relatable term, such as work-days or a labor card, drawing on the familiar imagery of government labor-scheme cards, so that players connect the token more directly to real household labor decisions. (*A practical trade-off: printed or laminated cards add a production and logistics burden compared with locally available stones*.)
- Frame the labor tokens explicitly as the free days remaining after farm and household work, for which players choose between migrant or wage labor and land aftercare, rather than as an undifferentiated pool, so that the trade-off the game is modelling is clearer to players.
- Add a way to represent indirect and non-monetary benefits of sustained aftercare (for example, reduced soil erosion, more pollinators, better biodiversity) through visual cues such as pictorial cards or a dashboard, alongside the direct income already shown. *(Challenge: tracking such changes across the board risks making the facilitator's task considerably harder, and the mechanism for doing this simply and reliably is not yet resolved.)*
- Simplify Variations 4 and 5 (wildlife risk and individual crop raiding), which were seen as too complex in their current form, without necessarily requiring every community to play them: the choice of which variation to use, if any, can be left to the facilitator based on issues specific to that community.
- Resolve and document edge cases in the regrowth rule, for example, what happens when there are too few remaining saplings on the board for the

standard 'saplings plus four' regrowth calculation to apply, so facilitators are not caught out mid-session.

- Decide consciously whether game figures should stay symbolic or be anchored more closely to the values estimated in the cost-benefit analysis. *(Challenge: the two carry a trade-off between realism and how easy calculations remain for a facilitator to manage in real time.)*

**Facilitation**

- Keep the total session, introduction, gameplay, and debrief, to around two to three hours, in recognition of participants' other daily priorities and to sustain engagement throughout.
- Ensure facilitators have a working knowledge of lantana ecology and removal methods, and of relevant government schemes and rule-making processes, so that the debrief can be informed and can guide communities credibly toward next steps.
- Guard against the facilitator slipping into a 'teaching' role: the facilitator's task is to provide facts when needed and to nudge where necessary, not to suggest or direct what communities should do. Surfacing participants' own reasoning and disagreement is more valuable than steering them to a particular conclusion.
- Include at least one or two players with some prior understanding of lantana's spread and impact within each group, to enrich the discussion and decision-making during play.
- Use visual aids, an infographic, or leaflet showing the pros and cons of the invasive species, and how outcomes change round by round, to aid understanding and sustain motivation. Favor formats that communities or partner organizations can reproduce locally, such as a printable A4 leaflet, over materials such as laminated posters that require production and travel to a town for printing, since this lowers the barrier to wider adoption, including by non-FES actors such as government programs.
- Time gameplay to the real restoration calendar: ideally played roughly two months before planned eradication activity, broadly across May–September, with sessions in the same village split into a pre-monsoon and a post-monsoon round to reflect the changing scenario over that period.

## Criteria and Tentative Timeline for Pilot Scaling

The workshop participants agreed on a practical pathway for taking the game from prototype to wider piloting across FES landscapes toward the end of 2026.

**Village selection criteria and scope**

- Madhya Pradesh (20 villages), Odisha (20 villages), Chhattisgarh (10 villages), and Andhra Pradesh (10 villages).
- Considerable community dependence on forest commons.
- Presence of lantana infestation.
- Long-standing FES presence, to ease facilitation and logistics.
- A mix of villages with and without restored landscape, allowing comparison.

## Questions for Future Exploration

### Game design, gameplay and debriefing

- How do gameplay results change with different group sizes, and as players gain more experience?
- How do different debriefing designs and facilitation approaches, for example, plenary versus small-group debriefing, or debriefing before rather than after gameplay, affect learning?
- Which aspects of the debrief matter most for communicating and reinforcing the intended lessons?

### Participant composition, targeting and learning

- How do gameplay and learning outcomes vary with participant composition (all-women or all-men groups, landless versus landholding participants, different age or caste groups)?
- Should the game target village leaders and other influential actors, or a broader or randomly selected sample of community members?
- How do individual, group, and community characteristics interact with gender and other social differences to shape collective-action outcomes?
- How do learning outcomes from the game compare with conventional approaches such as informational campaigns or lantana-focused workshops?

### Collective action, leadership and equity

- Can the game effectively foster learning about collective discipline, enforceable norms, and shared accountability in managing common-pool resources?
- What role does leadership play, and how does gameplay change under strong versus weak leadership, or when leadership rotates between participants?
- How can communities balance equity and inclusion with the need to prevent degradation of the commons?

- What factors enable communities to sustain collective action for lantana removal and aftercare?

**Context and community conditions**

- How does the effectiveness of the game vary across different community and institutional contexts, including secure versus insecure tenure and strong versus weak village institutions?
- How does the level of community dependence on lantana-affected resources influence gameplay, learning and collective-action outcomes?

**Sustaining lantana removal and aftercare**

- How can communities better sustain lantana clearance and prevent reinvasion after initial removal?
- What individual, group, institutional, and contextual factors influence the ability of communities to sustain aftercare?
- Can the game help communities identify and deliberate on practical strategies for maintaining restoration outcomes over time?

**Scaling, adaptation and future application**

- Which landscapes would be most appropriate for scaling the game, and where are its lessons likely to be most relevant?
- What adaptations are required to use the game effectively across different social, ecological, and institutional contexts, and different participant groups?
- What evidence is needed to determine whether and where the game should be scaled further?

## Conclusion

The two-day workshop in Bhubaneswar brought together the FES and IFPRI teams, along with representatives from different FES landscapes, to review the experience from the pilot, refine the game and its facilitator manual, and develop strategies for further piloting, contextual adaptation and scaling.

The workshop combined thematic discussions, experiential gameplay, structured reflection, collaborative game refinement, and discussions on future piloting and scaling. The first day established a shared understanding of invasive species, the challenges associated with their management, and the governance and collective-action dimensions of restoration aftercare. This was followed by gameplay of the current prototype, a structured debrief, and discussion of learnings from the Mandla pilot and the Cost-Benefit Analysis.

The second day focused on translating the learning from the gameplay and pilot into revisions to the game and facilitator manual. Participants worked in small groups to discuss what to add, remove, or change in the game. They discussed research and learning opportunities, approaches for scaling the game across different landscapes and user groups, and next steps.

The workshop resulted in:

1. A refined experiential learning game incorporating learnings from the Mandla pilot, the cost-benefit analysis, and gameplay experience and discussion by FES and IFPRI participants.
2. Greater clarity on the learning objectives and key governance/collective-action challenges that the game seeks to surface.
3. A preliminary strategy for further piloting and contextual adaptation of the game across different FES landscapes.
4. A strategy for scaling the game to additional locations, participant groups and potential partner organizations.

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