

Transylvania Exploratory Pilot Project for Biodiversity Monitoring at Scale. Testing emerging mobile technologies.

Mosaic Earth aims to empower 1 billion people worldwide to become custodians of our most valuable asset: Nature. This will be achieved by involving local communities and land users 'ground truthing' data using smartphones, data which can then be efficiently validated by experts. From 3D Modelling of quadrats using pictures taken with smartphones in the field - to drone like exploration of a plot using simple smartphone video recordings captured while walking the field. This will make large-scale monitoring practical, economical, and will reward the local volunteers for data gathered.

The pilot project in Transylvania will begin by involving farmers and community representatives in Sighișoara-Târnava Mare area, and will then spread more widely.

The compiled Biodiversity Dataset will have the potential to enhance local people's lives and garner support for conservation.

Project Coordinators: Mozaic Earth & Fundația ADEPT & rePLANET.

IBRC plant biodiversity experts: Anamaria Roman & Tudor Ursu

Project Duration: 2023-2025

Project links: <https://www.mozaic.earth>; <https://www.replanet.org.uk/project/quantifying-biodiversity-gains/>





Mozaic Earth

Empowering 1 Billion people to become custodians of our most valuable asset: Nature.

WWW.MOZAIC.EARTH

Transylvania Exploratory Pilot – Report out & Solution Demo

Reminder: Objectives of the exploratory pilot


- Understand the current monitoring process for plants being carried out by local botanists
- Test various methods for biodiversity data capture using smartphones
- Understand opportunities and challenges associated with empowering local communities and farmers to capture biodiversity data
- Determine cost efficiency of smartphone-based monitoring relative to existing surveys
- Calibrate the design of the solution based on the learnings of the pilot



Agenda

- Summary of key activities
- Key learnings & insights:
 - Data capture: Plants and Birds
 - Demos: Project Developer & Ecologists
 - Community engagement
- Proposed next steps



A high-angle photograph showing a traditional wooden shingle roof in the foreground, sloping down towards a village. The village consists of numerous houses with red-tiled roofs, nestled in a valley. The background features rolling green hills under a clear blue sky with a few wispy clouds. The overall scene is peaceful and rural.

Part I: Summary of key activities

Summary of our week in Transylvania

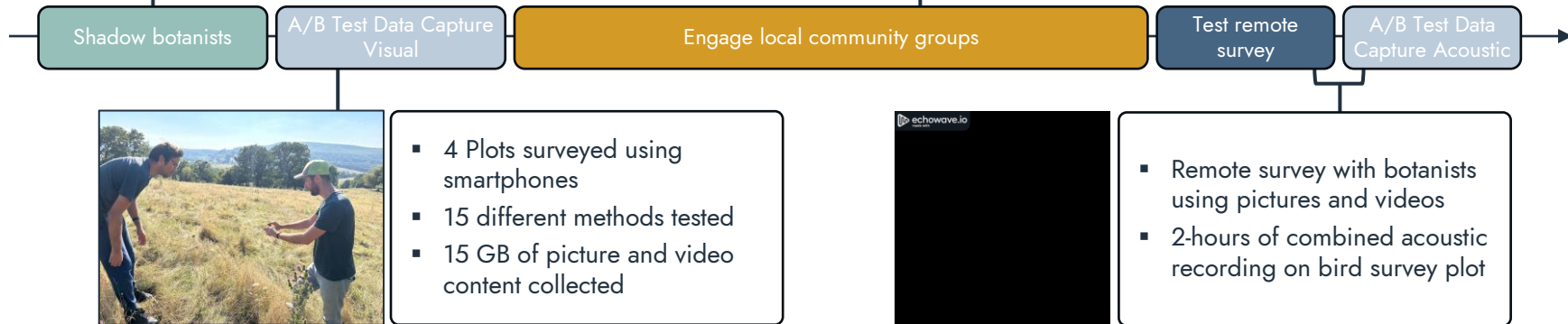
researchers Anamaria Roman & Tudor Ursu (IBRC)



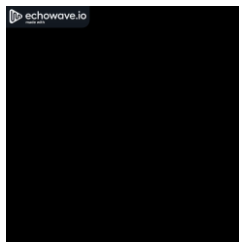
- 10 plots surveyed over 2 days
- Diversity of land (pasture, hay meadows, undergrazed, overgrazed, ...)
- Q&A with expert botanists



- 6 key interviews with representatives of local community groups (elected officials, farmers, NGOs)
- Additional conversations across ADEPT & rePLANET



- 4 Plots surveyed using smartphones
- 15 different methods tested
- 15 GB of picture and video content collected



- Remote survey with botanists using pictures and videos
- 2-hours of combined acoustic recording on bird survey plot



A scenic view of a village with a tiled roof in the foreground and rolling green hills in the background. The foreground shows a close-up of a dark, weathered wooden roof with a red-tiled ridge. Below the roof, there are lush green trees. In the middle ground, a village with numerous houses featuring red-tiled roofs is visible, surrounded by green fields and trees. The background consists of rolling green hills under a clear blue sky with a few wispy clouds.

Part II: Key takeaways — data capture

Digital survey methods: replicating current state

5 methods were tested to replicate quadrat analysis

Method 1: 1 Picture
(from above)



Method 2: 2 pictures
(top and Angled)



Method 3: 5 close-up pictures



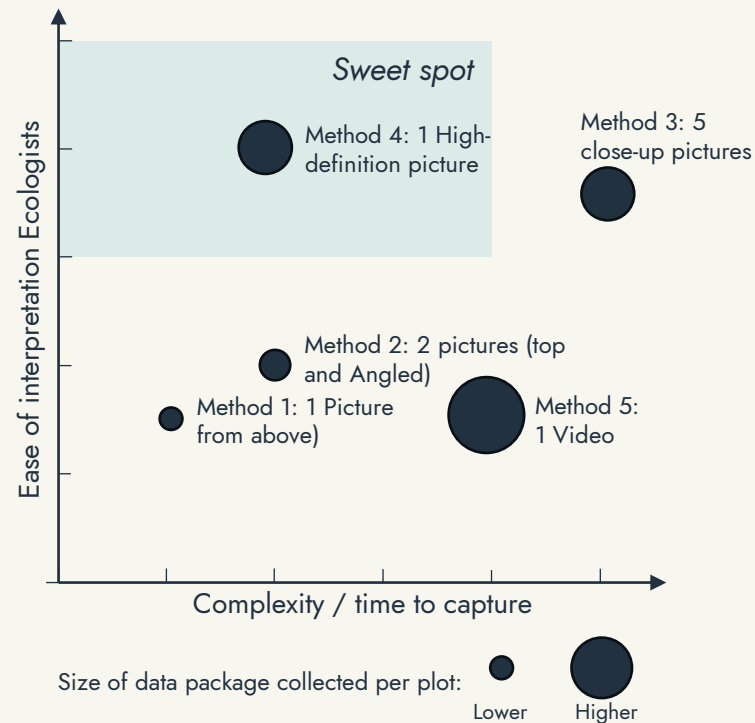
Method 4: 1 High-definition picture
(50 Mega Pixels)



Method 5: 1 Video



Expert botanists assessed each methods



Conclusions:

- If Guardians equipped with high-definition smartphones, Method 4 provides the best value/effort ratio
- In most cases, taking close-up pictures of the quadrat and 'rebuilding' a high-def pic for the ecologists is best option



Digital survey methods: unconstrained approaches

A few additional approaches were tested to map as much of the plot as possible with least time and effort

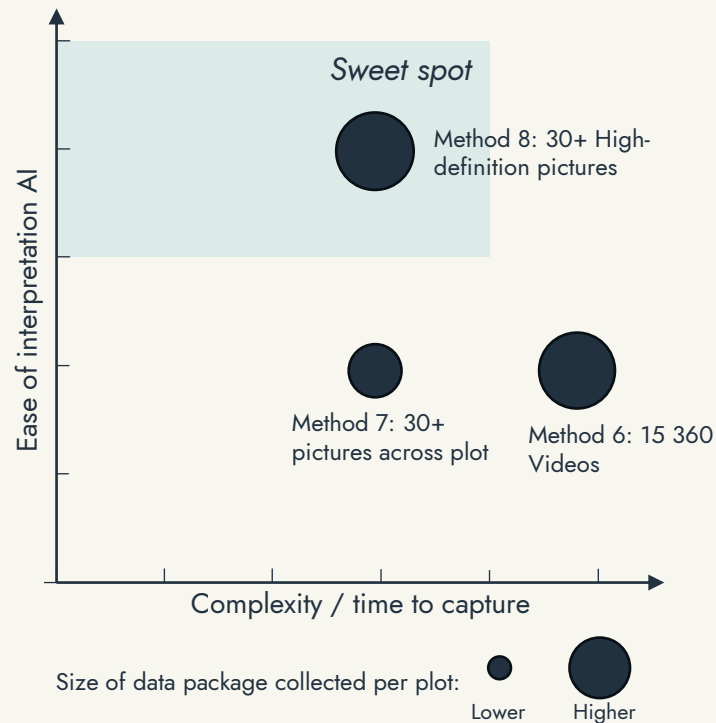


Current state: Quadrats covered for Plot 14*

Removing observer bias: More observations, randomized



We tested each methods with AI applications



Conclusions:

- Taking pictures across the plot in a randomized way optimizing # of picture / time ratio is the best approach
- Videos are valuable to assess overall ecosystem / habitat structure, but AI not mature enough to interpret it yet



Remote survey by botanists



Data: High-definition picture of a quadrat

Process:

- Botanists had 2 minutes to identify as many species as possible from the picture
- Picture presented on an iPad
- They both interacted very naturally with the tablet, zooming in and out to navigate the picture

Results:

- Total species identified on picture: **13**
 - # of species identified with certainty: **10 (77%)**
 - Total number of species identified in the field: **13**
- Accuracy of remote survey*: **80-100%**

*Based on 2 different surveys and for environment well-known to ecologists



Testing emerging mobile technologies



From 3D Modelling of quadrats using pictures taken with smartphones in the field...

Potential use: Enhanced remote quadrat species identification?



... to drone-like exploration of a plot using simple smartphone video taken walking the field

Potential use: Ecosystem structure and health assessment?

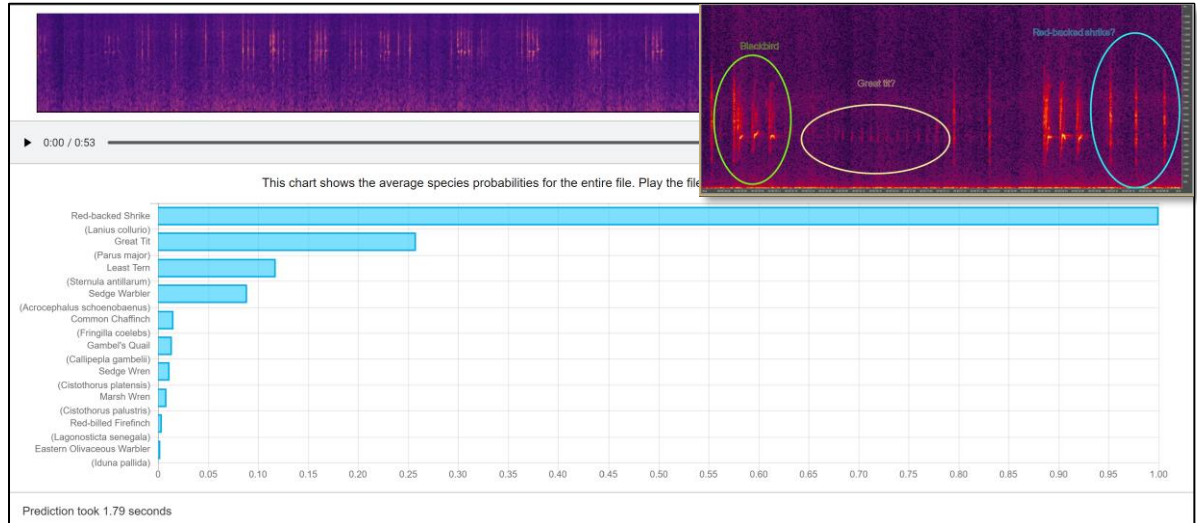


Digital survey methods: birds (preliminary)

Data: Sound files recorded on iPhone and Android

Process:


- Recorded 20 minutes audio recordings on smartphone at different positions (analysed best 3 minutes)
- Sound file analysed through public databases (BirdNet, etc.) to identify 10 potential species
- Sound file sent to our expert ornithologist for manual ID of spectrograms



Results:

- Total species identified by algorithms within audio: **10**
- # of species identified with higher level of certainty by ornithologist: **4** (*Shrike, Blackbird, Great Tit, and Magpie*)



A high-angle, wide shot of a village nestled in a valley. In the immediate foreground, the dark, weathered wooden shingles of a steeply pitched roof are visible, with a red-tiled ridge running along the edge. Below the roof, lush green trees and foliage fill the lower part of the frame. In the middle ground, a cluster of houses with red-tiled roofs is scattered across a green field. The background consists of rolling green hills under a clear blue sky with a few wispy clouds. The overall scene is bright and sunny, suggesting a clear day.

Part II: Key takeaways — product demo

We are building an integrated monitoring platform

Insights dashboard for Project Developers



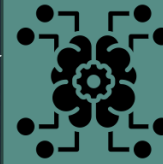
- **'Ground Truth'** from smartphones
- **Biodiversity change insights**
- Carbon sequestration insights
- Sampling management
- **Monitoring performance (costs, incentives, quality)**

Remote survey dashboard for Ecologists



- **Manual species labelling from smartphone data**
- Verification of automated labelling from AI
- **Assessment of smartphone data quality & improvement options**
- **Rewards & incentives**

AI for automated smartphone content interpretation



- Automated species labelling from visual and acoustic content
- Probabilistic estimates of species abundance, richness & biomass
- ML models configuration
- Input data management

Mobile application for local communities



- **Biodiversity data collection**
- Carbon data collection
- SDG data collection
- Local biodiversity insights
- Forest devices management
- **Rewards & incentives**

Mobile application for local communities



KEY FEATURES



Guided survey steps for different taxa (starting with plant diversity survey)



Ability to capture picture, video or acoustic content about local biodiversity offline with auto-upload on wifi



Easy-to-use application in Romanian that requires little to no training

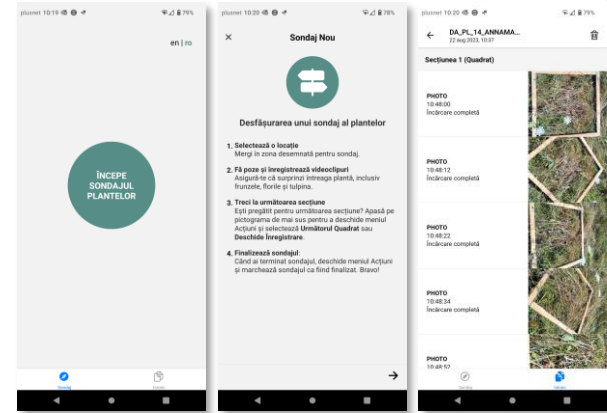


Key insights about local biodiversity with useful data about areas of land needing to be monitored



Reward system linked to successful completion of monitoring tasks in the application

Future development



Value:

- Empowers local community members and farmers to perform monitoring easily, and get compensated for it
- Provides key insights about value of biodiversity to drive behavioural change over time
- Enables collection of primary data, recorded & auditable



Ecologists Remote Survey Dashboard



KEY FEATURES (UNDER DEVELOPMENT)



Media content (picture, videos, acoustic) with all metadata available to ecologist for analysis



Ability to **label species directly on the media content** (starting with Plants)



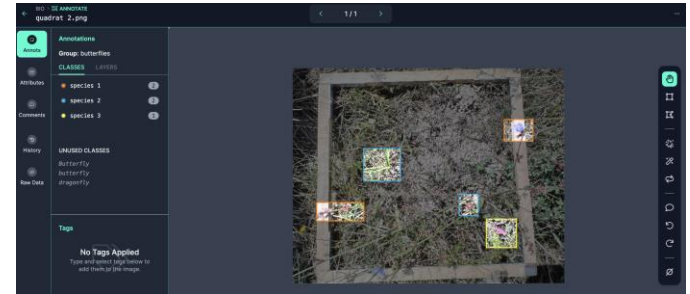
Ability to accept or reject content and **add level of confidence on the identification** based on quality



Ability to **provide additional commentary** on the media for future reference



AI learning in background from expert labelling of species identified



Value:

- Ecologists can focus 100% of their time on what they do best: evaluate the biodiversity
- Digital traceability of identification process for future reference and audit
- As AI progresses, automation will lead to more leverage



- Annots
- Attributes
- Comments
- History
- Raw Data

Annotations

Group: Plants

CLASSES LAYERS

UNUSED CLASSES

Plants species 3

Tags

No Tags Applied

Type and select tags below to add them to the image.



- Hand icon
- Rectangle icon
- Eraser icon
- Selection tool icon
- Undo icon
- Redo icon
- Close icon

Project developer Insights Dashboard



KEY FEATURES (UNDER DEVELOPMENT)



Geographic & time integration of ground truth, smartphone data with satellite data for the region



Contextualised insights on Projects' biodiversity evolution over time, at plot, project and portfolio level



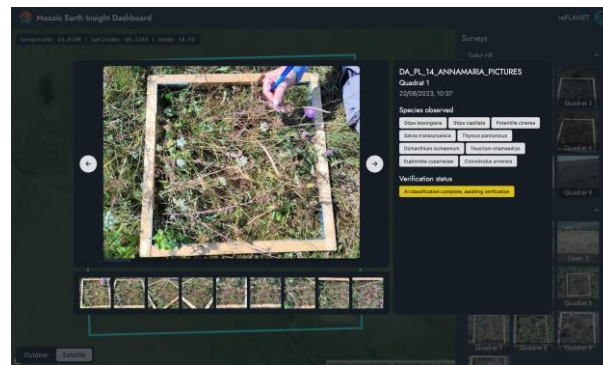
Ability to select specific areas for **times-series analyses of key indicators**



Integration of ecologists input with AI-generated analyses with levels of confidence




User friendly visualisation and search of all projects' polygons and key data



Value:

- Central 'control tower' to monitor biodiversity insights across rePLANET's portfolio
- All projects biodiversity data easily accessible and searchable (incl. internal & external data)
- Better auditability of biodiversity surveys



A scenic view of a village with red-tiled roofs and green hills, seen from an elevated position looking down over a large wooden roof. The foreground shows the intricate details of a dark, weathered wooden roof with a red-tiled ridge. Below it, a smaller red-tiled roof is visible. The middle ground features a dense cluster of houses with red-tiled roofs, surrounded by lush green trees. The background consists of rolling green hills under a clear blue sky with a few wispy clouds. A dark semi-transparent banner is overlaid on the left side of the image, containing the text 'Part II: Key takeaways — community'.

Part II: Key takeaways — community

Local community engagement: takeaways

- **ADEPT & townhalls key to community engagement** & deployment of any solution
- Land ownership & access constraints make **farmers priority group for data gathering**
- **Cautiously optimistic response from farmers** but important to **clearly demonstrate value for them**
- **Easy-to-use mobile application with insights about the land monitored and continued support are critical**
- **Financial incentives only real option to start with. Payment infrastructure are already in place** and broadly used (via government payments for farmers etc)
- Financial incentives could be **direct payment, OR indirect via increased revenue from credits** if monitoring costs reduced
- Finding ways to **engage next generation is very important to enable retention of youth** in the region: e.g. engaging schools and teachers (green week, outdoors week)
- **Eco-tourism growing in the region** and NGOs trying to manage it to be least impactful on landscapes – **opportunity to engage for monitoring** tho land access is an issue

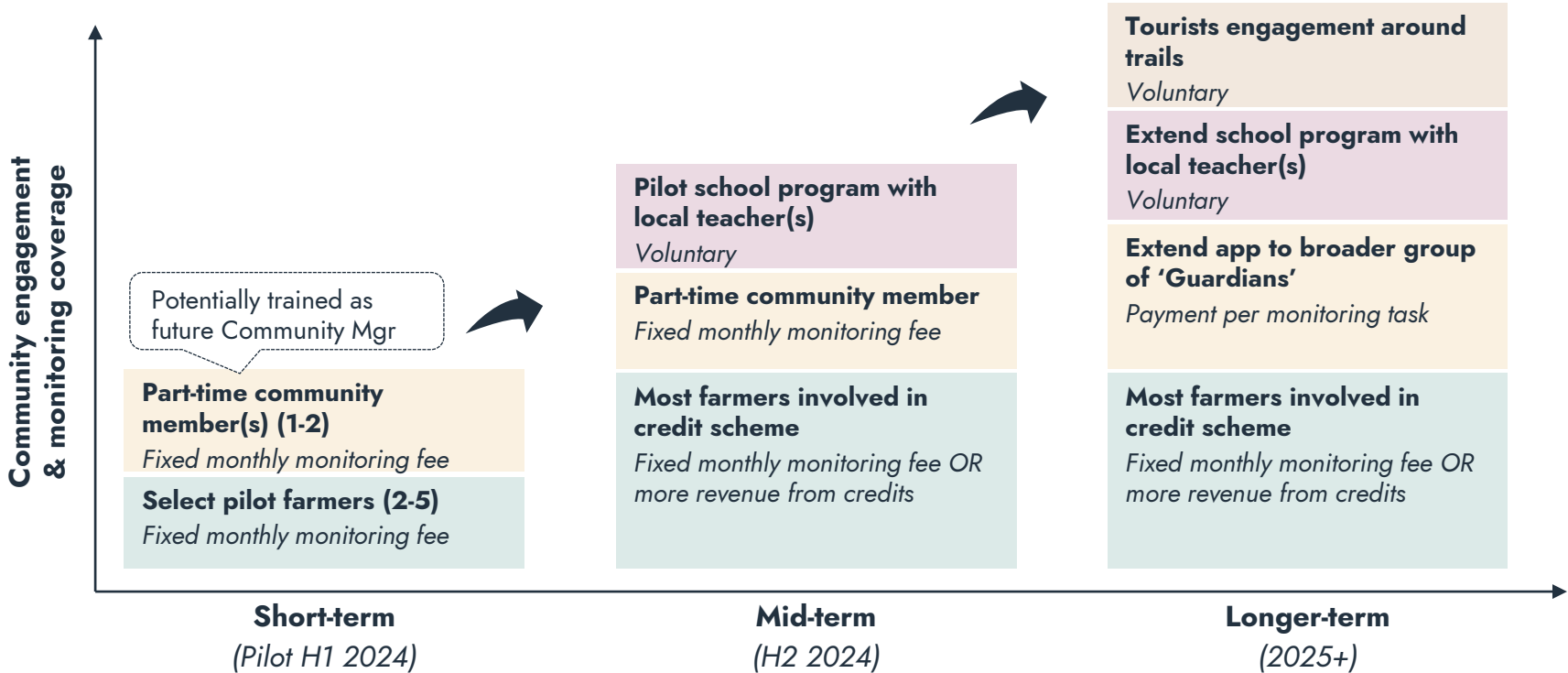


Priority groups for community-led monitoring

	← More important							Less important →
	Survey plot ease of access	Predictability of outcome	Financial incentive	Time availability	Frequency of monitoring	Scalability of community	Technology Mindedness	
Recommended options to start	Selected Farmers <i>(based on land location & appetite)</i>	High <i>(for plots on their land)</i>	Medium <i>(if they see value, they will do it)</i>	Medium <i>(large range of wealth)</i>	Medium <i>(busy with multiple activities)</i>	Medium <i>(synergies with other activities)</i>	High <i>(if value seen, word of mouth)</i>	Medium <i>(basic use of smartphones)</i>
	Selected Local Community members <i>(extended ADEPT network?)</i>	Medium <i>(can be negotiated)</i>	High <i>(can be trained and monitored)</i>	Low <i>(Assuming junior profile)</i>	High <i>(could be hired part-time)</i>	High <i>(can be agreed proactively)</i>	Medium <i>(not necessarily part of existing group)</i>	High <i>(can be part of selection criteria)</i>
	Eco Tourists in the area	Medium <i>(plots in proximity of trails)</i>	Low <i>(cannot guarantee outcome)</i>	Low <i>(could be fully voluntary)</i>	Low <i>(willingness to stop on trails)</i>	Medium <i>(very seasonal -> holidays)</i>	Medium <i>(tourism growing in the region)</i>	High <i>(tourist category younger)</i>
	School programs	Medium <i>(can be negotiated)</i>	Medium <i>(part of program training)</i>	Low <i>(completely voluntary)</i>	Low <i>(likely 1 week a year)</i>	Low <i>(likely 1 week a year)</i>	Medium <i>(across schools in the region)</i>	High <i>(young generation)</i>
	Anyone in the community with the app	Low <i>(hard to manage with landowners)</i>	Low <i>(harder to monitor & control)</i>	Medium <i>(large range of wealth)</i>	High <i>(on aggregate across community)</i>	High <i>(if enough people participate)</i>	High <i>(anyone in the community)</i>	High <i>(self-selected to participate)</i>



Proposed incentive program approach



A scenic view of a village with a prominent wooden shingle roof in the foreground, overlooking rolling green hills under a blue sky. The foreground shows the intricate details of a steeply pitched roof covered in dark, weathered wooden shingles. A red-tiled ridge runs along the peak. In the middle ground, a cluster of houses with red-tiled roofs is nestled among lush green trees. The background features rolling green hills and a clear blue sky with a few wispy clouds. A dark grey semi-transparent box is overlaid on the left side of the image, containing the text 'Part III: Next steps' in white.

Part III: Next steps



Thank You!