Land Governance for Climate Resilience

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Key words: Land management, Security of tenure, Climate resilience, Land use planning, Community engagement

SUMMARY

Climate change is now generally accepted as one of the world's most pressing global challenges, and it has very strong links to land and land use and therefore to land governance. This paper is a scoping study into the nexus between land governance interventions and climate resilience, as found and expressed in the LAND-at-scale programme. Specifically, this study paid particular attention to land governance project interventions aimed at enhancing tenure security and improving land use planning and, if and how these pay off in terms of strengthening the climate resilience of the targeted communities and their living environments. Two questions in particular guided the study: How is the nexus between land governance and climate resilience conceived in the recent scientific literature, including links with social diversity and intersectionality? How can land governance, through improved tenure security and land use planning, contribute to effective climate change mitigation and adaptation and increased climate resilience, in different project settings? The methodology combines a literature review to produce a framework to guide the investigation of project implementation experiences and a series of activities designed to document the experiences and insights form four of the LAND-at-scale projects in Colombia, Mozambique, Uganda and Somalia. Among the main observations are: the importance of clear legal frameworks and institutions, but communities can play a role in absence of government support; connections between climate resilience and land governance are multiple and complex requiring careful consideration before taking decisions that may lead to maladaptation; having sufficient and good quality and timely data is a major issue particularly in Africa; large-scale climate-induced migration creates major challenges for communities and governments alike; scaling land governance interventions for climate resilience should address spatial and temporal issues; for some types of climate-related hazards watershed based approaches should be adopted when planning hazard mitigation measures.

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1. Introduction

This report is a contribution of the knowledge management component of the LAND-at-scale programme (LAS) which is funded by the Netherlands Ministry of Foreign Affairs, and implemented by the Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland - RVO). LAND-at-scale is a seven-year programme (2019-2026), that aims to contribute to fair and just tenure security, access to land and natural resources for all. In so doing, it is expected to lead to more sustainable and efficient use of land and natural resources for food, housing and production and reduce conflicts and competing claims over land. By contrast with many other development related projects, LAND-at-scale has an explicit focus on supporting the upscaling of successful pilots, providing support to innovative interventions with upscaling potential, integrating tested and new initiatives, and investing in increased knowledge and learning. Together with the land governance issues of tenure security, gender, conflict and scaling, climate change is a special theme for mainstreaming within the LAND-at-scale programme. Climate change is now generally accepted as one of the world's most pressing global challenges, and it has very strong links to land and land use and therefore to land governance (Intergovernmental Panel on Climate Change, 2022). The importance of this link is also clear from the inclusion of "the degree in which the potential intervention contributes to improved adaptation to climate change" as one of the criteria for selecting projects for funding under the programme.

This report should be read as a scoping study into the nexus between land governance interventions and climate resilience, as found and expressed in the LAND-at-scale programme. The term scoping study refers to the nature of the work that has largely involved conceptual review and development by the main author, Richard Sliuzas from the University of Twente, with some interaction with collaborators from the implementation teams of four LAND-at scale projects and the LAND-at-scale Knowledge Management Coordinator, Dr Wytske Chamberlain-van der Werf, Utrecht University, over the period March-September 2023. Therefore, this study provides insights into the land–climate nexus but should not be considered as a comprehensive and exhaustive investigation of the relations. Specifically, this study paid particular attention to land governance project interventions aimed at enhancing tenure security and improving land use planning and, if and how these pay off in terms of strengthening the climate resilience of the targeted communities and their living environments.

Three main questions guided the study:

- How is the nexus between land governance and climate resilience conceived in recent scientific literature, including links with social diversity and intersectionality?
- In what ways is climate change expected to affect the territories and communities of selected LAND-at-scale projects by 2030-50?
- How can land governance, through improved tenure security and land use planning, contribute to effective climate change mitigation and adaptation and increased climate resilience, in different project settings?

By collating and documenting the experiences of several project partners in developing and using different types of land governance instruments with a view to increasing climate resilience in different contexts, knowledge on the nexus may be identified and shared within and beyond the LAND-at-scale community. The remainder of the report is divided into four sections. The following section briefly explains the methodology used for the study, section three reviews some key literature on the land-climate resilience nexus and uses this to develop a framework that guides the case studies. LAND-at-scale projects from Colombia, Mozambique, Uganda and Somalia were examined in the study and are discussed in Section 4. This section also seeks to extract cross cutting lessons from the previous analysis by relating theoretical perspectives with project implementation practices.

2. Methodology

This section briefly describes the approach used to conduct this study that was designed in a manner which would lead to general, though reliable and useful insights, into the land-climate nexus. The work was therefore undertaken as a scoping study, requiring an appropriate mix of scientific and practical knowledge obtained from LAND-at-scale implementation teams. Broadly, there were two main activities: a literature review to produce a framework to guide the investigation of project implementation experiences and a series of activities designed to document the experiences and insights form four of the LAND-at-scale projects in Colombia, Mozambique, Uganda and Somalia. The first three projects are focussed on rural settings while the Somalia case has a more urban focus though it too has strong links to climate impacts in rural areas of Somalia. Each component is discussed in more detail below**.**

2.1 Literature study and framework development

Knowledge management is an important component of the LAND-at-scale programme. All projects are designed with a knowledge cycle approach. Knowledge generation and dissemination should lead to lessons that can be taken up through projects and form a basis for further reflection that informs further cycles of learning within and beyond the LAND-at-scale network. The juxtaposition of the practical experiences of project work within a scientific framework adds rigour and value to the lessons learned and makes them of greater importance to the global community.

Three main lines were used to identify relevant literature for this study:

1. Key documents from recent IPCC reports were selected as references as these provide a general framework for the study and they have already been subjected to intensive peer review process and can be considered to represent the state of the art in climate science reporting.
2. A set of academic papers published since 2012 were selected via two online searches with the SCOPUS search engine. Bibliographic details of these articles are provided as supplementary material.
3. Selected reports from UN-HABITAT's Global Land Tool Network (GLTN) that specifically addressed land governance and climate resilience were included. GLTN's publications are relevant to this study as its mandate is to improve tenure security and land governance, and to produce and share innovative land tools.

The selected sources were screened and the most relevant have formed the basis for the development of the framework for this study.

2.2 Online workshops

A two-hour online workshop was held with each of the case study teams in the period May-June 2023. Each workshop was facilitated by the LAND-at-scale Knowledge Management (KM) representatives (the lead author Prof Richard Sliuzas and Dr Wytske Chamberlain-van der Werf acted as co-lead and prepared notes based on each workshop). During the workshops the participants explored the three study questions (1 Introduction) for their project's context, providing the KM team with more insights into the project and especially the connections between land governance and climate resilience in the project. Later, the lead author prepared a causal loop diagram to act as a visual summary of the relations highlighted in each discussion (Dhirasasna & Sahin, 2019). A causal loop diagram (CLD) is a useful tool for exploring the structure of a socio-ecological system in a qualitative way and can form the basis for the quantitative modelling, for example with a systems dynamics model (Gray, Paolisso, Jordan, & Gray, 2016). A CLD was developed for each case study to illustrate the chain of causal relations between a set of variables that characterise the dynamic issues at play in each setting. CLDs can be used to show both positive and negative relations[1] between two variables and to identify the presence feedback loops that can be either reinforcing (i.e. that encompass positive feedback between two or more variables that can lead to growth in systems and potentially system collapse) or balancing loops (i.e. that encompass negative feedback between two or more variables that promote self-correcting or stabilising behaviour in systems) (Figure 1). The CLDs were shared with the workshop participants for validation and feedback that was used for revision purposes.

[1] For readers unfamiliar with systems thinking and modelling, it is important to realise that the nature of the relation between two variables in a system is not necessarily the same as the societal impact. For example, hurricanes and floods have a positive relation; an increase in the number of hurricanes will lead to an increase in flooding, both of which will lead to an increase in damage and loss. Consequently, the reverse is also true. If hurricanes decrease, floods will also decrease and both will lead to a decrease in loss and damage.

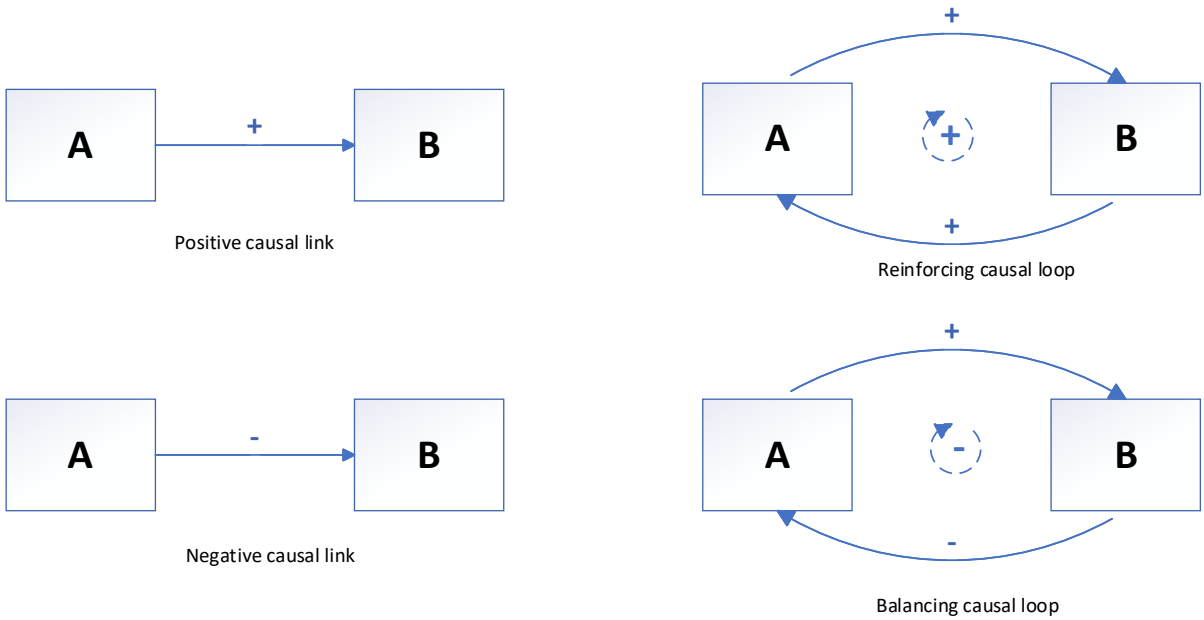

Figure 1: Relations between variables and feedback loops as shown in CLDs (adapted from Gray et al., 2016)

2.3 Other activities

Knowledge on the different case studies was also shared during in-person activities conducted at the 2023 LAND-at-scale Exchange in Utrecht organised by RVO to bring project partners together for knowledge sharing and learning activities as a basis for programme planning. In this two-day event (26-27 June) project partners had opportunities to share their insights and lessons concerning land governance and climate relations through a world café process and additional interactive sessions that allowed for deeper discussions on specific issues and projects. Also, the four case study projects for this study were presented during a special session (Does strengthening land governance align with fair climate transitions?) co-organised by the lead author and Dr Chamberlain-van der Werf) during the IOS Fair Transitions / LANDac Conference 2023 that took place from 28-30 June in Utrecht. These additional activities have provided additional context and information that have enriched this report.

3. The relation between land governance and climate resilience

3.1 Literature search with Scopus

Two main search strategies were used in Scopus (Table 1). Both concentrated on selecting open access articles that can be readily accessed by any LAND-at-scale partner. Initially, no country filter was used for search strategy #2 resulting in almost 4,000 selected papers. Including the specific countries addressed in the case studies as a filter resulted in 29 papers, including one review paper. Given the available resources for this study these papers have not been explicitly analysed and discussed in this report, but they may be useful for future reference.

Land Governance for Climate Resilience (12435)
Richard Sliuzas (Netherlands), Borges Chivambo (Mozambique), Simon-Peter Mwesigye (Uganda), Maria Clara van der Hammen (Colombia), Monica Lengoiboni (Netherlands), Berta Rafael (Mozambique), Teddy Kisembo, Jordana Wamboga, Evelyn Ajambo (Uganda), Carlos Rodriguez (Colombia), Federica Acquaviva, Karel Boers (Kenya) and Marta Cavallaro (Italy)

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Table 1: Keywords used to identify key literature in the Scopus search engine

ID	Search keywords	Number of papers	Review papers
1	TITLE-ABS-KEY ("tenure security" OR "land title" AND ("climate resilience" OR "climate change")) AND PUBYEAR > 2011 AND (EXCLUDE (SUBJAREA , "CENG") OR EXCLUDE (SUBJAREA , "COMP") OR EXCLUDE (SUBJAREA , "MEDI") OR EXCLUDE (SUBJAREA , "ENGI") OR EXCLUDE (SUBJAREA , "BIOC")) AND (LIMIT-TO (OA , "all"))	18	1
2	(((TITLE-ABS-KEY ("urban planning") OR TITLE-ABS-KEY ("land use planning") OR TITLE-ABS-KEY ("spatial planning"))) AND TITLE-ABS-KEY (("climate change" OR "climate action" OR "climate mitigation" OR "climate adaptation")) AND TITLE-ABS-KEY (((somalia OR uganda OR mozambique OR colombia OR rwanda OR burundi OR chad OR mali)))) AND PUBYEAR > 2011 AND PUBYEAR < 2024 AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (OA , "all"))	29	1

3.2 A framework for relating land governance and climate resilience

This section presents some key literature concerning land governance and climate resilience leading to a framework that will be used to examine this relation specifically in four selected LAND-at-scale projects. Ideally, the framework should also be applicable to other LAND-at-scale projects and more broadly. Throughout the section frequent use is made of certain terms that require clear definitions to aid understanding. These terms are found in Annex A and their definitions are drawn from a recent publication of the IPCC that deals specifically with climate change and land (IPCC, 2022).

The connection between land use, climate change and climate risk has long been recognised in IPCC literature and elsewhere. Since their AR5 report of 2014, the IPCC has adopted a notion of climate risk that is aligned with that notion of risk as conceptualised by the UNDRR (Figure 2). In other words, climate risk is seen as a product of the interplay of climate hazards (e.g., heatwaves, drought, severe windstorms, sea level rise, floods of various kinds, landslides), the vulnerability of the potentially affected population or eco-system, and the degree of exposure to the hazards. On the right-hand side of this diagram, we see three types of socio-economic processes (i.e., socio-economic pathways, adaptation and mitigation actions, and governance arrangements) which together largely determine the levels of vulnerability and exposure and to a lesser degree, the climate-related hazards in any socio-ecological system (SES). They also determine how land is used and how this land use changes, and as such drives the anthropogenic component of climate change. Combined with the natural variability of climate, these are the main drivers of climate change. Climate-related risks can have severe impacts such as effects on lives, livelihoods, health and well-being, ecosystems and species, economic, social and cultural assets, services (including

ecosystem services), and infrastructure. Ideally, such impacts should result in learning and adjustment of the socio-economic processes to reduce risks by taking adaptation measures that will seek to mitigate the hazards, or reduce vulnerability and exposure.

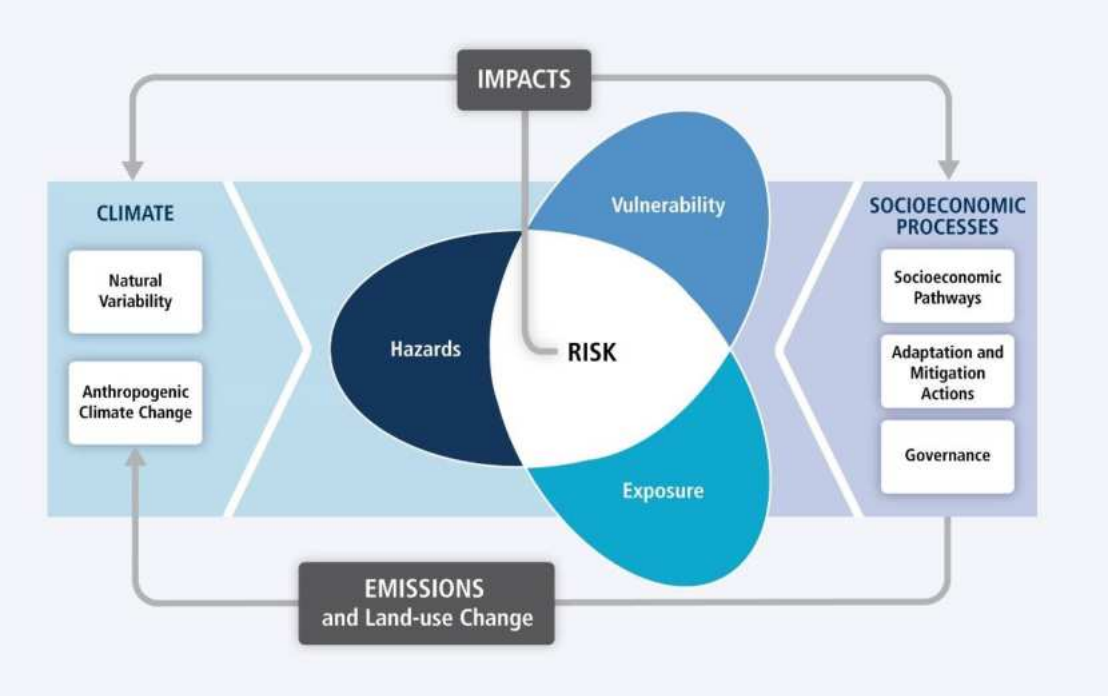

Figure 2: The relationship between socio-economic pathways and climate related risks
Source IPCC AR5, 2014

To illustrate the possible directions of change we can add green and red arrows to represent decreasing or increasing influence of the three risk components on risk (Figure 3). Recent research has also shown that this diagram hides a great deal of complexity and interactions between responses to climate risk or climate actions and the components of risk (Simpson et al., 2021). For example, climate-related hazards often are complex events that combine multiple types of hazards and cascading effects. And adaptation responses, however well considered, may have unforeseen effects, some of which may entail a degree of maladaptation (Reckien et al., 2023).

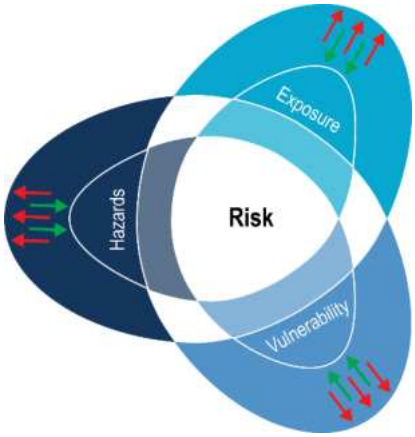

Figure 3: An adapted climate risk figure showing that the three components may decrease (green arrows) or increase (red arrows)

Mitchell and McEvoy (2019) showed how land governance is strongly connected to climate vulnerability and therefore to climate resilience. Though they used an earlier climate risk framework, from the IPCC AR4 report, their work provides some valuable insights and that *"good land governance is a critical component in enhancing community resilience to a variety of natural and human-induced shocks and stresses"* (op cit, pXI). Their study shows that actions to increase tenure security should be strongly connected to land use planning processes and instruments if land governance is to reduce vulnerability and exposure to different shocks and stresses, including those that are climate related. Moreover, they show that both tenure security and land use planning need to be implemented in a climate sensitive manner. In other words, when issuing land tenure documents of whatever kind or when making spatial plans, it is important to consider to what extent the land parcels and land use zones are or will be affected by climate-related hazards. Such an approach is consistent with other authors who advocate the mainstreaming of climate adaptation in spatial planning processes and spatial plans (Runhaar, Wilk, Persson, Uittenbroek, & Wamsler, 2018). Further, Mitchell and McEvoy (2019) promote an approach that recognises diversity within communities and gives specific attention to the most vulnerable groups based upon an intersectional view that considers multiple forms of vulnerability amongst community members. Moreover, they show that there is also a need to related climate change adaptation actions to more general disaster risk reduction measures (Figure 4).

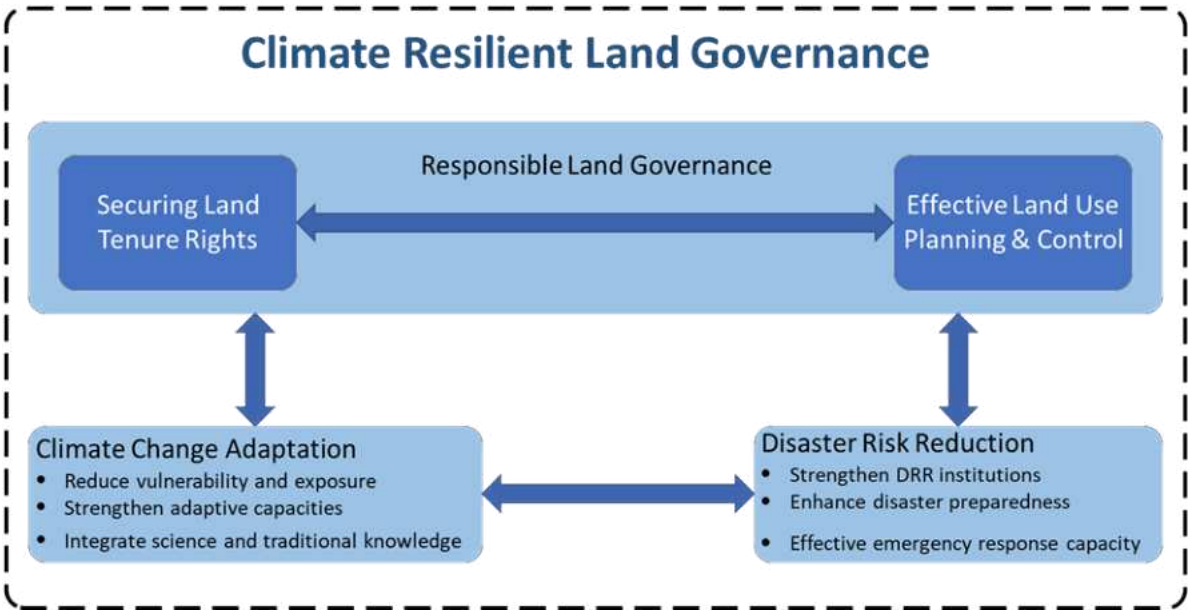

Figure 4: Relations between land tenure, land use planning, climate change adaptation and disaster risk reduction (Adapted from Mitchell and McEvoy, 2019)

What is important to realise is that in many countries of the majority world there are often many barriers to overcome. Institutions related to land and land use planning may be weak and in some cases largely absent (see for example the case of Somalia in this report). In remote rural areas public land institutions may be barely functioning and have insufficient knowledge and resources to actually administer the multiple forms of land tenure systems within their jurisdiction, let alone conduct regular land use inventories, prepare strategic and annual land use plans and then implement them. In such circumstances it is necessary to consider the role of Fit-for-Purpose (FfP) land tenure registration and adopt more collaborative, community-based approaches to spatial planning that may fill some of the gaps in formal land use planning processes (IPCC, 2022; Mitchell and McEvoy, 2019).

Ultimately, in addition to the mapping of land rights and the production of land use plans to guide and regulate how communities use their land, climate resilience requires investments that enable present and future climate risk to be properly assessed. This requires the ability to conduct and use hazard assessments and vulnerability assessments, and to effectively determine the levels of exposure that are likely to occur under different scenarios that consider hazards and vulnerability in an integrated manner (Figure 5). Such efforts also assume a national and local capacity for risk management planning (Tagarev et al., 2020) and implementation that may not be present or within reach of a specific community. One consequence of weak formal institutions in risk management and land governance is that local, community-based solutions may be required to fill the gaps, both in climate risk management and in land governance. The latter approach is strongly evident in the cases included in this report.

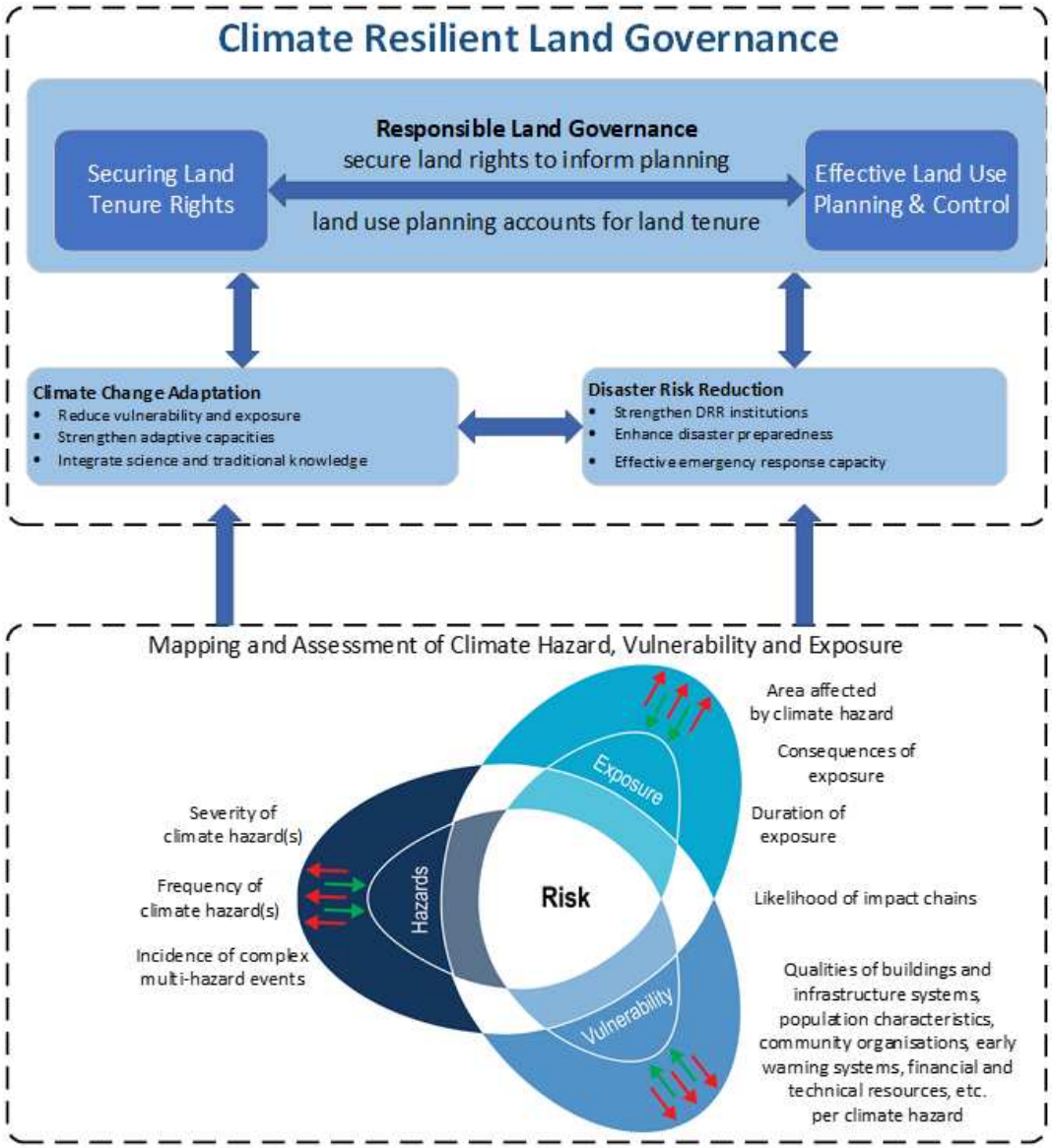

Figure 5: Components of climate resilient land governance (Adapted from Mitchell and McEvoy, 2019)

The report, Climate Change and Land (IPCC, 2022), is of particular relevance to many of the LAND-at-scale projects, which are mostly directed at rural settings and communities. In such settings there is a strong focus on rural livelihoods and ecosystems and this report gives much attention to issues such as crop production, land degradation, deforestation, desertification and water. It also identifies many response options grouped into three main categories (responses based on land management, responses based on value chain management, and responses based on risk management). Moreover, they identify the potential role of many measures for climate mitigation, adaptation and specifically to combat desertification, land degradation and food security (Figure 6). Their data also indicates the degree of certainty that applies for each evaluation item and the estimated cost. Also relevant for this study, is that

they identify two land related response options that may have negative implications for food security (i.e. reduced grassland conversion to cropland, and restoration and reduced conversion of peatlands) while also indicating that in some cases the effects can be positive or negative or may not yet be determinable due to a lack of data. Furthermore, they include

management of urban sprawl as a risk management option, an issue that is specifically relevant for the Somalian case.

The nature of the relations between land governance and climate resilience is well voiced in the following statement by the IPCC:

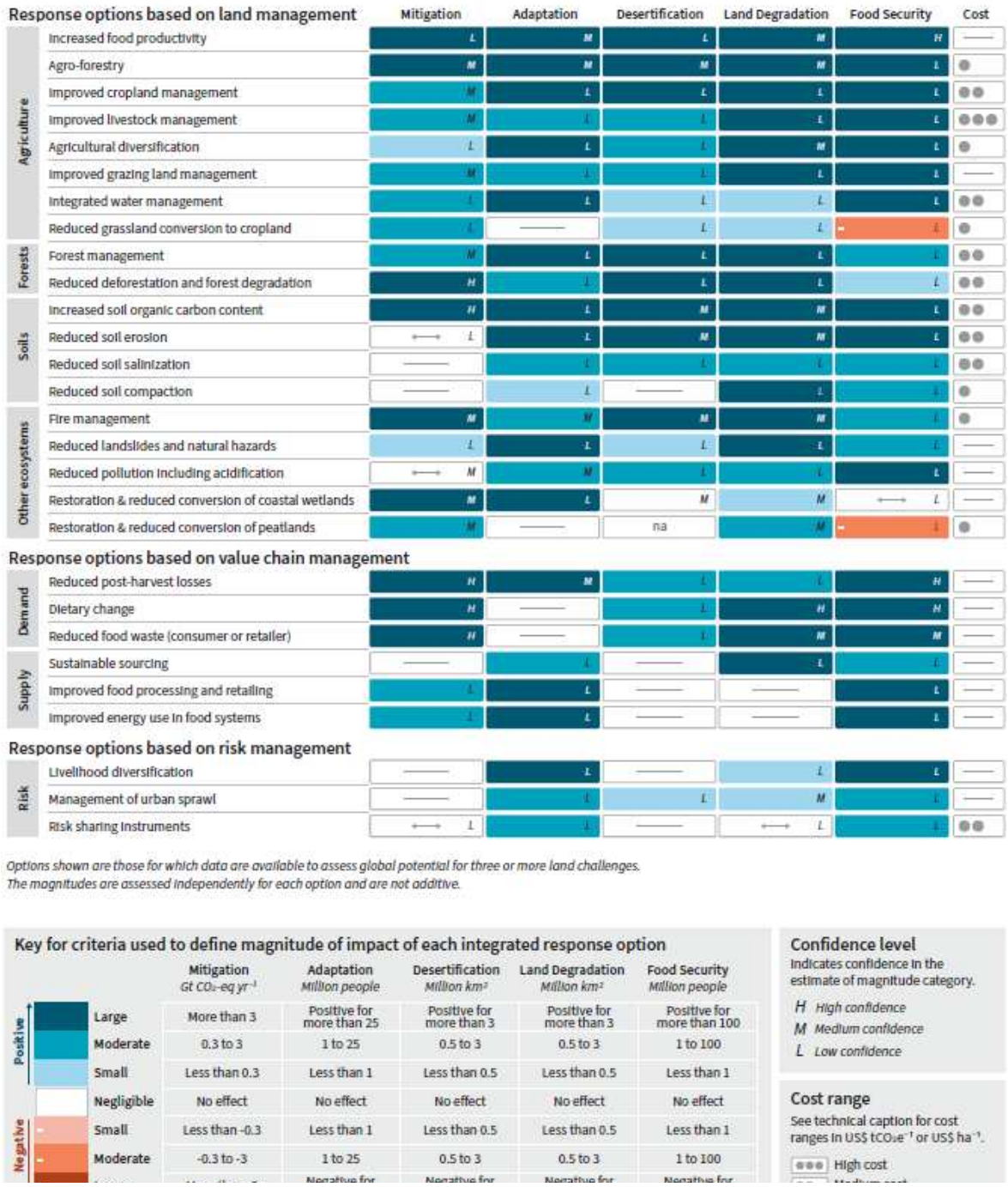

Figure 6: Potential global contribution of response options to mitigation, adaptation, combating desertification and land degradation, and food security (high confidence) (Source: IPCC, 2022, p64)

"The complex spatial, cultural and temporal dynamics of risk and uncertainty in relation to land and climate interactions and food security, require a flexible, adaptive, iterative approach to assessing risks, revising decisions and policy instruments. Adaptive, iterative decision making moves beyond standard economic appraisal techniques to new methods such as dynamic adaptation pathways with risks identified by trigger points through indicators. Scenarios can provide valuable information at all planning stages in relation to land, climate and food; adaptive management addresses uncertainty in scenario planning with pathway choices made and reassessed to respond to new information and data as it becomes available." (adapted from IPCC, 2022).

In the workshops with the team members from the four LAND-at-scale projects we endeavoured to do justice to this view by seeking to identify where land governance interventions and climate responses (adaptation and mitigation) reinforce each other and can be considered to represent climate smart solutions and where there is potential for maladaptation to occur (Figure 7). In the following section the key features of each project are explained.

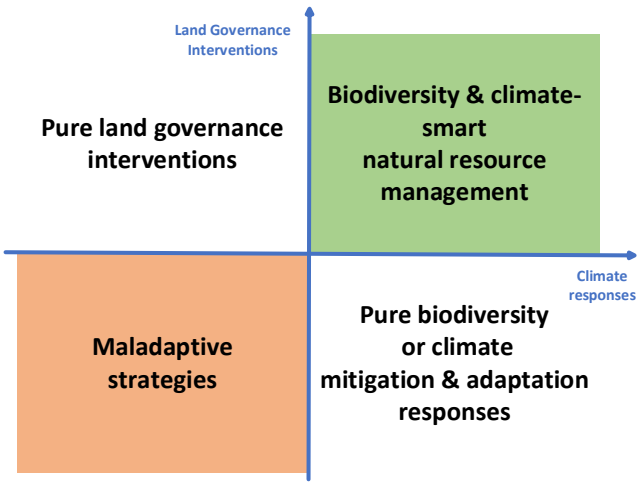

Figure 7: Framework used to guide discussions on how land governance interventions add to or detract from climate resilience (as proposed by R. Hallin, KIT)

4. Discussion of the four cases

4.1 Overview of the case studies

The case studies are drawn from four projects, in Búzi District, Mozambique; Butaleja District, Uganda; Solano, Colombia and the city of Baidoa, Somalia. The first two of these are similar in that they focus on rural communities with agricultural economies bordering water resources (rivers and wetlands respectively). Land tenure and land governance are key foci of each project, albeit in a context specific manner. In the Búzi case, there is a strong focus on capacity building for community members on existing land laws and institutions, including the management of resettlement from flood prone lands. By contrast, in Butaleja, there is a focus on building community capacities for wetland planning and management,

including the creation of community-based committees for these functions. Improving land tenure security through a Fit-for-Purpose approach based on the Social Tenure Domain Model is a key component of this work. The new community-based bodies are expected to become institutionalised over time, especially as the project also engages strongly with local government officials who can see the benefit of more empowered communities managing their own land and environmental affairs. In both cases, Búzi and Butaleja, there is considerable attention for climate related hazards such as flooding and the changing weather patterns that are affecting agricultural practices and increasing pressure on sensitive wetland areas that, in addition to food, also have important roles in flood water retention and storage.

The case in Solano municipality, Colombia, is situated in the deforestation frontier of the Amazon forest. Indigenous people are seeking verification and expansion of the boundaries of their reserves, the rights over which are protected by law. At the same time, the indigenous people are supported in the improvement of their livelihood through the commercialisation of a local oil palm, in dedicated areas within the reserve. By using a small part of the forest for economic activities, they are able to conserve the forest. The collaboration within the LAND-at-scale intervention has spilled over into the municipal planning spaces in which the indigenous people are regarded as agents of change. “According to the logic of the project, it is expected that by generating greater formality in tenure, with economic empowerment and good environmental management, it will contribute to the stability of the area and stop deforestation.” (ICCO Conexión and Tropenbos Colombia, 2023).

In Baidoa, Somalia, a massive influx of Internally Displaced Persons (IDPs) has put extreme pressure on an already weak local government system. Baidoa’s population has surged from about 70,000 to more than 700,000 and is expected to grow to more than 1 million by 2035. Most IDP mobilities are attributed to severe droughts that have decimated crop yields and livestock, thereby reducing the liveability of many rural areas that are also settings for political conflict. The majority of IDPs locate in autonomously identified locations, some of which may be flood-prone, or live as tenants on privately owned land. In either case, such areas are unplanned, and usually poorly serviced with basic infrastructures (water, sanitation, health, education, electricity, transport). The project seeks to create new institutions and processes that can offer durable solutions for generating sustainable neighbourhoods for large IDP populations. It is expected that most IDPs will remain in Baidoa regardless of improvements in the liveability of their places of origin. It is thus important to develop strategies that address needs that go beyond those normally handled by humanitarian aid.

As Table 2 shows, each of the cases uses a variety of response options that may contribute to climate resilience. Many of the response options already identified by the IPCC have a strong link to land and therefore to land governance (see shaded cells in Table 2, column 1). In addition to those options that originate from the IPCC, the table includes several options that originate specifically from land governance or disaster risk reduction that have been added to the bottom of the table.

Table 2: Response options applied in each case study (adapted from IPCC, 2022)

Response option	Búzi Mozambique	Butaleja Uganda	Solano Colombia	Baidoa Somalia
Increased food productivity	X	X	X	X
Agro-forestry			X	
Improved cropland management	X	X	X	X
Improved livestock management				
Agricultural diversification				
Improved grazing land management				
Integrated water management	X	X		X
Reduced grassland to cropland conversion				
Forest management			X	
Reduced deforestation & forest degradation	X	X	X	
Increased soil organic carbon content				
Reduced soil erosion		X		
Reduced soil salinization				
Reduced soil compaction				
Fire management				X
Reduced landslides and natural hazards	X	X	X	X
Reduced pollution including acidification				
Restoration & reduced conversion of coastal wetlands				
Restoration & reduced conversion of peatlands and wetlands		X		
Reduced post-harvest loss				
Dietary change				
Reduced food waste (consumer or retailer)				
Sustainable sourcing				
Improved food processing & retailing				
Improved energy use in food systems				
Livelihood diversification	X	X	X	X
Management of urban sprawl				X
Risk-sharing instruments				
Management of IDPs & resettlement	X			X
Fit for purpose land tenure	X	X	X	X
Improved community planning capacity		X	X	X
Community sensitization on land and environmental issues	X	X	X	X
Improved community management capacity		X		X
Creation of new land related legislation				X
Creation of new land institutions		X		X
Community capacity building on land laws	X	X	X	X
Community capacity building on natural resource management	X	X	X	X
Training of government officers	X	X	X	X
Environmental or land use plan	X	X	X	X
Risk assessment and management plan	X	X		X
Early Warning Systems for floods				
Creation of a local adaptation plan (LAP)	X		X	
Improve urban infrastructures and services				X

Shaded options have a strong land governance or disaster risk management focus
X = response options applied in case

Given the interdependency between land tenure security and land use planning, as shown in the framework of Mitchell and McEvoy (2019) presented in section 3.2, we can conclude that

the response options shown in Table 2 that relate to some form of environmental or land use planning and management processes for plan implementation will all rely on communities having a strong perception of secure land tenure. In this respect, we can argue that land tenure is a pre-condition for various types of spatial planning and associated management practices and for many response options that seek to increase the climate resilience of communities. As many climate responses require changes in behaviour or investment of often scarce resources, it is logical that community members will be more willing to make such land-based investments if their ownership or use rights to their land is documented and secure.

On the other hand, we must also be cognisant of the fact that in some locations, climate-related hazards may make land unusable, even despite tenure security. Already some coastal communities, in the Pacific Islands and elsewhere, have experienced the loss of their lands due to sea-level rise (McEvoy, Mitchell, & Trundle, 2020), a phenomenon that is expected to become more common over the coming decades as global warming proceeds. Similarly, processes such as desertification and severe land degradation may render much land unusable, irrespective of the land tenure situation. It is therefore imperative that land governance issues are explicitly considered and mainstreamed within climate resilience thinking and actions, and vice versa.

Each case can be considered as a complex socio-ecological system with multiple cross-scale connections. Such complexity inevitably poses great difficulty for any project that proports to deal with sustainable, climate resilient development. Project frameworks may over-simplify complex system structures and relationships and assume away issues which ultimately may derail or redirect a project from its original goals and targets. In part, such problems are inherent in any socio-ecological system, though in the relatively data poor situations that exist in several of the cases discussed here, there is considerable space and opportunity for scientific research and development that incorporates open (citizen) science approaches.

4.2 Reflections from the case studies

In reflecting on the literature and the four cases, several key observations can be made:

- It is important to have clear legal frameworks and institutions to guide land governance and climate resilience building. Nevertheless, this does not imply that the making of development plans and local adaptation plans is the sole prerogative of government. The signs are that, where there is government support and backing, community-based planning and management systems that are fit-for-purpose and well aligned to land tenure issues can produce durable and sustainable outcomes.
- Many connections between land governance and climate resilience have been identified, and it is important that adequate attention is given to mainstreaming between all fields before decisions are taken that may give rise to maladaptation. It is important that the consequences of any land governance measure on climate resilience are considered in decision making and vice versa.
- In all situations, even those with relatively weak public sector institutions, LAND-at-scale projects should seek to develop supportive and productive relations with government bodies and officials. Their support adds to the legitimacy of the projects and their actions and therefore their sustainability.

- Having sufficient good quality and timely data is a major issue. Downscaled data on climate-related hazard scenarios for the Africa region is often poor.
    - There is an absence of data and information to determine the risks for communities (climate models). It is important to improve our understanding of what current and future climate hazards are likely to impact communities - the extent, frequency and intensity and duration of events – and what levels of exposure will be experienced by whom. This information needs to be made available for those actors responsible for land-use planning.
    - In addition to mapping land rights through a Fit-for-Purpose approach it is also necessary to map vulnerability from a multi-dimensional perspective. Many aspects of vulnerability are intersectional, requiring combinations of gender, age, health, education and other characteristics.
- Large-scale displacement and migration create major challenges for communities and governments alike. Guidelines and regulations on how to deal with climate-related migration (either temporary or permanent) in a systematic and humane manner that considers the needs of both the displaced persons and the host communities are required. Attention needs to be given to the legal tenure rights of migrants, both within their host communities and the lands they leave behind. Here too, questions of scaling while recognizing substantive and procedural legitimacy and justice are of paramount importance. Large-scale mobility may also generate climate-related effects. For example, the large-scale unplanned urbanization of cities like Baidoa, reduces its climate resilience through the reliance on poor-quality shelter options that do not provide adequate protection from environmental conditions and inappropriate siting of migrant camps in floodplains. Therefore, it is important to address the complex interactions associated with displacement and migration; both for those who migrate and for the receiving communities.
- Though community-based approaches are to be welcomed, we should not be naïve about them. There is also diversity within communities – gender, age, wealth, health, knowledge, ability, power – and methods and practices need to acknowledge and address differences and intersectionality.
- Scaling should address spatial and temporal issues. In addition to scaling by expanding spatially to new communities, mappings, plans and management systems must be updated over time and beyond the project timeframe to be sustainable.
- For some types of climate-related hazards (e.g., severe windstorms and precipitation that generate large scale flooding) watershed-based approaches should be adopted when planning hazard mitigation measures.

As stated in section 1, this is a scoping study into the relations between land governance and climate resilience, as they emerge in four LAND-at-scale projects. With more resources much more could be learned and shared from these and other projects within this programme. Nevertheless, this report can serve as a foundation for a deeper investigation into these relations, which are becoming increasingly important. In any event, its findings should be shared and debated more widely and become part of the Knowledge Management infrastructure on the LAND-at-scale programme.

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