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Complexity, Climate and Evaluation

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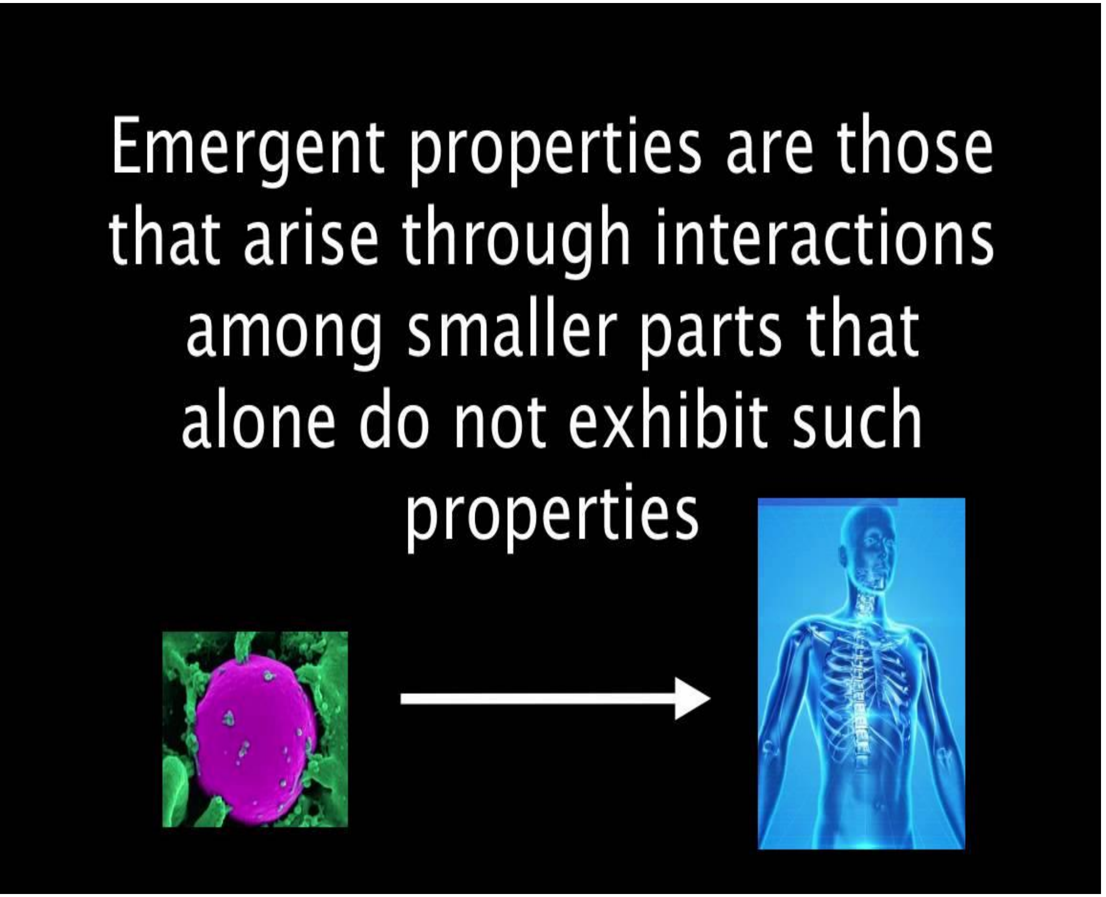
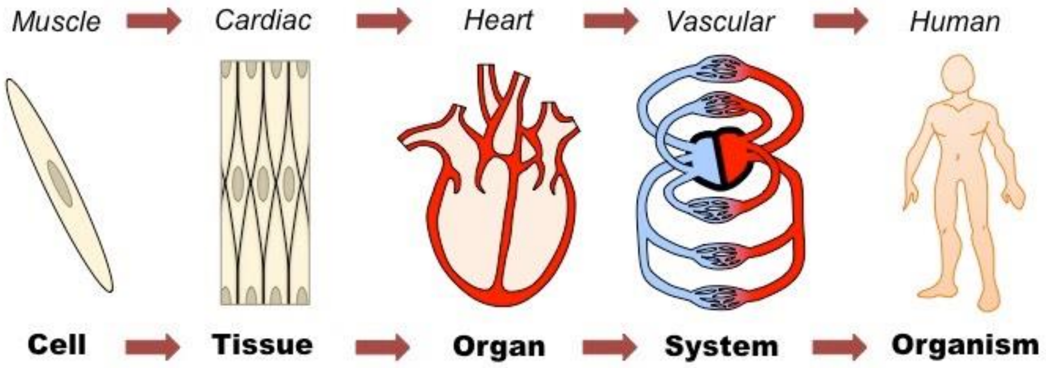
What do we see?

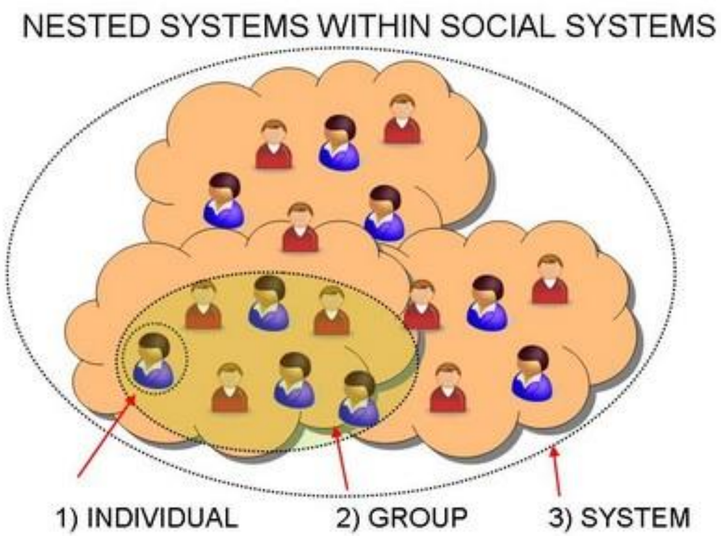
How does this work?

- Ants work together despite not having a leader telling them what to do
  - **decentralized signaling** and self-organization.
- Ants change their behavior based on what they see others doing
  - **adaptive interaction**
- The whole (fire ant bridge) is greater than the sum of its parts (individual ants)
  - **Emergence!**

Emergence: The fundamental characteristic of Complex Systems







Complex vs. Complicated

- Multiple moving parts
- Parts work together in a network to produce an outcome

- System adapts to its environment
- Agents communicate in a decentralized way
- Potential for unpredictable behaviour

Complicated is not those things

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Complexity and climate change?

- **Climate patterns** are complex!
- Climate change **project is a complex system**
  - **Multiple** stakeholders
  - Potential for **secondary** effects
  - **Shifting baselines** with changing climate
  - **Feedbacks** to reinforce trends
  - **Tipping points** – ecological collapse?

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Two main questions

Can we measure the complexity in climate change projects?

What does complexity mean for evaluating climate change programs?

What we did

- Qualitative analysis of 10 random project proposals
  - **Evalua~~bility, c~~omplexity, proposed evaluation design**
- Rubric to rate levels of complexity
  - **Based on proxy indicators**
- Literature review of complexity and evaluation
  - **Suggests methods for evaluation and identifies gaps**

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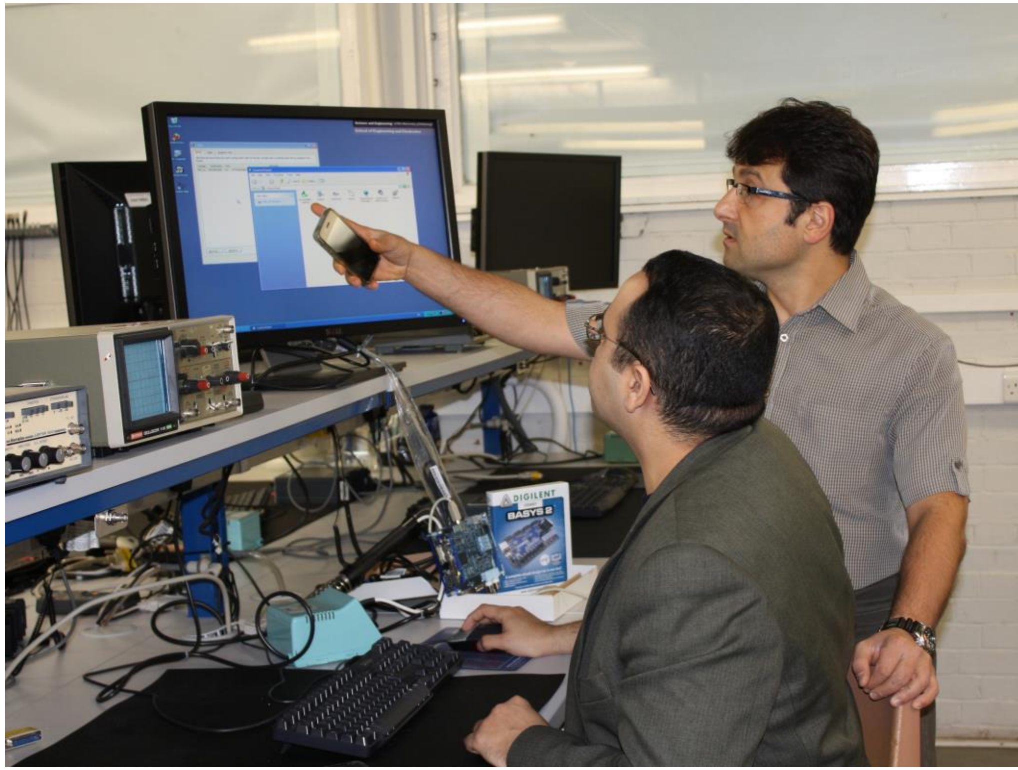
What we found: Qualitative Proposal Analysis

- Theories of Change **weak**.
- More interventions, more potential for **confounding** amongst them and unexpected outcomes.
- **Mitigation-only projects** not as complex as adaptation or both
- **Potential for evaluation** if proper steps.
- **Measure institutional and policy** interventions?



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THE COMPLEXITY RUBRIC

Proxy	Rationale for inclusion in the complexity rubric
Number of Interventions	A larger number of interventions on the same population indicates a higher potential for interactions between the interventions to lead to emergent properties and feedback loops.
Theory of Change Quality	A weak theory of change indicates a higher amount of uncertainty as to whether projects will lead to their intended outcomes and challenges the ability of evaluators to understand its effectiveness.
Number of Stakeholder Groups	A larger number of stakeholder groups indicates a greater diversity of actions and interactions between agents.
Number of Sectors	When a project involves multiple sectors, it requires more interdisciplinary collaboration, which may involve the management of multiple stakeholders with competing priorities.
Target Outcome (Mitigation, Adaptation or Cross-Cutting)	Adaptation and Mitigation/Adaptation interventions tend to be more complex than projects that target only Mitigation because they often have more interventions in different sectors, longer timescales to understand effects and more uncertainty as to how climate change will affect the beneficiaries.

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What we found: Complexity Rating

- Project complexity: 3 high, 6 medium, 1 low
- More interventions = more complexity
- Limited by proxies
- Limited to what is written in project proposal.

Project Name Shortcut	Type of project	Complexity rating	Challenges to evaluability	Suggested evaluation methods
1: Building the Resilience of Wetlands in Peru	Mitigation and Adaptation	**Medium**	Limited baseline information; residents in rural indigenous communities do not have registered IDs	Randomized impact evaluation; participatory community research; spatial analysis for forest cover outcomes
4: Climate-Resilient Infrastructure Mainstreaming in Bangladesh	Adaptation	**Medium**	Unclear baselines for previous disaster losses and co-benefits in education; Challenging to measure loss in disaster scenarios; Spatial and temporal confounds in shelter use	Randomized phase-in of shelter construction; time series of welfare and asset trends as connected to cyclone frequency
11: Ecosystem-based Adaptation in the Gambia	Adaptation	**Medium**	Confounding factors related to ecological changes from climate change itself	Randomized evaluation of bio-business programs; spatial analysis of ecosystems; in situ measurements of ecosystem health; time series for institutional and policy changes
13: Improving resilience in coastal Viet Nam	Mitigation and Adaptation	**Medium**	Timescale of resilience to coastal events spans beyond that of the project	Randomized evaluation of climate-resilient house design and CBDRM; spatial analysis for mangrove rehabilitation; time series for climate risk mainstreaming
17: Solar Energy Development in Chile	Mitigation	**Low**	Hard to randomize a single large-scale solar project; cannot assume that additional solar energy will directly reduce the use of fossil fuels	Time series for energy usage patterns; 'Theory of No Change' to measure barriers to success (Worden, 2011); network analysis of market stakeholders
18: Glacial Lake Outburst Flood risk reduction in Northern Pakistan	Adaptation	**Medium**	Hard to discern the impact of this program as compared to the many programs already operating in this region; Many sub-interventions to be measured; Unpredictability of flood frequency and magnitude	Randomized evaluation for early warning alert systems, CBDRM training, agriculture systems; Ecosystem monitoring for reforestation efforts; Participatory community research/Most significant change
19: Financial and Land-Use Planning Instruments to Reduce Emissions from Deforestation	Mitigation	**High**	Large number of interventions; Many interventions work on a macroeconomic scale (policies and regulations); Interventions at various levels of analysis spanning a whole system	Spatial analysis for land use plans; Randomized evaluation of farmer training and sustainable production grants; Time series for taxation, financial tools, and product certification; Process evaluation for REDD+, project funds, forest traceability programs, and inter-institutional agreements
26: Sustainable Landscapes in Eastern Madagascar	Mitigation and Adaptation	**High**	Lack of clarity and specificity of theories of change; Many interventions which may interact; Potential for spillovers in project impacts	Randomized evaluation for sustainable agriculture program; Process evaluation for climate-smart planning modules; Time series for climate investment fund activities; Spatial analysis for forestry program
35: Climate Information Services for Resilient Development in Vanuatu	Adaptation	**High**	Inconsistent baselines (assumes absence of a baseline is zero); Unclear as to how systems will affect behavioural change; Many simultaneous interventions could be challenging to measure separately	'Participatory case studies' already planned in the program, if these were to be randomized they could serve as pilots for future scale-ups; Web analytics to measure IT- and ICT-based interventions; Integrating information from climate information systems (weather pattern data) into measurements of human welfare outcomes.
41: Simiyu Climate Resilient Development Programme	Adaptation	**Medium**	Public infrastructure projects such as latrines and water treatment cannot be easily randomized	Randomized evaluation of agriculture programs; pre-post surveys or instrumental variables for infrastructure projects; Participatory community research for capacity building and training

Table 3. Rating of ten GCF projects based on complexity

Examining complexity

- **Learning-oriented real-time impact assessment programme (LORTA)**
- Sustainable landscapes in Madagascar
- Collaboration between private and public sector (Conservation International and EIB)
- Forest corridors

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MADAGASCAR- OBJECTIVES

- Increase resilience of vulnerable farmers (85700 farmers)
- Reduce GHG emissions from deforestation and forest degradation (680000 ha of forests; 5 MtCO_2)
- Protect forests
- Improve access to energy with low emission electricity (448000 farmers)
- May 2018 – May 2022 (public sector) and till 2027 for private sector.

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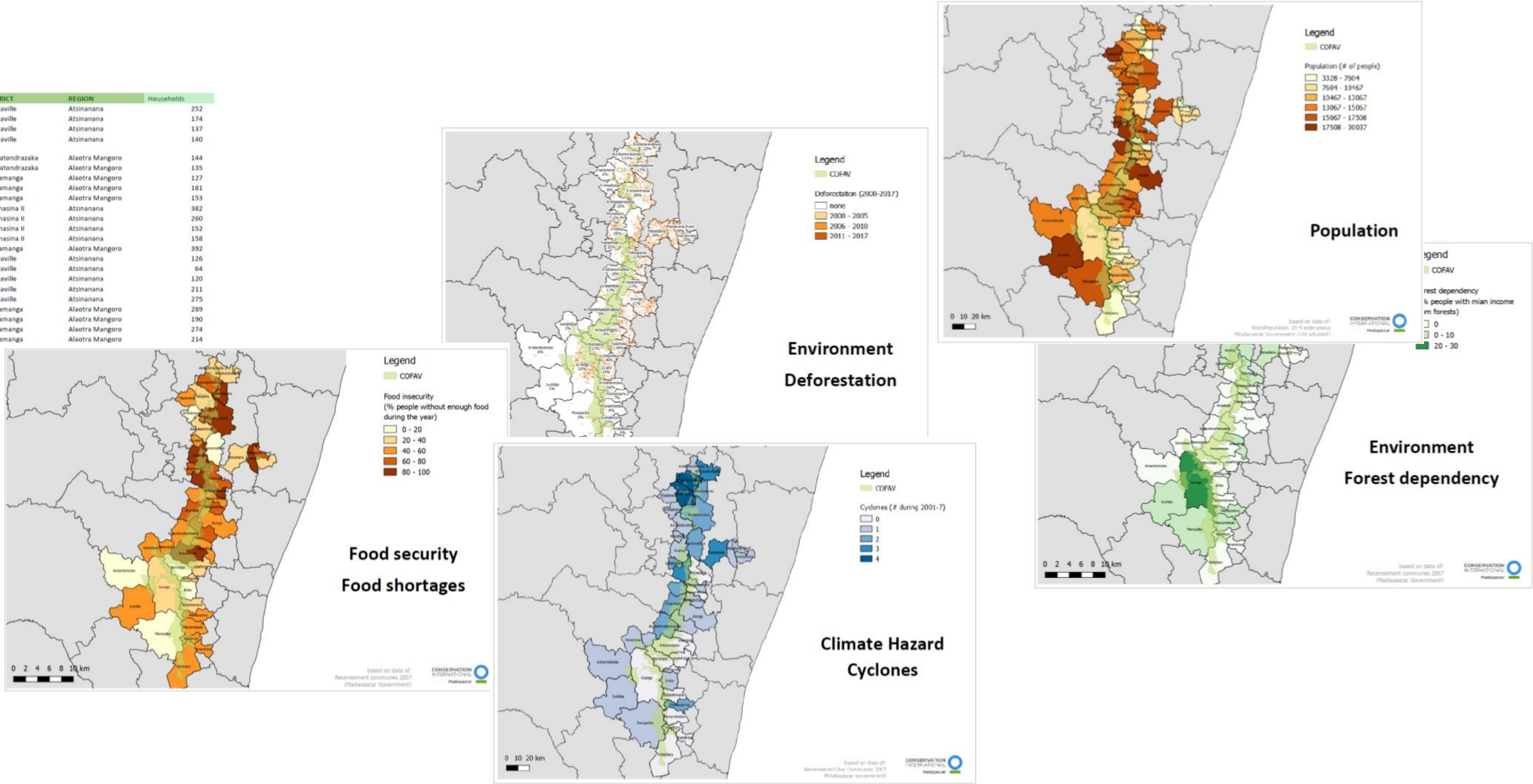
GIS Data beforehand

CAZ Administrative

CODE	FOKONTANY	COMMUNE	DISTRICT	REGION	Households
MDG31306210001	Ambalarondra	Ambalarondra	Brickaville	Atsinanana	252
MDG31306210012	Ambilamaina	Ambalarondra	Brickaville	Atsinanana	174
MDG31306210013	Andovokabe	Ambalarondra	Brickaville	Atsinanana	137
MDG31306210005	Sahalambo	Ambalarondra	Brickaville	Atsinanana	140
MDG33313032010	Ambolomborona	Ambatondrazaka Suburbaine	Ambatondrazaka	Alaotra Mangoro	144
MDG33313130008	Ambatomasina	Ambatosoratra	Ambatondrazaka	Alaotra Mangoro	135
MDG33314210002	Andonaka	Ambatovola	Moramanga	Alaotra Mangoro	127
MDG33314210007	Fanovana	Ambatovola	Moramanga	Alaotra Mangoro	181
MDG33314210003	Vohibazaha	Ambatovola	Moramanga	Alaotra Mangoro	153
MDG31310150004	Ambodinonoka	Ambodilazana	Toamasina II	Atsinanana	382
MDG31310150006	Amboditeza	Ambodilazana	Toamasina II	Atsinanana	260
MDG31310150002	Ampitarafana	Ambodilazana	Toamasina II	Atsinanana	152
MDG31310150005	Ankosibe	Ambodilazana	Toamasina II	Atsinanana	158
MDG33314030011	Ampahitra	Ambohibary	Moramanga	Alaotra Mangoro	392
MDG31306270004	Ambodialampona	Ambohimanana	Brickaville	Atsinanana	126
MDG31306270006	Ambodinonoka	Ambohimanana	Brickaville	Atsinanana	64
MDG31306270005	Asindro	Ambohimanana	Brickaville	Atsinanana	120
MDG31306270007	Bezamba	Ambohimanana	Brickaville	Atsinanana	211
MDG31306270002	Manankasina	Ambohimanana	Brickaville	Atsinanana	275
MDG33314050004	Ambatoharanana	Ampasimpotsy Gara	Moramanga	Alaotra Mangoro	289
MDG33314050005	Ambodiriana	Ampasimpotsy Gara	Moramanga	Alaotra Mangoro	190
MDG33314050003	Amparafara	Ampasimpotsy Gara	Moramanga	Alaotra Mangoro	274
MDG33314070006	Ampangalantsary	Andasibe	Moramanga	Alaotra Mangoro	214
MDG33314070005	Morafeno	Andasibe	Mora		
MDG31306252002	Ambalatenina	Andekaleka	Brick		
MDG31306252003	Maromitety	Andekaleka	Brick		
MDG31310230002	Andranovaky	Andranobolaha	Toan		
MDG31306290008	Afasimpotsy	Anjahamana	Brick		
MDG31306290007	Ambatohambana	Anjahamana	Brick		



		Year 0	Year 1	Yea			
Phase 1 (59 COBAs)							
HH data collection (survey data)	14 households per COBAs. COBAs phase 1: 59	Total: 826 hhs	No data collection	826 fi by Ap			=
Training and distribution Patrolling		Starts in Year 0 after data collection AFTER year 0	Continues	Continues			
Monitoring (high frequency data) and GIS.		Starts in Year 0 and continues through the year AFTER data collection in Year 0	Continues	Continue		completed	
Phase 2 (59 COBAs)							
HH data collection	COBAs phase 2: 59 CAZ: COFAV:	No hh data collection	No hh data collection	No hh data collection	No hh data collection	No hh data collection	0
HH data collection (hh survey)		Collect data on 826 households	None	None	Collect data in 826 households in	Collect data in 826 households in	826 x 3 times = 2478 observations
Total obs. For household data collection	178	(Phase 1: 826 Phase 2: 0 Phase 3: 826	0			26	**8177**

Data collection

Interventions

Qualitative data collection

Comparison sites and design

What we found (aligned with the literature)

- What does **high complexity** mean for evaluation?
  - We **might not** be able to capture **important changes** – simplistic theories of change.
  - **Different methods, more** methods?
  - Most suggested methods are **qualitative** – what does it mean for **rigorous causal inference**?
- There isn't much literature on complexity and evaluation; for climate change there is even less

Method	Description	Benefits	Suggested by
Emergent logic models	Convey multiple causal strands at different levels of analysis in a logic model and adapt the model as new outcomes emerge.	Addresses the challenge of overly simplistic single causal models by capturing emergent outcomes, which occur only during and after interventions as a product of interactions.	Rogers (2008)
Network Theory	Present agents in the system as nodes and the connections between them as networks. Analyze the behaviours and frequency of interactions between nodes.	Helps understand patterns in peer effects, cooperation, and the spread of information (Chandrasekhar, n.d.).	Preskill and Gopal (2014); Banerjee, Chandrasekhar, Duflo, Jackson (2013)
Most Significant Change	Collect and analyze stories on which interventions appear to stakeholders to have provoked the most significant change.	Engages stakeholders in the evaluation process and helps recognize unanticipated emergent properties.	USAID (2016); Preskill and Gopal (2014)
Time Series or Panel Data	Analyze data from multiple time periods (time series) and/or for multiple different outcomes (panel data) to measure change over time.	Facilitates the capture of trends that are not observable in a randomized setting due to temporal and feasibility constraints.	Preskill and Gopal (2014); Douthwaite, Mayne, McDougall, Paz-Ybarnegaray, (2017)
Outcome evidencing	Identify outcomes that appear most important to measuring change in a program, examine critical linkages and who is experiencing change, analyze findings, and repeat this process. (Douthwaite and Paz-Ybarnegaray, n.d.)	Allows for iterative and real-time learning; the evaluation can adapt as the complex system evolves.	Douthwaite, Mayne, McDougall, Paz-Ybarnegaray, (2017); USAID (2016)
Sentinel indicators	Identify outcomes which act as 'keystone species' to indicate the overall health or success of a system.	Prioritizes the evaluation's most important outcomes; creates a simple decision rule as to whether an intervention is successful.	USAID (2016)

Table 1. Suggested approaches from the literature on evaluation in complex systems

Learning for design and implementation till now

- Outcomes are emergent properties of complex systems
- Adaptive experimentation.
- Results based payments?
- Let the experts implement and design.

Ideas for a path forward

- **Useful** framework of analysis?
- How to better identify and measure complexity?
- **New approaches for understanding complex projects**
  - R**eal-time learning**
  - **Innovation with technology:** GIS, CIS, wearables, mobile data, apps
  - **Innovation with methods:** Econometrics like synthetic control; machine learning for predictive inference

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Thank you!

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A Rhino bond

- Results based payments
- Let the experts implement and design.
- Adaptive experimentation.
- Outcomes are emergent properties of complex systems

How the Rhino Impact Bond works

Changing the way conservation funding works