



Master Thesis

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‘To be eating always, or to eat your cake once’: how a gold rush threatens the future of cocoa in a transformed social-ecological system in Ghana

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Date: 13/08/2025

Acknowledgements:

I would like to thank many people for the support they showed me during this process. Firstly, I would like to thank Jangay Basnet and Evans Sarkodie for the constant company and laughs during the two months I spent in Ghana. The support from the rest of the team in Asankragua across Rikolto, Solidaridad and Touton was also hugely important, both for the outcome of the research and the support they offered throughout: thank you to Victor, Kemi, Elvis, Kofi, Hayford, Kofi, Dominik and Abdallah for helping with coordination, translation, and explaining the (many) things I did not understand. I would also like to thank Chief Nana Ntony for the biggest welcome of all: his constant help with organising elements of the research as well as invitations to weddings, shared dinners and honey collecting were some of the highlights of the trip.

I would like to thank Thorsten Treue for his invaluable and generous guidance and support throughout the process; Richard Asare from the International Institute of Tropical Agriculture (IITA) for his insights, particularly in helping me understand the broader context and key issues; and Shalom Daniel Addo-Danso from Preferred by Nature (PbN) and PbN more generally for their support on the project, especially facilitating access to incredibly helpful people.

Finally, none of this could be possible without the participation of all respondents: farmers, miners, Chiefs, buying officers and government officials, all of whom showed me great kindness, welcome, and willingness to engage. I am hugely grateful.

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Abstract

Artisanal or small-scale gold mining (ASM) poses an increasingly urgent challenge to the sustainability of cocoa production in Ghana's Western Region. This paper investigates the drivers of land use change in cocoa-growing areas, focusing on the interplay between environmental pressures, shifts in institutional authority, and evolving livelihood strategies. Using a conceptual framework that integrates social-ecological systems (SES) resilience theory with Lund's (2024) regimes of possession and cross-scalar institutional analysis, the research explores how changes in land rights and governance are reshaping landscapes and reinforcing, or creating, feedback loops that threaten long-term agricultural viability. While these dynamics risk undermining cocoa supply and farmer security, the study also identifies system elements – such as tenure arrangements and farmer agency – that could be strengthened to support more equitable and resilient outcomes. Understanding how power, rights, and environmental feedbacks interact is essential for those seeking to stabilise cocoa production systems while enhancing farmers' livelihoods. The framework presented here offers a practical tool for identifying leverage points in similar frontier contexts and informing interventions that align environmental sustainability with social equity.

1. Introduction

Ecosystems across the globe, including those underpinning food production vital to human wellbeing, are facing unprecedented levels of stress and change. Climate change is altering baseline conditions and contributing to more frequent and severe extreme events (IPCC, 2022). Elsewhere, differences in the ways that humans want to use the land, for example when a new resource or extraction method is found, leads to the emergence of new ‘frontiers’ with corresponding changes in land use and the governing systems (Rasmussen and Lund, 2018). These pressures can interact, as one system becomes unfeasible due to climate change, people may decide to change their land use as an adaptation strategy (Mendelsohn and Dinar, 2009). People remaining in these places not only react to such changes, but interact with them, in turn shaping these human and nonhuman dynamics (Van Der Leeuw and Folke, 2021).

Resilience and transformation are increasingly popular concepts for understanding this process. Traditionally, resilience was often equated to ‘robustness’, the ability to cope with change and ‘bounce back’ to pre-change levels (Holling, 1973; Walker et al., 2004). As changes, particularly climate, increase in unpredictability and intensity (IPCC, 2022), this focus on returning to a predefined ‘pre-change’ state can extend into management practices with potentially negative outcomes (Berkes and Ross, 2016). For adaptive management to unknown future shocks, one must understand the specific place and system-related interactions that determine how people and their environment are able to respond to, adapt, and shape change (Folke, 2006). These characteristics can be conceptualised under a Social Ecological System (SES) framework, a tool to identify and understand these human-environment interactions (Berkes and Folke, 1994).

A key element of many SES is the recursive nature of the system, as changes in one characteristic feed back into and influence others, in turn reinforcing or weakening itself. This is often conceptualised as an adaptive cycle (Kinzig et al., 2006; Walker et al., 2006). This paper introduces a new framework to explore how recursiveness extends into the institutions of an SES, understood as the rules, norms, and organizations that coordinate resource management and balance individual and collective interests (Ostrom, 2009a). By incorporating adaptive cycles at different scales (e.g., household, community, state), along with a focused analysis of power and institutions – primarily drawn from Lund's (2024) regimes of possession – this framework builds on Galappaththi et al.'s (2019) foundational approach to understanding SES changes. The new framework focuses on how changes within the system – driven by institutions and authority – can shift other social and ecological elements and how these shifts, in turn, influence the authority itself. This inclusion responds to

common critiques of SES analyses that there is insufficient critical focus on power and cause-and-effect dynamics of institutional changes and resulting land uses (Cote and Nightingale, 2012; Cumming et al., 2020; Epstein et al., 2014). It also demonstrates that understanding the system as a whole, including environmental changes at different scales, can strengthen an analysis of institutional changes over time.

The paper applies the framework to a case study of a traditional cocoa farming landscape in Western Ghana which is rapidly undergoing change as farming land is sold to small scale gold miners. Cocoa production remains a key livelihood for many households in Ghana, yet national yields have been declining. Survey data suggests that the number of households engaged in cocoa cultivation dropped from approximately 800,000 in the early 2000s to 620,000 by 2018 (Kumeh, 2024). This decline is commonly attributed to poverty, increasing climatic uncertainty, and the growing prevalence of pests and diseases (Kumeh, 2024). However, the expansion of illegal gold mining – known locally as ‘galamsey’ – has placed additional pressure on cocoa-producing communities (Laari, 2018; Siaw et al., 2023). The expansion is frequently linked to structural economic conditions such as poverty and a lack of alternative employment opportunities, as galamsey represents a source of income, particularly for low skilled workers, with higher wages in comparison to other sectors (Wilson et al., 2015). The surge in gold prices after 2008, combined with an influx of Chinese investors and mechanised technology, led to a rapid proliferation of these mining operations (Crawford and Botchwey, 2017). This shift has also been accompanied by widespread environmental degradation, including increased mercury use, soil contamination, and the destruction of arable land.

This paper conceptualises the landscape explored in the case study as an SES experiencing shocks and longer-term changes, both internally (for instance through pollution and governance mechanisms), and externally (for instance through climate change and market prices). Accordingly, the *research aims to explore cause and effect dynamics influencing how cocoa land is transformed into gold mines*, including initial catalysts for change and ongoing interactions between different elements of the transformed SES. The *research also aims to characterize how these changes influence system structures, including how rights are impacted and inequalities perpetuated or shifted*. The case study approach is used to provide an in-depth, coherent and representative understanding of reality, reflective of actual human behaviour, including how and why choices are made, and the impact this has on those in the system (Flyvbjerg, 2006). By applying this approach to the conceptual framework developed here, the case study allows for a detailed exploration of how institutional

changes and power dynamics manifest in real-world contexts, offering insights into the adaptive cycles and interactions within the SES.

2. Background and Literature Review

2.1. Social Ecological Systems, Resilience and Transformation

One way to understand the dynamics of change within a system is to look at not just the change itself, but also to identify which factors are pushing the change forward, and which are tempering it. The ability of the system to withstand this change while maintaining its core functionality (without switching into a completely different type of system) can be understood as the resilience of the system (Berkes and Ross, 2016; Holling, 1973; Walker et al., 2004). This follows work from Holling (1973) who argues that a system necessarily experiences shocks and changes over time, and that change and surprise are inherent to a system. Such a system can move between different ‘basins of attraction’, understood as specific configurations the system is ‘attracted to’, and likely to remain in for some time (Van Der Leeuw and Folke, 2021; Walker et al., 2004). Resilience should not always be understood as a positive thing: some basins may be extremely resilient but not particularly desirable. This refers to its “capacity to sustain natural resources and provide ecosystem services for societal development” (Folke, 2006, p. 257). In some cases, systems can be so resilient that they become trapped, making it difficult to recover or shift towards a more desirable state (Gunderson et al., 2017; Walker et al., 2004).

An SES-resilience approach enables an understanding of change in systems encompassing human and environmental elements. By not seeing separate social and ecological processes which operate in parallel, but highlighting how their interactions generate feedback between them; the SES framing provides a framework to understand the complex, transient interactions between society and nature: the social influences the ecological and back again (Folke, 2006). SES are often conceptualised as complex adaptive systems (CAS). These are ‘evolving’ or re-organising systems which exhibit non-linearity and multiple feedbacks across different scales (Abel et al., 2006). By conceptualising a system as operating at different scales, both temporally and spatially, one can see how some changes move across up or down the hierarchies, which factors make this change and its impact move faster, and what counteracts or slows down the change (Gunderson and Holling, 2002; Walker et al., 2006). For instance, recovery after a collapse in a local reef fishing area will depend on factors in various spatial scales. This includes the ecosystem in the local reef, the fish availability in the regional fishing zone and general conditions in the global ocean system. The recovery will also depend on temporal scales: specific past overfishing practices, for instance which fish were targeted and how reproductive cycles were impacted; as well as future conservation practices and climate-driven changes in oceans. These factors and changes will, in turn, influence how the system grows and builds resilience, until a

future state of change and transformation. This model of ecosystem dynamics, growing, adapting, transforming, collapsing, growing again in a loop at different spatial and temporal scales can be termed ‘panarchy’ and is applied in SES thinking to understand how disturbances and changes at one area or scale can influence and cascade up to others (Gunderson and Holling, 2002). As a foundational part of the research design, this is explored further in the conceptual framework.

2.2.SES and Recursive Institutional Dynamics

The concept of SES resilience is helpful insofar as it enables a comprehensive look at the different factors influencing the pushing or resistance to change, and in understanding that the social and ecological do not act separately but influence each other (Partelow, 2018). In particular, this understanding can be applied to the different sub-systems of an SES, with managers taking advantage of components of system memory to nurture resilience or create a transformation in a desired direction (Olsson et al., 2022). To date, however, most SES analyses do not highlight this cyclical and recursive nature when it comes to institutional and governance processes, with many applications of the framework not sufficiently addressing concepts of power or the less formalised parts of governance of systems and areas (Cote and Nightingale, 2012; Cumming, 2011; Ingalls, 2017).

In particular, a common critique levelled against the many attempts to look at institutions is that even where social relations are put at the centre, there is a tendency to treat inequality and power merely as results of institutional design, rather than as fundamental drivers of system dynamics (Agrawal, 2014; Cote and Nightingale, 2012; Epstein et al., 2014). Core SES frameworks often focus on the commons (Ostrom, 2009b; Partelow, 2018) and can be limited by the assumption that collective action benefits the whole, without looking at power dynamics within or across groups (Agrawal, 2003; Epstein et al., 2014). Many other analyses, such as polycentric governance – which emphasizes multiple interdependent centres of authority and layered governance structures – neglect to explore the underlying mechanisms through which institutions evolve and influence, or are influenced by, decisions about and outcomes of resource-use, including of actors operating in other scales (Cumming et al., 2020). Fabinyi et al. (2014) argue that SES resilience literature also tends to narrowly frame people’s interests as primarily environmental, often overlooking other motivations, actor heterogeneity, and the centrality of power and social diversity in shaping both livelihoods and ecological outcomes.

While SES resilience applies a largely holistic approach, in order to adequately address these concerns, broader understandings from political ecology should, it is argued, also be incorporated (Ingalls and Stedman, 2016). Furthermore, when looking at a particular SES, whether adapting or

transforming, Abel et al. (2006) find that the complex adaptive cycle framework is helpful to understand system transformations, but that additional disciplinary theories can be needed to explain cause and effect. Likewise, Cumming et al. (2020) find SES resilience alone is unable to address causal relations between institutions and different outcomes. As a response to these critiques, some scholars explicitly incorporate social theory into their analysis. May (2022) combines analytic dualism with Ostrom's hierarchies of institutions and the panarchy framework to demonstrate that power and privilege can produce resilience that maintains inequitable socio-ecological outcomes. By distinguishing between institutions, organisations and practices at different levels, this approach identifies where and for whom power is embedded across formal and informal systems, and how it shapes organisational actions. Further, Ingalls (2017) centres power in the SES analysis to show how it produces different socio-ecological outcomes such as defining space (e.g. boundary creation) and to show that this impacts different groups differently.

However, while in many ways the strength of the resilience framework is that it allows for an understanding of non-linearity and complexity, analyses can miss the non-linear and complex understandings of *how* power and authority is shaped within an SES. In particular, governance structures in land and resource management are not neutral; they reflect and reproduce existing power relations (Raik et al., 2008; Townley, 1993; Van Assche et al., 2017). Decisions about what to make resilient, for whom, and for what purpose are inherently political and shaped by the distribution of power among stakeholders (Lebel et al., 2006). This recursive process means that powerful actors can influence institutional arrangements, which then reinforce their position and shape future governance outcomes (Sikor and Lund, 2009). In general, these issues have received a lot of attention in political ecology but are overlooked within SES literature (Ingalls and Stedman, 2016). In particular, specific analyses that take the recursive nature of power and resource rights as a focus of analysis, while also investigating how this interacts with other elements in the SES, are absent.

This paper fills this gap. It does so by incorporating Lund's (2024) regimes of possession into an SES approach. By delineating three regimes of possession: property, actors and authority, Lund demonstrates how changes in power and decision making at one level can, over time, cascade upward through the hierarchy and then flow back down, reshaping other parts of the system. New governance systems can therefore be created, which can then exist in tandem with previous ones, influencing each other back and forth recursively. This focus on feedback loops (though not described as such) and recursive nature allows the two frameworks (Lund and SES resilience) to be combined, as in the Conceptual Framework (CF) section below. The paper therefore aims to provide a new tool for

investigating the different elements of the SES while paying attention to how power shapes these processes and cause-and-effect dynamics. The SES resilience approach in turn provides concrete tools for understanding the complexities and multi-scalar nature of a system, while simultaneously addressing critiques of political ecology that not enough attention has been paid to other ecological or systemic processes outside of critical social elements (Ingalls and Stedman, 2016).

2.3 Gold Mining and Cocoa in Ghana

Gold mining-cocoa nexus

Following the above, this paper contends that conceptualising a landscape as a CAS, with a variety of characteristics each operating at different scales – past influencing future, local level influencing national – is helpful to understand how and why a particular change can spread and potentially transform a system. The cocoa-gold mining nexus in Ghana represents an appropriate case study to apply such a model as changes to the farming system, led by an increase in gold mining, much of which is through converted cocoa land (Koomson et al., 2025), in turn impacts cocoa farming in other ways. This includes competition for land (Koomson et al., 2025; Yeboah, 2014), pollution of water, soil and crops (Afriyie et al., 2023; Darko et al., 2023; Enu-Kwesi et al., 2023; Gyamfi et al., 2019) and contributions to deforestation (Barenblitt et al., 2021). Labour availability also becomes an issue as the workers who would previously offer their services to cocoa farmers switch to working in mines for higher daily rates (Enu-Kwesi et al., 2023). This represents a possible feedback loop. Understanding the potential mechanisms by which land is converted to mining and how the remaining farmers are influenced by this can help to identify cause and effect mechanisms as well as which parts of the system are more or less conducive to resilience. If a desirable basin is one in which natural resources and ecosystem services are maintained, as above, a resilient and desirable basin in this context can be understood as the SES not losing all agricultural functionality. This is something that has been recorded in other parts of the country where mining has taken over and subsequently left, leaving behind a barren landscape with limited livelihood opportunities (Baah-Ennumh, 2012). Both findings could prove useful to managers of the landscape, whether in controlling change or in looking forward and seeing how a new system might look, and what elements can be strengthened in order to make the system more desirable to residents, rather than to gold-mining companies.

Ghanaian land tenure and governance, as related to farming and gold mining

Due to some of the core results of the study explored later relating to land tenure, this section provides a brief background, and how this related to cocoa and gold. Ghana's land governance is characterised

by a plurality of legal systems, land types, and tenure arrangements, resulting in a complex landscape of overlapping authorities and potential contradictions (Agbosu, 2000; Kasanga and Kotey, 2001). State-owned land, which includes areas originally acquired by the British colonial administration or later by the Ghanaian state, comprises approximately 18% of the country and is typically reserved for infrastructure such as airports, hospitals, and roads (Kasanga & Kotey, 2001). An additional 2% consists of vested lands, where the President holds the land in trust for the people (Kasanga & Kotey, 2001). The remaining 80% is customary land, held by traditional authorities such as Chiefs, families, tribes, or kingdoms. This category includes land most commonly used for artisanal gold mining (Nyame and Blocher, 2010) and cocoa farming (Addaney et al., 2022; Ajagun et al., 2022).

In southern Ghana, customary lands are referred to as “Stool lands,” with Chiefs acting as custodians on behalf of their people, future generations, and the spiritual entities believed to inhabit the land (Mensah, 2021). The Office of the Administrator of Stool Lands, an independent public office, is legally responsible for collecting rents, dues, royalties, and other payments on behalf of the Stool. According to the Constitution, 10% of the revenue is retained by the Administrator’s office for administrative purposes, 25% is returned to the Stool for maintenance, 20% goes to the traditional authority, and the remaining 55% is allocated to the relevant District Assembly (*The Constitution of the Republic of Ghana, 1992 (as Amended to 1996)*, 1996).

Two tenure systems apply across Ghanaian lands—Statutory and Customary. Statutory tenure is more formalised, involving documented transactions and governed by mechanisms such as compulsory acquisition, land registration, land-use planning, and legal dispute resolution (Yeboah and Shaw, 2013). Importantly, under the statutory system, mineral rights are owned by the state regardless of land ownership.

Article 257(6) of the 1992/1996 Constitution:

“every mineral in its natural state in, under or upon any land in Ghana, rivers, streams, water, courses throughout Ghana, the exclusive economic zone and any area covered by the territorial sea or continental shelf is the property of the Republic of Ghana and shall be vested in the President on behalf of, and in trust for the people of Ghana”

Customary tenure systems, by contrast, are more varied and reflect local customs and traditions. The highest form of customary ownership, the allodial title – “beyond which there is no superior interest in land” – is typically held by the Stool or Skin, depending on the region (Kasanga & Kotey, 2001, p. 13; Nyame & Blocher, 2010). Families can acquire customary freehold rights, which are considered

near-maximal: they are secure, transferable, and inheritable, and often passed down through matrilineal or patrilineal lines depending on the region (Kasanga & Kotey, 2001). This land is often virgin forest that was cleared for crops, and since then has been passed down through the family (Kasanga and Kotey, 2001). Legally, according to the State system and following the Constitution, the family rents or leases for a long period of time (for instance fifty years), which can be renewed, but otherwise reverts back to the allodial titleholder (Asumadu, 2003). When used by indigens for agricultural purposes such as cocoa production, rent does not have to be paid. Migrants from other parts of the country have access to land generally through a sharecropping agreement, either *abunu* or *abusa*, whereby the migrant helps to clear the land and plant (generally cocoa) trees, for which they then become responsible for and receive the output from half or one third of the farm, respectively (Kasanga and Kotey, 2001). Although land tenure is not typically seen as a major constraint for cocoa farmers, missing or undocumented ownership records are common and can lead to boundary disputes or conflicts between landowners and sharecroppers (Asamoah and Owusu-Ansah, 2017). The Ghana Cocoa Board (COCOBOD) is the sole legal buyer of cocoa in Ghana, setting annual prices and providing farmers with subsidised inputs, seedlings, and training via agricultural extension officer (Abbey et al., 2016; Abdulai et al., 2018). While Licensed Buying Companies (LBCs) require a licence to operate under COCOBOD, individual cocoa farmers do not require any licence to cultivate.

Gold mining operates across the informal-formal, Statutory-Customary divide. Small-scale or artisanal mining can be legal, as per the 2006 Minerals and Mining Act. For this, a licence must be obtained, land provided for by the State, and mining activities regulated and enforced, including monitoring adherence to environmental standards (Mensah, 2021). The licencing process is widely reported to be overly bureaucratic, time-consuming, and inaccessible to many prospective miners. These administrative delays and procedural complexities have been identified as significant contributors to the widespread illegality in the sector (Ampaw et al., 2023; Koomson et al., 2025; McQuilken and Hilson, 2016). Moreover, state land allocation policies have shown a clear bias towards Large-Scale Mining (LSM) companies, who benefit from more favourable legal, financial, and institutional arrangements while small-scale miners are frequently denied access to land or face burdensome requirements to obtain it (McQuilken and Hilson, 2016; Mensah, 2021; Okoh and Hilson, 2011). Even when licences are secured, the regulatory framework suffers from weak enforcement capacity. Monitoring of environmental compliance and illegal operations is minimal due

to limited institutional resources, political interference, and, in some cases, complicity with illegal operators (Ampaw et al., 2023; Siaw et al., 2023).

As a result, the legal framework for small-scale mining is effectively undermined by its inaccessibility and by the lack of state capacity or will to regulate, allowing informal systems – often based on customary land transactions – to fill the gap. Koomson et al. (2025) find that Chiefs will allocate land through customary systems, for which they receive compensation, but are limited in their power to enforce what happens in other areas, particularly when it comes to sites that are given in concession by the government. Stacey (2025) demonstrate how a multitude of both formal and customary laws are followed, ignored or altered as seen fit by different actors within the illegal gold mining sector. This includes land acquisitions for galamsey, with the complex property system allowing for coercion of farmers to sell and reliance on Chiefs to allocate land and uphold galamseymers' claims. Further, Nyame and Blocher (2010) argue that in Ghana two parallel systems operate: one formal, used by larger and licensed operators; and one informal, where artisanal miners negotiate land access directly with customary landowners. However, while they recognise that actual 'ownership' of land is rare and notoriously difficult to be certain of, how this influences the transactions is not made clear. Overall, they, along with others (Hilson, 2011, 2001; Koomson et al., 2025; Mensah, 2021) contend that the customary route offers a faster, simpler, and more accessible alternative which pushes prospective miners into illegality.

3. Conceptual Framework

This paper introduces a new framework to understand cause and effect dynamics within a changing SES, including the role of institutions and authority. As a foundation, it draws on the framework developed by Galappaththi et al. (2019) which takes a comprehensive view of change in SES to understand the key components of system resilience and transformative ability. However, by using the complex adaptive systems model, change is understood not as a linear process, as with previous applications of the framework, but one with cross-scalar interactions and feedback loops, as provided for by the panarchy model (Gunderson and Holling 2002). This different view of change is incorporated into the new framework. Lund's (2024) regimes of possession, with three interlinking regimes of property, rights subjects and public authority, which are inherently interlinked and thus can change, reinforce, or undermine each other, are also incorporated. This provides a way of understanding how this interplay works both to catalyse change in the system and reinforce authority and other inequalities. This conceptual framework is represented by Figure 1 and discussed further below.

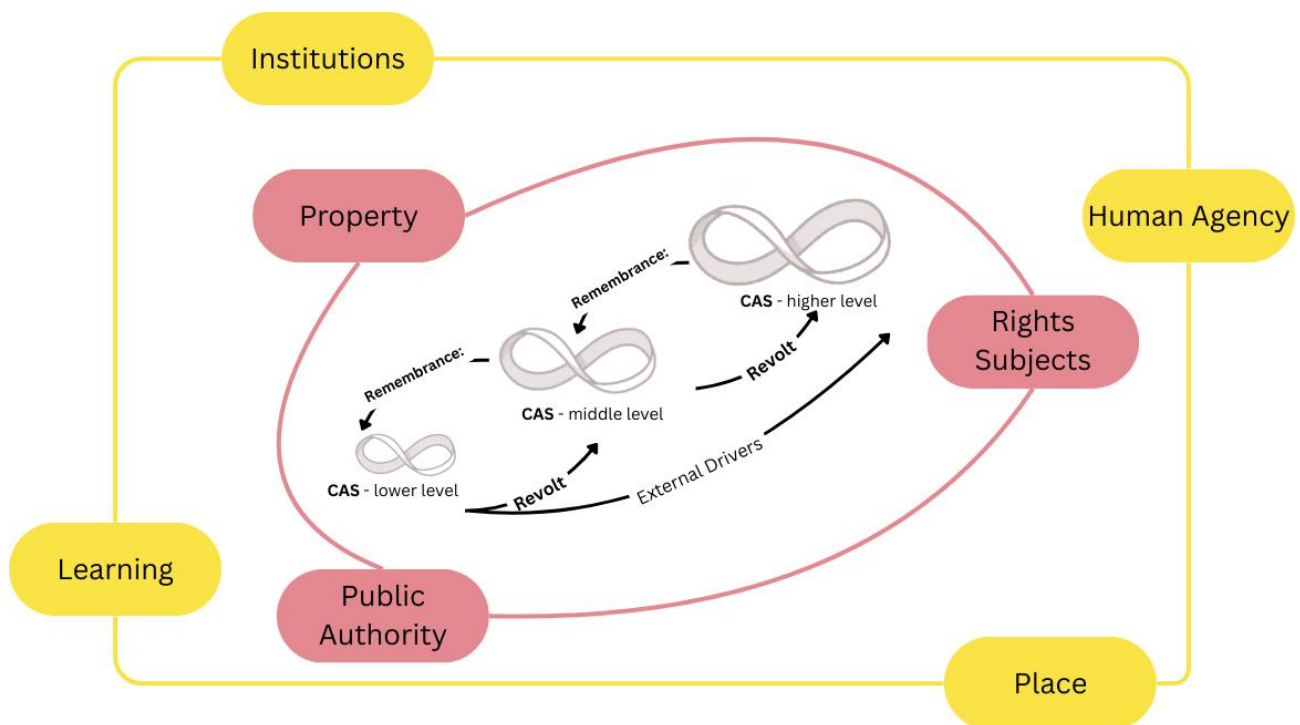


Figure 1: Conceptual Framework

3.1. SES Resilience Framework

This paper uses as a foundation the conceptual tool by developed by Galappaththi et al. (2019) for analysis of community resilience to SES changes in a fishing context. This tool integrates SES

resilience understandings as three dimensions (3D) of coping capacity, adaptive capacity, and transformative capacity, with a development-centred approach focusing on the “3Rs of resistance, rootedness and resourcefulness” (Galappaththi et al., 2019, p. 4). The framework is explicitly place-specific and identifies how different aspects of the local setting impact a community’s experience, and response to, change. Four ‘place-based elements’ of collective action, institutions, human agency, and indigenous and local knowledge, are identified as the key factors which influence the ability of communities to cope, adapt and transform (Figure 2).

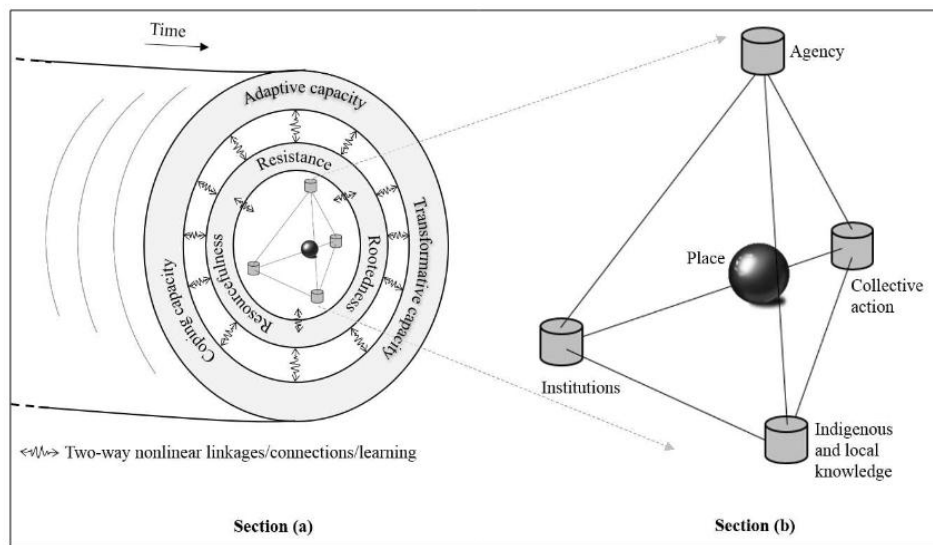


Figure 2: Galappaththi et al. Framework, source (Galappaththi et al., 2019)

Place, forming the basis of the analysis, is “the social and physical space that has place attachments to individuals (or cultural groups) and processors” (Galappaththi et al., 2019, p. 6). **Human Agency** is central to resilience when understood “not only as a response to change but also as a strategy for building the capacity to deal with and shape the change” (Brown, 2015, p. 6). Galappaththi et al. define Collective Action as “action taken together by a group of two or more people to meet a common desired objective” and institutions as “local organizations formed by the society to facilitate collective action that meets a local goal” (2019, p. 6). Here, I combine the two under **institutions**, following Ostrom’s definition, understood as the rules, norms, and organizations that coordinate resource management and balance individual and collective interests within SES (Ostrom, 2009a). Local ecological knowledge is understood to be a core part of resilience (Berkes and Folke, 1994; Folke, 2006). For this framework, **knowledge and learning** refer to the body of knowledge belonging to people in a specific place, and the process by which this evolves as people improve or otherwise change the way they manage their environment.

3.2. Cross-Scalar Interactions

While maintaining critical functionality is generally understood to be a core component of resilience (Gunderson et al., 2017), a system can move between basins of attraction. The adaptive cycle is a key process of a CAS or complex SES. Its four stages of transformation – growth, conservation, collapse and reorganisation – are used to visualise how a system moves between such states (van Apeldoorn et al., 2011; Walker et al., 2006). This happens cyclically, although not necessarily concurrently, and so the growth and conservation phases as a new configuration establishes itself will depend on what remained in the previous configuration, and the processes of collapse and reorganisation before it (Folke, 2006; Walker et al., 2006). Through the lens of panarchy, an SES is understood to consist of multiple, adaptive cycles occurring at different scales. These are linked through the dynamics of revolt and remembrance (Figure 3).

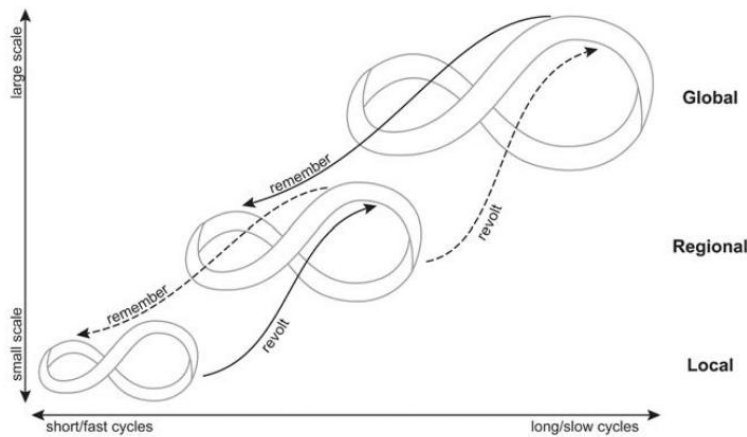


Figure 3 Panarchy of interconnected adaptive cycles (local, regional and global) at different spatial and temporal scales. Source (Olsson et al., 2022)

A revolt is a disturbance or small change that ‘cascades’ up the levels (Kinzig et al., 2006), for example as a forest fire spreads from the ground, to the crown of a tree, to a stand, and then to a large forested area (Berkes and Ross, 2016). Remembrance is a feedback dynamic in the opposite direction that can stabilise the processes of change, as well as provide context for the renewal phases (Olsson et al., 2022). For instance, the weather of previous months and forest type will shape how the revolt spreads, and the seedbank of the soil and the surrounding areas will alter how the new forest will emerge. Stronger remembrance or greater resilience is not always ‘good’. Strong remembrance can limit the positive potential of revolts if, for instance, entrenched institutions reflect dominant values that continue to reproduce harmful or unjust patterns (Olsson et al., 2022).

This understanding of change as occurring across different temporal and spatial scales (Figure 3), as per the panarchy cycle, is incorporated into the framework (Figure 1) rather than the more linear approach in the original application (Figure 2). The panarchy model can be critiqued for being too deterministic and focused on ecological processes (Folke, 2006), which while true, is used here more as a useful heuristic to conceptualise dynamics and processes of a system and its changes, rather than to claim a specific type of cycle or stage is at play. In particular, the strength of applying the panarchy model is that it allows an understanding of the system's dynamics at different phases, and how things can interact between different levels (Abel et al., 2006; Gunderson and Holling, 2002). This in turn allows an understanding of how the past can remain and influence a newer system how transformative change can be encouraged, and (Folke et al., 2010; Olsson et al., 2022).

3.3. Recursiveness and Authority

Recursiveness influences all aspects of social and environmental interactions, and adaptation to change “must be understood through the recursive relationship between knowledge, agency and context as mediated by power, culture and history” (Cote and Nightingale, 2012, p. 484). While three key interconnections are recognised as linkages in Galappaththi et al.'s framework: learning from events to improve or limit future capacity (social-ecological learning); feedbacks across scales; and the triggering of a self-organisation (Galappaththi et al., 2019), the recursive role of power and history are not explicitly included. Panarchy can provide a way to explicitly frame this non-linearity (Gunderson and Holling, 2002), as in May's (2022) application to show how adaptive cycles at different levels of institutions, organisations, and people are interconnected, and how power and privilege within these cycles can create uneven resistance and pressure for change.

Resilience is not a neutral or detached concept, it cannot be “seen from nowhere” (Haraway, 1991, in Cote and Nightingale, 2012) and is inherently shaped by power relations that weave through both social and ecological dimensions. This raises critical questions – “does the resilience of some livelihoods result in the vulnerability of others? Do specific social institutional processes that encourage social inequalities have implications for the resilience of these groups?” (Cote and Nightingale, 2012, p. 482) – which underline the need to move beyond treating institutions as mere variables or background conditions. Following this, institutions should be seen as constitutive elements of the system itself and a way to understand causes of change, rather than external factors to be measured and controlled. Although not previously applied to resilience or SES, Lund's (2024) ‘regimes of possession’ can help to describe how such human-environment relationships and

decisions influence future configurations, where, importantly, not just the rights themselves find new codes and principles, but the authority over legitimising these is also made anew (Lund, 2024).

This process can be broken down into three constituent, changing, regimes of possession (Lund, 2024). The first of which is the property itself, understanding property not as an objective *thing*, but the way that it is perceived by rights subjects, including the ways in which it can be used or transacted. The second regime is rights subjects. This encompasses the people and groups who claim the property rights and what they can do with different parts of the resource. Different people/groups may have claims over different parts of the right, and the general ability to claim a right in the first place can be influenced by other factors like race and gender. The third regime is public authority, which encompasses essentially how, and by whom, the first two are decided and how a claim becomes an enforceable right. If, for instance, different people and groups claim differently, how do these transfer into actual use of the resource? An authority, likely public, who has the ability to grant a claim and does so, then receives recognition from their subjects that they are in a position to recognise or deny such rights, thereby confirming their own authority (Lund, 2024; Rasmussen and Lund, 2018).

This paper argues that in this way, Lund's regimes of possession highlight how transformations in property and authority co-evolve recursively, just as in an SES, changes experienced in one realm (place) can extend to others (agency, institutions) and back again, strengthening the power of some actors while limiting others (Delaney et al., 2018; Partelow, 2018; Walker et al., 2006). Both approaches reveal that resilience and institutional change are not linear shifts, but contingent, layered dynamics shaped by power and memory. The framework maps panarchy's 'revolt' onto the emergence of new rights claims or actors, which can then cascade up the levels as more land changes hands and the political tenure system transforms, while 'remembrance' is understood as the embedded norms and institutional memory shaping how these new rights manifest and evolve. Additionally, in an SES when applying panarchy theory, collapse does not involve one system being replaced entirely by a new one, but the old and new existing in parallel and then interacting to determine how the transformation will play out (Moore, 2017). Similarly, Lund (2024) explains how it is the complex, new uses of land, whether as a response to, or symptom of, changes, which results in different systems of control and decision making. These systems, which then often co-exist, inform and influence each other. In many ways, Lund's heuristic can be seen to exemplify a CAS, where non-linear dynamics at different scales move upwards and downwards, a process by which the transformation is shaped "in a complex interplay" (Olsson et al., 2022, p. 161). By mapping Lund's framework onto SES

theory, the conceptual framework developed here bridges existing gaps, offering deeper insight into how power dynamics and resource management evolve within social-ecological systems.

The research builds on the literature on the cocoa-mining nexus in Ghana which focuses on the negative impacts on cocoa farms or general drivers of increased mining. By applying an SES resilience perspective, the focus shifts from simply measuring the impacts to understanding the complex interplay between ecological changes, social dynamics and governance structures, and the way these contribute to the structure of the SES, including the resilience of the communities within it. Rather than viewing mining solely as an external shock that reduces yields or degrades the environment, this approach takes the cocoa-mining landscape as an adapting or transforming system. It examines how mining alters the SES – affecting everything from soil quality and water resources to local institutions and livelihood diversification – and how these processes, in turn, influence the mining. It recognises that disturbances like mining are part of a broader adaptive cycle, where institutions at different hierarchical levels are involved in shaping the change. This perspective opens avenues for policy interventions that support long-term resilience by addressing the interconnected nature of environmental and social change.

4. Methodology

4.1. Study Site

The research was carried out in Wassa Amenfi West Municipal, an area that has historically been recognised as a significant producer of cocoa but has more recently seen a decrease in cocoa yield alongside a significant increase in galamsey operations (Enu-Kwesi et al., 2023). According to Ministry of Food and Agriculture (MoFA), the last census showed about 75% of the 140,000 population were involved in agriculture, most of whom are engaged in some way in cocoa (interview, MoFA). The location was chosen as it was the site of an ongoing project on cocoa and landscape changes. As the aim was to gain an understanding of the changing landscape and the system as a whole, multiple (n=6) different communities in the area were visited. This is because the impacts of changes to the system are not limited to one community; for instance galamsey operations likely affect all farms in a watershed, which includes those in faraway villages. Farmers also often have multiple plots spanning different parts of the local area. Additionally, because the research aimed to gain a broad understanding of different ways of managing these changes, from community initiatives to the role of traditional authorities, a range of communities was important. The researcher was based in Asankragua, the capital of the district, which was used as a base to travel to different communities in the area, as well as enabling access to key stakeholders who were based there. government officials, buying officers and many miners also use it as a base.

4.2. Data collection

Research Design

A qualitative, mixed-method approach was used in order to examine the different relationships between people, environment and power and the processes at play in the changing SES (Longhurst and Johnston, 2023). Two Focus Group Discussions (FGDs) (one male and one female) were used at the beginning to inform question design and to provide important context for understanding communities' perceptions of change and place. Guiding questions for these initial focus groups at the beginning:

- What are the main changes you have noticed in your farm over the last ten years?
- What do you do to cope in the short term?
- What do you do to adapt (emphasis for participants on long term changes, farm and off-farm)?
- What makes these changes worse, and what makes them easier?

These questions were kept broad. Discussion and back-and-forth was encouraged as much as possible, with participants allowed to approach the questions from whichever angle made the most sense to them (Longhurst and Johnston, 2023). The framework developed above in the Conceptual Framework section was used to design farmer Semi-Structured Interviews (SSI) (Annex A). Adaptions to the indicators used by Galappaththi et al. (2019) were made primarily to make them more context-relevant to cocoa and Ghana, and to expand the institutions section to include nested institutions and the role of the Chief and other agencies such as government and NGOs. These questions were then refined further following the FGDs

Key Informant Interviews (KIIs) with other stakeholders including government officials, cocoa buyers, galamseyers and local NGOs also formed a core part of the research. These questions were specific to the stakeholder interviewed, iterative and updated as the research progressed. Most were carried out towards the end of the research so they could be adapted in the light of finding from SSI and informal discussions, enabling the use of more targeted questions.

Informant identification

Farmers were identified with the help of the Purchasing Clerks – farmers in the community who buy cocoa beans from their neighbours on behalf of LBCs. This was for ease but also to get a representative mix of sharecropping, landowner and sharecropping-landowner, and of male and female farmers, which would have been difficult through random sampling from databases alone, as landownership status is not collected. SSI were taken until saturation, which was around n=25, and continued until reaching n=30. An initial explanation of the research was given and consent for participation and recordings was given verbally. A translator was used, with nearly all interviews carried out in Twi. The questions were designed to be open-ended to encourage farmers to talk freely.

There were no formal networks which could aid in identifying miners, and with such a sensitive topic, it was important to speak only to those who volunteered themselves in order to ensure safety for all involved. Therefore, a convenience sampling approach was taken with miners willing to speak to us found through discussions with people in the town. Not all government officials targeted were willing to be interviewed. This may be partially explained by the very recent elections, which meant leaders had been in post in some cases less than a week. Other stakeholders suggested the officials would not want to risk anything by talking to outsiders, especially on such sensitive topics. Previous recent research in the region, resulting in the dismissal of some government staff, may have added to this reluctance. Two of the government interviews were carried out by sending questions and answers

(and then follow-ups) via email/WhatsApp. The Police did not agree to be interviewed. The District Assembly referred us to MoFA, and COCOBOD informed us of new bureaucratic processes which were not possible to follow given the time constraints. All miners and government officials were ensured anonymity. Finally, informal conversations with people in the community were particularly helpful to understand galamsey dynamics that not everyone was willing to talk about ‘on the record’. The full list of participants is given in Box 1

Focus Group Discussions (n=2)		
Gender	Female	8
	Male	6
Farmer Interviews (n=30)		
Gender	Female	9
	Male	21
Land-ownership Status	Owned farm	12
	Sharecropping (Abunu)	8
	Both owned and sharecropped (different plots)	10
Key Informant Interviews (n=13)		
government officials	MoFA	1
	Minerals Commission	1
	Office of Stool Administration	1
	EPA	1
Odikro Chiefs	Mining town	2
	Non-Mining town	1
LBCs	LBCs	2
Galamseyers	Farmer-miner middle-man	1
	Site Master	1
	Day workers	2

Box 1: List of Participants

Positionality and Sensitivity

In all (SSI and KII), precautions were taken, particularly as galamsey is a sensitive subject and deals with illegal activities. Because a significant proportion of initial respondents asked not to be recorded, I stopped asking and took detailed notes instead. This was both to reduce any discomfort on the part of the respondent and to ensure more trust in order to get more accurate and candid answers. Additionally, a key decision was whether to use local translators who were known to the interviewees. Although there is a possibility that using people known to the participants may mean some questions were not answered fully (for instance, which farming practices are being done, how helpful were training sessions?), in discussion with partners it was agreed that working with someone known would

bring significant benefits, particularly to questions most important to the research topic. For farmers, sustainability officers were chosen as it was felt that they would help the farmers feel more comfortable answering these particularly sensitive questions. For miners, translators were people from the community who were known to both the miners and me. No questions were asked about specific places, people or groups.

Finally, as a non-local researcher investigating sensitive livelihood and illegal mining practices, I was aware of my own cultural and institutional positioning (Maguire-Rajpaul et al., 2025). The use of translators known to respondents and help from many local organisations on the ground were invaluable in bridging some of these differences, but my background (e.g., European, academic and general affiliation with NGOs) could likely have signalled expertise and authority, influencing which topics farmers and miners felt comfortable discussing. While this paper endeavours to reflect a wide range of perspectives and experiences, it is important to acknowledge the inherently asymmetric power relations embedded in the research process (Bilgen et al., 2021). The analysis presented here is primarily constructed through the lens of a white European scholar and may be afforded more legitimacy than the voices of respondents themselves. This dynamic should be critically examined, with attention given to the implications of representation, authority, and voice in the interpretation of the research.

4.3.Data Analysis

Interviews were transcribed and/or detailed notes were typed and transferred into QSR NVivo 14. A hybrid inductive-deductive coding approach was used (Fereday and Muir-Cochrane, 2006; Proudfoot, 2023). This involves the inductive generation of themes from the data, alongside a deductive analysis using predetermined themes from the theoretical framework, developed from the literature, which are then combined, "mutually enhancing one another" (Proudfoot, 2023, p. 308). As coding was initially carried out inductively, with the focus on the raw data and the themes emerging from it without paying particular attention to the framework or specific research questions, these data-driven codes were able to provide a rich analysis without forcing answers into preconceived ideas (Braun and Clarke, 2006; Nowell et al., 2017). Once the key codes were identified, over a series of iterations, they were combined or split into more specific codes where necessary, and then organised into hierarchies of groups and themes. Despite the data collection tools largely following the CF, the inductive approach meant that the emerging themes did not immediately map onto the framework. A second stage of analysis involved a deductive approach, organising the emerging themes within the components of

the framework to produce a comprehensive and empirically grounded analysis. This is summarised in Box 2 and further explored in the discussion.

5. Results

This section follows the four main characteristics identified from the framework (Figure 1) and relating to the SES: place, human agency, institutions and learning and knowledge. The key findings, i.e. what stands out and is relevant for the analysis, are included. This grouping is not necessarily how they were reported to me or asked about. This section follows the themes as shown in (Box 2).

Place	1.1 Changes to the Farming Environment 1.2 Relationship to the Land
Human Agency	2.1 Control over Land 2.2 Food Availability 2.3 Coping Mechanisms
Institutions and Collective Action	3.1 Tenure Agreements and Land Transfer Arrangements 3.2 Chief-Miner Collaboration 3.3. Chief-government Collaboration 3.4 Farmer Organisation
Knowledge and Learning	4.1 Knowledge and Learning

Box 2: Coding results - Groupings and Themes

5.1.Place

Theme 1.1: Changes to the Farming Environment

When asked about changes to farms in recent years, nearly all respondents across the FGD, SSI and KIIs mentioned changes due to the climate (non-mining) or linked to mining itself, particularly water-related.

Non-mining-related

All FGD participants and most SSI/FGD respondents (n=33, 77%) mentioned climate change and/or changing weather; *“the sun scorches hard of late and for a very long time”* (Women’s FGD), which many say either completely kills their trees or affects flower formation and yield. The lack of rain is also a common challenge. Respondents reported a longer than normal dry season, with no rain between July and January/February. Seven farmers (23%) mentioned the shorter season and/or no ‘light season’ where they would also harvest some smaller amounts of cocoa.

“even for the main crop we get just 2 or 3 weeks of rain. It used to rain frequently even in December in the dry period we would get some.”

Official figures for Ghana State of the Climate report (Ghana Meteorological Agency, 2025) showed below-average rainfall in the South of Ghana for both July-August-September (JAS) (North major rainy season) and the September-October-November (SON) (South minor rainy season).



Figure 4: July August September 2024 rainfall period. Source: (Ghana Meteorological Agency, 2025) (study region highlighted in red)

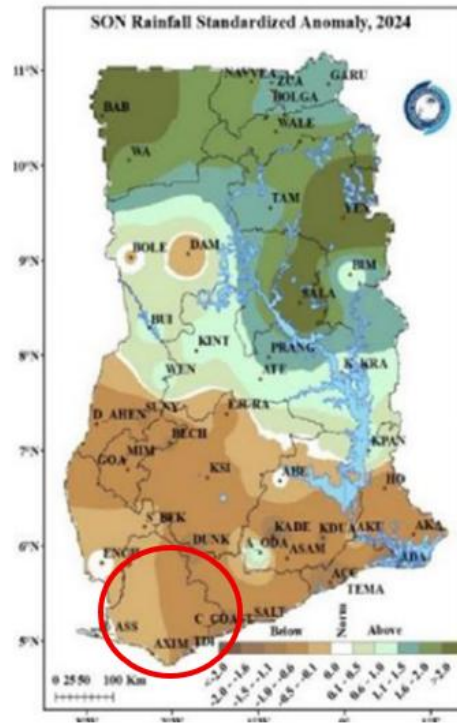


Figure 5: September October November 2024 rainfall period. Source: (Ghana Meteorological Agency, 2025) (study region highlighted in red)

This impacts total yield and therefore income. It also exacerbates the pre-existing challenges associated with seasonality, which farmers commonly mentioned as trigger for financial instability, for instance “*farming season comes once a year. When the dry season comes there is no money to buy fertiliser or other inputs*” and how this affects their lives “*healthcare and education are easy in the major cocoa season, but now in the off season it is difficult to access*”. Half (n=15) of the SSI respondents also mentioned an increase in pests and disease, as well as invasive plants and soil fertility issues.



Image 1: Black Pod, a fungal disease, noted by farmers as increasingly prevalent

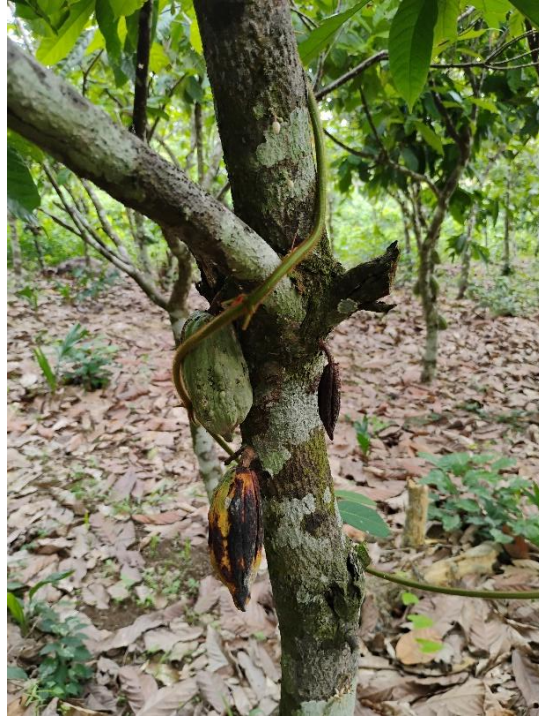


Image 2: A cocoa pod which ripened too early due to high temperatures

Mining related

Of mining-related changes, the most commonly mentioned is the impact on water (n=23): streams that used to pass through or near farms are either now empty or polluted, both with chemicals and mud. This is due to the high water-needs of mining operations, which divert streams or simply take a large amount from the waterbody impacting farms lower down and leading to mud pollution. A more insidious issue raised, however, is the mercury poisoning, due to the very common and unregulated use of the heavy metal, particularly in the end stages of the process, to bind gold dust together. Farmers expressed that this pollution and/or absence of water means they have to limit how often they can carry out farming practices such as spraying against insects and fungal diseases, where they must either carry water from their homes, which is expensive and difficult, or spray with polluted and contaminated water. In some cases, streams directly run through the farms with polluted water and the farmers wish for these to be diverted – no water is better than polluted water.

“[the galamsey is] not close by, but still it impacts. Because I cannot get water from the farm, it is very dry. Previously there was a stream, now there is no stream. This is the case for all the plots. I have to walk extra miles or bring from home in a tricycle.”

“There is a spillover. When there is a rainfall, it spills over into my farm as mine is above the farm. Some are saying there are chemicals in the water, may cause the dying of the trees, but I am not sure.”



Image 3: Aboboyaa or tricycle, collecting water from the town to take closer to farms for spraying



Image 4: galamsey or artisanal mining, including water pumping machines, operating near cocoa farms

As well as natural soil fertility loss, degradation and pollution of the soil was also mentioned. Additionally, there is a lot of uncertainty around the impact of galamsey. It was commonly mentioned that when bordering a mine, trees close to it have died, or are less productive...

“Next to one [mine], I share my boundaries. I do not know if it is impacting but the yield is low in that plot, even though they are young trees 6-7 years and so should have much higher than other plots of over 15 years.”

...or that the timelines align. Several respondents noted that these changes began around six to seven years ago, corresponding with the rapid expansion of galamsey. Many others mention that weather changes are caused by the degradation of the land from galamsey.

“It is because of the galamsey and destroying trees that we have no rainfall. Where there are more trees, there is more rain. When the trees are not there, where will we get rain?”

This reflects the complexity of the situation with different interlinking pressures. The galamsey certainly impacts farmers in many ways, but they also face more general challenges of climate change and soil degradation. The coinciding timings – galamsey becoming more intensive as the weather changes become more noticeable – makes it even more difficult to separate, both in the mind of the farmer and for understanding how and what is impacting productivity.

Theme 1.2: Relationship to the Land

People's relationship to their land and farms can be understood through the reasons they continue to farm, either, as with many farmers, in the face of offers to buy, and/or in their motivations for replanting trees¹. One of the most common things to hear when discussing the high rate of farmers selling their land to galamsey is the disparity in pay between being a cocoa farmer and the price you can get for selling your land, for example, from a galamseyer:

“You see people who have been mining for 2 months, they have mansions, nice cars etc. The farmer who has been farming for years cannot even buy a single room house for him and his family.”

This is likely a simplistic representation of reality, and a comprehensive comparison of the two livelihood approaches is beyond the scope of this study. However, the disparity in immediate opportunities between farming and selling land were mentioned repeatedly, in both formal and informal discussions. Representatives from two LBCs explained that it is common for a farmer to get around two 64kg bags per acre, for which they receive the COCOBOD-approved price of 3,100 Ghana cedis (294 USD) per bag, so 6,200 cedis per acre. Inputs (mostly agrochemicals and farm labour) then take a significant proportion of that income. A range of interviewees also confirmed that the price per acre for selling to galamsey is between 100,000 to 250,000 cedis (9,500 – 24,000 USD), potentially even higher with rising gold prices. The reported amount spent on inputs varies, but if a conservative estimate of 1,000 cedis per acre is taken (not including the value of the farmer's time in the fields), this would mean that selling the acre would amount to 38 years of cocoa profit, while also freeing up time for the farmer to spend in other income generating activities. As reported consistently by all stakeholders and farmers interviewed, very many farmers in the area have sold their land to miners. This is supported by satellite images below (5 and 6), showing changes in Moseaso, one of the villages included in the study, between 2013 and 2022. The images show an increase in mining sites, especially near rivers, a reduction in green areas such as forests and farms, and river pollution caused by mud.

¹ As the research is being carried out right at the start of the rainy season, many farmers have trees that died during the longer- and hotter-than-expected dry season



Image 5: Satellite imagery of Moseaso village in 2013 source Google Earth (2025)

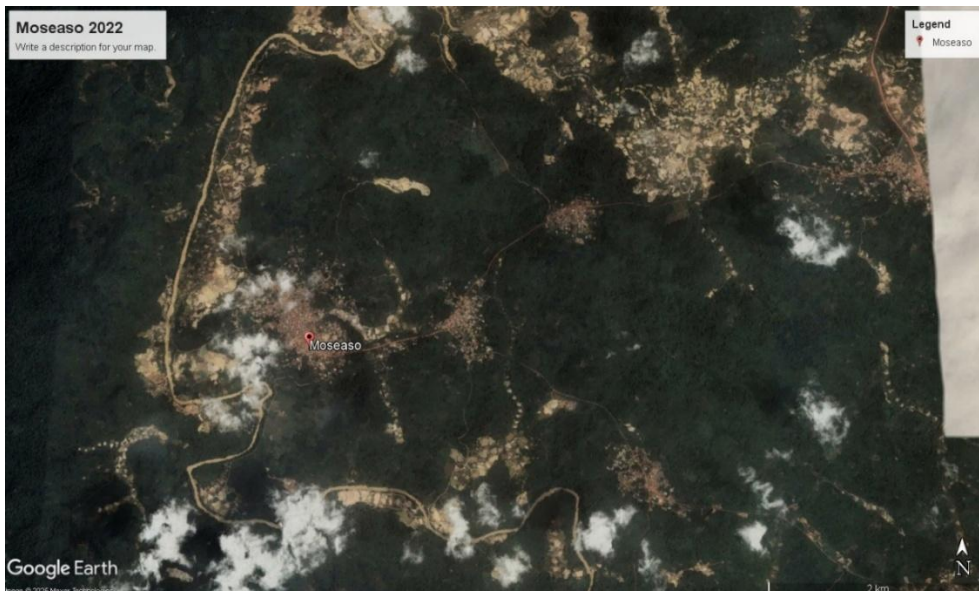


Image 6: Satellite imagery of Moseaso village in 2022 source Google Earth (2025)

Despite this large difference in potential revenue from selling land, of the farmers interviewed, most had already been approached multiple times with offers which they had declined. The only farmers that had not been approached had either already announced to the wider community that they were not interested in selling, and so should not be approached, or had been informed that there was no gold in their land or it was too steep for mining. Reasons for the refusal to sell invariably contained references to their inheritance *“It is something that fed you and your family years back, now it’s your turn to maintain and sustain it”*, as a pension or alternative to social security *“we have to work hard to maintain it now so that it can continue to provide for us when we are old”*, or providing for their children in the future. This economic incentive interacts with other more social and personal reasons

to keep it such as “*my father didn’t sell so I will not*”. Many other farmers stay on the land and continue to replant simply because of a lack of alternatives. However, with increased uncertainty most farmers expressed worry at the ability of the land to provide for them in the future, which could undermine this as a key factor holding the miners at bay, and maintaining the SES core functions of cocoa cultivation.

5.2.Human agency

Theme 2.1: Control over Land

In general, farmers feel secure over the future ownership of their land. The different tenure status of farmers are discussed further in Section 5.3, but all (100%, n=22) farmers who claim to own all of some of their land (as opposed to farmers operating on a shareholder agreement), agreed that it is their own choice whether the land is sold to mining – not that of the Chief or anyone else in the community. Further, nearly all (except one) sharecropping farmers were very confident that until the lease agreement is finished, the landowner cannot and will not sell their land. However, the lease generally ends when the cocoa trees die. Many of the farmers therefore expressed the need to not let the cocoa die.

“When the cocoa dies, the owner will come and take it [the land] back, but I will not let the cocoa die. If it starts to die, I will replant, so it will never die. I even plant before the tree dies.”

Sharecropping farmers are also much more likely to be ‘immigrants’ from elsewhere in the country, renting family land that has passed down through families of ‘indigens’ (farmer interviews, Stool commission interview, Chiefs). As the system relies largely on the elders to resolve land agreements (farmer interviews, Stool commission interview, Chiefs), this can mean that sharecropping farmers feel like they have even less control. As one farmer put it:

“if the owner sells it now, there is nothing I can say. Because I am a stranger here, there is nothing I can do. All I have to do is take my luggages and move back to my hometown. Even if he sells my land now, all I can do is move back”.

Another, however, expressed feelings that while they feel they “*cannot do anything, I can’t approach elders because I’m not an indigen of the town. So there is nothing I can do*”, for issues such as selling before the crops die, which would constitute a breach of contract, they would still go to the courts or Chief. However, most sharecroppers were confident that the landowner did not have any plans to sell

and/or would not, even after the contract ended. The reasons reported for this are the same as those above, such as long-term provision for families, as well as the inherent bias in the sample (those who would sell have already decided to do so).

Theme 2.2: Food Availability

Two thirds (n=20) of the farmers reported growing crops other than cocoa, and two-thirds of these (n=13) through intercropping, with others on nearby or separate plots. This was the most common reported diversification strategy and is used to cope in times of lower-than-expected yield. However, agriculture is subject to same pressures as cocoa. Most farmers reported similar impacts from climate and galamsey: *“Even plantain dies. The cassava it feels very hot when it’s being harvested because of too much sun”* (Women’s FGD). Additionally, the competition for land between the two (farming and galamsey) may be more pronounced in this realm. Rice and maize lands are particularly vulnerable to galamsey, as lower wetter areas are often the first places miners go. Secondly, the impacts of a reduced yield – reductions in yield per plot, for instance, from previous years’ drought and overall reductions due to land loss – are felt immediately in the form of availability, market prices, and the need to import food from elsewhere.

“Galamsey collapsed cocoa, and now the land is not there for us. We used to get plantain, cassava, and cocoyam, all from farms. Because the galamsey destroyed the land, now you have to go to town to buy this, and it’s more expensive than before. If the land is there you see more people growing. Now the land is not there, so they don’t grow” – Chief in Mining Town

This was also reported to contribute to the reasons why farmers were not willing to sell their land to galamsey. They have seen the high food prices in other areas where much of the land is being sold – in fact sometimes they are the ones selling it to them at the inflated price. As one farmer put it:

“food [there] is so expensive, 200 cedis for some cassava – to make a soup for the family suddenly you’ve paid 1000 cedis. How will you survive? Why would you sell everything to pay 1000 for your soup?”

Land, therefore, whether it is currently used for cocoa or not, is an important safety net as it can be converted to food in times of need. *“Food is scarce nowadays, even if land is not filled with cocoa you can use it to plant food crops to feed your family”*.

Theme 2.3: Coping Mechanisms

Among other factors, the SES is characterised by high levels of vulnerability. Of the 25 respondents, 18 (72%) reported having periods in the last year where they were worried about being able to feed their families. The SES is also characterised by a strong community, evidenced by people turning to neighbours or family members for help in such times of crisis, for food, or for help on the farm when labour is not affordable. However, this also has a gendered element; women reported that they are often now expected to work in the fields where before they wouldn't, but that their home tasks have not reduced. Occasionally, farmers will get other work to pay farm labourers, but mostly work more themselves.

From talking to the different groups it became clear that while some were able to take loans, this depended on circumstance. For instance, if a farmer does not have savings with a bank already they are much less likely to get a loan. Some farmers had family or neighbours willing to lend, whereas others did not. Over half of farmers (56%), reported that they are unable to take a loan, either because the bank will not provide one, the interest is too high, or because of declining cocoa yields: *“when you plan to pay it back, when you get to that time and you have no money to pay it back because there was no cocoa”, “what bags I get from the cocoa nowadays is very small. I wouldn't be able to pay back any loan”*.

In sum, accessible and good credit facilities are missing from the SES. Village Saving and Loan Associations (VSLAs) set up by local NGOs were generally not mentioned by farmers. This could be because they are still fairly new, that not all farmers are members, or that loan amounts are relatively small, however this is beyond the scope of this study. It could reflect the wider problem in poor communities, reported by some stakeholders that you can't always depend on neighbours, as something that affects one farmer is likely to affect others, for instance a drought. *“People don't rely on others, because if you go to them and they have nothing to give you, you will just be disappointed. So the little that you have, you rely on that.”* (Chief interview)

5.3. Institutions and Collective Action

These themes differ from those above as the findings emerged from synthesising data from the series of formal and a few informal interviews with multiple stakeholders, where a more iterative approach was used with questions changed and updated as a result of previous interviews. In general, notes were made during these discussions but not recorded verbatim, so there are fewer direct quotes, and many of the findings cannot be attributed to a specific interviewee. government (Govt.) and Galamsey

Operators (GO) were guaranteed anonymity and are thus referred to simply as Govt. and GO. Informal discussions (ID) were also particularly important for this section.

Theme 3.1: Tenure Agreements and Land Transfer Arrangements

An important distinction is the various reasons a mining operation may be illegal, which can be largely grouped into concession and non-concession. In the first, the government, which since the Minerals Act of 1962 has rights to all minerals in the land, despite who may own the land itself (Nyame and Blocher, 2010), has provided a mining group with a concession. They therefore obtain access to the land legally - they have the right to mine there and must give compensation to the farmer who was previously the deed holder. This can become illegal if practices violate regulations, including abuses of human rights, the use of child labour, or harmful environmental practices. In non-concession mining, the government is not involved in any land acquisition (Govt. x2, GO, ID). Deals are made between the farmer and the mining group, with a large up-front payment made to the farmer (Govt.x2, GO, ID). In this region, the second type is more common (Govt., farmers). It is also influenced by the SES itself, whereas the first type is more of an external ‘shock’. The focus is therefore more on the second type as a component of the SES.

As reported in all farmer interviews, for these non-concession land-transfers, the farmer believes themselves to be the landowner. All farmers interviewed, who were not sharecropping, reported that they owned the land and it was solely their decision whether to sell (farmer interviews). However, as discussed in Section 2.3, legally, all land belongs to the Stool, and the farmers are leaseholders (Govt., Chiefs (non-mining), GO; Constitution of Ghana). As reported by government officials and Chiefs, most of these leaseholds never had the proper paperwork which explicitly laid these conditions out, such as rent payments and length (generally 50 years), and very many leases have expired with no consequences until now. It was conjectured by some participants (Govt., Chief, ID) that this understanding among farmers that they are the landowner could be due to the not having to pay rent, and that their “father’s father was farming on this land” with exclusive rights to it. ‘Land-owning’ migrants may either be under the same impression when in fact they are sub-leasing it from the original indigens, and are therefore subject to the same expiry period. However, unlike indigens, migrants must pay rent to the Stool, even on agricultural lands.

With concession-mining, Stool Chiefs have limited options as the government has the power of the State behind them to enforce the land acquisitions (Chief interviews). In contrast, with non-concession mining, the Stool Chief is able to exert greater control. While in the main area visited for

the research, galamsey is prevalent, and all respondents frequently mentioned that farmers had sold their land for galamsey, while remaining farmers reported that it was solely their decision whether to sell it or not. However, as the farmers don't legally (in accordance with State law) own the land, as per the Constitution and explanation in the Literature Review above, this decision is not available to farmers in the neighbouring Stool, where Chiefs enforce farmers' status as leaseholders, effectively preventing small-scale galamsey (Chief interview). This legal enforcement can create tensions, as some farmers wish to sell their land, following the example of neighbouring areas, but are unable to do so (Govt., ID with farmers). As put by the Chief.

“The land here is for the Stool. It is the Chieftaincy matter. You are farming the land but it is not yours forever. If the Chief does not give you permission to sell it, you cannot.”

In Ghana, traditional leadership is organized in a hierarchy led by a Paramount Chief, with support from sub-Chiefs (Stool) and Village Chiefs (odikros) (Hirons et al., 2018). The odikro may likely be the person who hears these complaints, but their job is to enforce the will of the Stool Chief. As reported by the odikro of the non-mining town, if a farmer has been found to sell rights, they could be sent away from the village, any other land taken from them and even money from the sale demanded back.

There is a much lower rate of Galamsey in this area, and most farmers don't experience pollution, although those close to rivers with sources in other Stools are beginning to experience it. This was confirmed by the odikro, farmers spoken to informally and other stakeholders knowledgeable of the region. However, a detailed study of the SES in this area was not feasible within the time and resource constraints. The images below, in comparison to images 5 and 6 in Section 5.1 above, show much less change due to mining. However, these are only reflective of one part of the Stool area, which is also more heavily forested, potentially limiting the accuracy of satellite imagery. These images are therefore illustrative, rather than evidence; further research would be needed to confirm the levels of small-scale galamsey in the two Stools.



Image 7: Satellite imagery of Nkrankrom village in 2015. Source: Google Earth (2025)



Image 8: Satellite imagery of Nkrankrom village in 2024. Source: Google Earth (2025)

Theme 3.2: Chief-Miner Collaboration

For normal farming land transfers, the odikro Chief may be involved as a mediator and to acknowledge the transfer of leasehold, likely without payment (Chief interviews). As above, the (fairly low) rent is not paid on most agricultural land, either because it is owned by indigens and/or the capacity of the institutions means it is not collected (Govt.). However, if there are transfers or resource extraction beyond that of farming, the farmer must pay for these rights, and so a proportion (generally 10%) of the compensation given to a farmer is paid to the Chief / Stool / ‘Chieftaincy

Institution’ (farmer interviews, Govt., Chiefs, GO). The Chief may also acquire other benefits, directly from the miners. This may be either for themselves or the community (different informants gave different information about this). It may be in the equivalent of a ‘rent’ paid by miners or commonly they are requested to help build a clinic, borehole, community centre or otherwise support the community such as clearing drains (farmer interviews, GO, Chiefs). The Chief can work directly with galamsey “*official not-official, secret not-secret*” (Chief) groups, as well as the more formal Small-Scale Mining Association, which works both with illegal and legal miners. These groups help the miners, for instance by collecting confiscated tools taken by the police in a raid (GO). In return, miners pay a small fee to the group and the Chiefs. If a miner doesn’t pay, the Association has the power to stop them mining in other sites.



Image 9: Medical clinic partially funded by illegal galamsey



Image 10: Community center in the process of being built, supported by galamsey financially, supplies such as concrete, and labour

This “official-not-official” status reflects the dual-nature of the galamsey in general. Firstly, it is on open display; it is directly next to many roads and towns, so there is no hiding, despite its supposed illegal status. Secondly, these mining organisations see themselves as “*official mining companies*” (GO). One worker explained their legitimacy due to the company structure: “*these are galamsey, but they are real official mining companies. You have Directors, Senior Foreman, Foreman, and the workers below*” (GO) or their activities: “*We are professionals ... we have an office, we also buy gold*” (GO). Thirdly, galamsey operators interact with formally recognised institutions of elders, such as by paying rent and taxes, carrying out negotiations prior to any mining, and contributing to the community. In one community, an ‘Official Receipt’ was found to be given to miners on collection of their contribution for development (Image 11 below). This is one important way that galamsey operators are legitimized by the Chiefs, and in turn how they legitimise the Chiefs as a public authority able to permit or deny operations and collect taxes. This is further analysed in the Discussion.

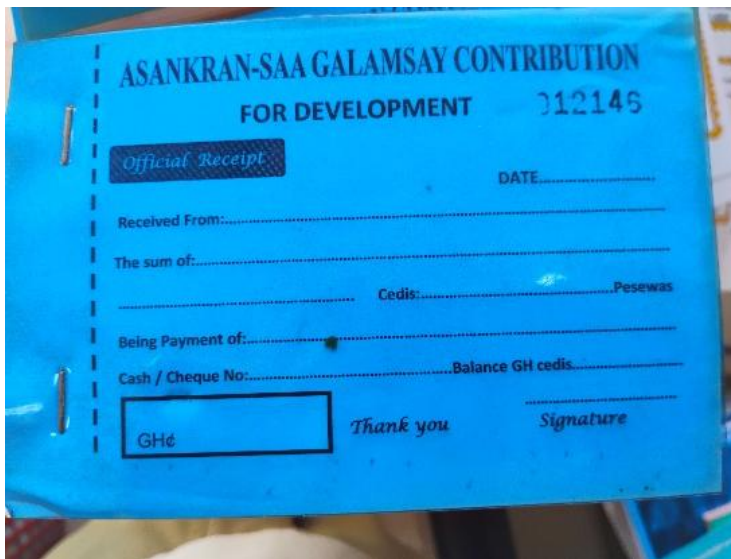


Image 11: Receipt for funds taken from the galamsey operators by the Chief

However, not every farmer in the village was aware of the supposed benefit from the galamsey, either because they hadn't heard of the collections, or that it had been a long time since they had (e.g. in one place the clinic extolled as a key example of the community benefiting was built over 7 years prior). For others there was suspicion of what the money collected was used for (*'we know he is collecting, but I don't know where it goes'*) (Farmer Interviews).

Theme 3.3: Chief-government Collaboration

This theme describes how miners continue to engage in the process of paying Chiefs, and farmers compensation, due to the power of the Chieftaincy as an institution, but also the way they can work with the government, either in reality or in the imagination of the miners. The miners reported that they engage with these taxes and requests because they understand the power of the Chiefs when it comes to the land. Despite many people claiming that the Chief has no power to prevent galamsey, others dispute this. The Galamsey master states:

"[we pay] because of land. The Parliament² Chief can come here and stop all galamsey people. He has the power to stop galamsey, just like that. The Chief can use military

² This Chief status does not exist in Ghana, reflecting how many people don't understand the complex nature of the different authority systems. The Paramount Chief does exist, which reflects the highest-ranking traditional authority within a traditional area (Mawuko-Yevugah and Attipoe, 2021)

enforcement to stop it. If he requested help from the government, they would give him the power and easily he could enforce and stop it."

Similarly, an odikro Chief from a mining village explained that:

"if we see people working on the land without consulting us, the Chief and the elders, we will call the police. They will stop them, or call them to us for negotiation. Then, if they agree with that, they can carry on. If they don't, the police maybe they will arrest them, or we continue with negotiations"

The extraction of rents and other coordination legitimises the galamsey activities, with little of the benefits that would occur had the legal requirements been enforced, particularly on limiting waterbody pollution and health and safety for those employed in the mines. Despite this, there does seem to be some recent attempts to limit the destruction. Some miners explained that:

"The odikro, if you're not working in the right place he can decide to halt your actions. For example, if you work in the forest or the near the rivers, he will come and make you move"

Therefore, in opposition to the consensus in the literature and the general rhetoric surrounding galamsey operations that a Chief can't do anything, a combination of elder legitimacy and government power forces miners to engage in the processes, pay tax and potentially even follow specific conditions, such as environmental protection. In this way, the institutions in the SES form a state-like structure, with new tax-paying citizens and their own laws. This is developed further in the discussion.

Theme 3.4: Farmer Organisation

Despite the impact on neighbours of converting a farm into a mine, the sale of land is seen as a very individual choice by all respondents – *"it is completely up to me... It will be my decision whether to give it up or keep it, it is mine forever"*. Many also expressed the futility of trying to persuade someone not to sell. Most farmers reported having their own tools, with very little reported sharing or communal labour. Some linked this to the rise of galamsey reducing farmer numbers.

"There used to be communal labour, but now because farmers who sold their land, they engaged in galamsey and other activities. Because now they are not farmers, they don't help you as they are not needing help in return."

The reduced farmer numbers also weaken what appears to already be fairly weak farming organisations, with some saying their group no longer exists because there are not enough farmers,

and many others expressed the pointlessness of being in one beyond getting free or subsidised inputs from COCOBOD. As these often don't arrive, the groups then don't meet.

5.4. Knowledge and Learning

Theme 4.1: Knowledge and Learning

Most farmers reported having learned cocoa farming practices from their parents, and most stated that they hardly use any new practices, despite reported (by farmers and organisations) trainings on different farming techniques. When new practices are reported as taken up, it is mostly simple things such as 'line and pegging' (planting around 10ft apart, rather than randomly), pruning, and introducing agrochemicals. The reasons for limited uptake of trainings is beyond the scope of the paper, but initial findings indicate that it is likely due to following the way their parents successfully did it in the past, and certain characteristics of the changing SES constraining their ability to adapt. In particular, the methods proposed during trainings are often costly and/or labour-intensive. As a result, the most frequently cited reason for not adopting certain practices – especially diversification and spraying – is a lack of financial resources:

“If you have knowledge, what can you do without money?”

This represents a key aspect of the SES feedback mechanism. High labour costs prevent farmers from implementing practices that are important for boosting productivity or reducing losses. A common example is the overuse of herbicides, as limited access to affordable labour makes manual weeding difficult. Farmers are aware that this practice can degrade soil quality, which in turn lowers income in subsequent seasons. Additionally, spraying pesticides – an activity many farmers expressed interest in doing more frequently – has become more challenging due to water pollution, which raises the cost and limits its use. This may contribute to increased pest and disease pressure, which could already be worsening due to climate change. Further research is needed in this area. Overall, farmers indicated that they would benefit most from support in the form of better cocoa prices and consistent access to subsidised or free inputs, especially fertiliser and irrigation.

6. Discussion

This section demonstrates how the study's theoretical framework, developed from the literature, combined with qualitative data from formal and informal participant focus groups and interviews, can be applied, and offer useful insights, into the context of cocoa farming in this part of Southern Ghana. Firstly, this approach highlights how a decisive change in authority, understood through Lund's coding regime (section 6.1), interacts with the highly connected components of the SES to set in motion a new series of feedbacks which influence how the system reorganises (section 6.2), as illustrated in Figure 6. This includes components within the SES itself, for instance how the impact of initial change (land conversion to mining) on water and labour availability, can interact with external 'shocks' such as climate change and gold prices, to 'speed up' the cascading of the revolt. Other factors, such as the relationship people have to their land, and the potential (whether realised or not) to grow food, can regulate this, acting as a 'remembrance' in the cycle. Coding the regimes of possession (Lund, 2024) helps to demonstrate how a stepping back of national-level authority can reshape rights and decision-making at the household-level, with these local shifts potentially cascading upward to influence power dynamics at intermediate levels. Ultimately, this new system configuration prioritizes the needs of some while exacerbating inequalities for others (Section 6.3).

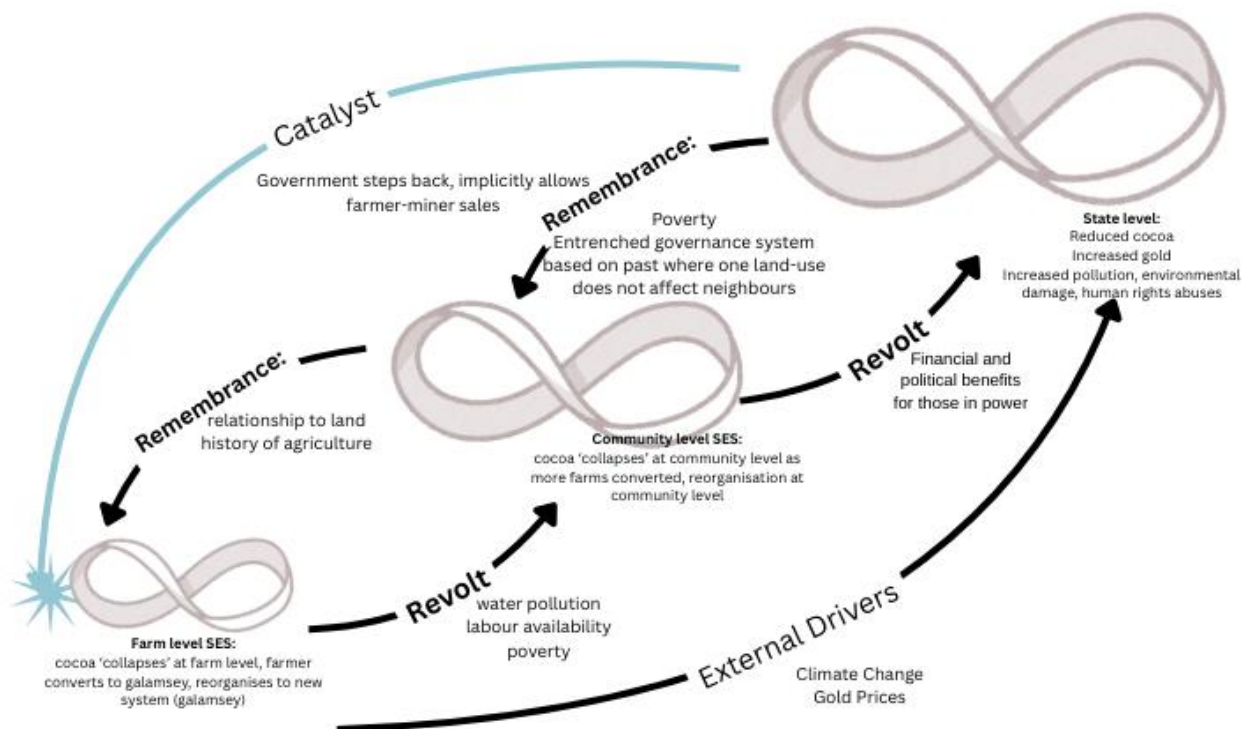


Figure 6: Overall feedbacks within the transforming SES

6.1. Recoding as a Catalyst

Combining Lund's coding of regimes of possession with the SES resilience understanding into the new framework (Figure 1) helps in understanding why and how the system reorganizes to allow extraction and how this impacts the rights, livelihoods, and resilience of those 'left behind'. This cause-and-effect approach allows an understanding of the initial catalyst for the changes in land use, which is key to understanding how the processes interact today. First, why a change or recoding in the value of the land happens, both from the perspective of farmers and the authorities. In Southern Ghana, land that was previously valued based on its quality of soil, access to water and pest-free environment is now also valuable based on its gold concentration, slope and amount of water. While there exists in the region a tradition of indigenous mining activities, particularly 'nkron' or chimney pipe mining where a long shaft or chimney is built to extract gold (Mantey et al., 2016; Ofosu-Mensah, 2013), this approach could not cover much area, and so cocoa-related characteristics were still the primary asset. Now, with excavators and other technologies enabled by an influx of capital, particularly through Chinese investors (Crawford and Botchwey, 2017), large areas can be covered relatively quickly, which combined with rising gold prices (Khadan and Temaj, 2025), makes the cocoa-use of land significantly less valuable than the gold-use.

While small-scale mining can be legal, bureaucratic processes and the high costs associated with meeting human rights and environmental regulations (Ampaw et al., 2023; Hilson, 2001; McQuilken and Hilson, 2016) initially prevent the full potential of this new value from being realized. According to national law, farmers are leaseholders on their land, which constrains their options and limits their ability to extract the new possible value from galamsey. While the state can allocate land, this often benefits larger companies (McQuilken and Hilson, 2016; Mensah, 2021; Okoh and Hilson, 2011) and poorer miners who cannot afford the proper equipment are even more unable to benefit from this: *"If you are using machines, you can call yourself small-scale, you can get them [contracts from LSM], but if you're using diggers or pickaxe you're galamsey. So even if they know it's illegal, with the machines they won't care because you're not galamsey"* (GO). It is also frequently reported that compensations associated with state-led concession land transfers are often not paid, delayed, or inadequate (Nyame and Blocher, 2010). As a result, neither farmers nor prospective small-scale miners gain much from following the legal system. Consequently, an alternative system, separate from the state, is relied upon to facilitate the recoding of land and the realization of its new value by those within the SES (*theme 3.1: Tenure Agreements and Land Transfer Arrangements*). In areas with non-concession galamsey, farmers are no longer recognized as leaseholders but as landowners, with

many having "sold" their land rights to galamsey operators for lump sums. All farmers interviewed reported that it was their decision whether to sell their land (*theme 2.1: Control over Land*). This shift, from leaseholders to rights-holders, allows farmers to benefit from galamsey, offering a more immediate and familiar solution than the state system provides.

However, farmers cannot independently decide what they do with their land. Their position as rights subjects depends on the stance of their Stool Chief – in some Stools farmers are able to sell, in others they are not (*theme 3.1: Tenure Agreements and Land Transfer Arrangements*). In the Stool without galamsey, the Chief relied on the State legal system and constitution in which no individual has “*a freehold interest howsoever described*” (The Constitution of the Republic of Ghana, 1992 (as Amended to 1996), 1996), preventing farmers from feeling that they have the option to sell. In contrast, in areas where the Stool Chief is willing to allow mining, recoding the farmers from leaseholders to owners allows the sell-off. Additionally, both the farmers and miners follow customary ‘laws’ which further provide their own legitimising effects. Chiefs and miners reported how it is necessary to meet and negotiate before any deal is made (*Theme 3.2: Chief-Miner Collaboration*). An initial fee is then paid with follow-up taxes and community contributions. This demonstrates the paradox at the heart of the system; only the Stools are offering people the opportunity to be recognised as a landowner or an employee at an ‘official mining company’, seemingly at odds to national laws and processes. This reflects findings by Siaw et al. (2023) of two parallel systems in the cocoa-mining nexus of Ghana, with the State operating in parallel with the customary land system.

Importantly, and as per Lund’s framework, this kind of shift in property rights and rights subjects also shifts public authority. In this case, the public authority has shifted from the State to the Chieftaincy system. Although the Stool may appear to relinquish certain rights – by permitting others to decide on land sales to which they legally retain alienable rights – this arrangement ultimately brings benefits. Firstly, they derive financial gain from galamsey activities, receiving a portion of initial land payments (typically 10%) as well as informal taxes from miners, all without assuming direct responsibility for the decision or facing backlash from opponents. Additionally, they avoid the politically sensitive task of displacing farmers themselves. Secondly, this process allows the Stool to reinforce its authority. In areas where Chiefs permit farmers to sell land, those farmers increasingly recognise the Stool as the legitimate source of land title, either for convenience or because of favourable rights arrangements. Through this dynamic, the Stool reasserts its own jurisdiction (Figure 7).

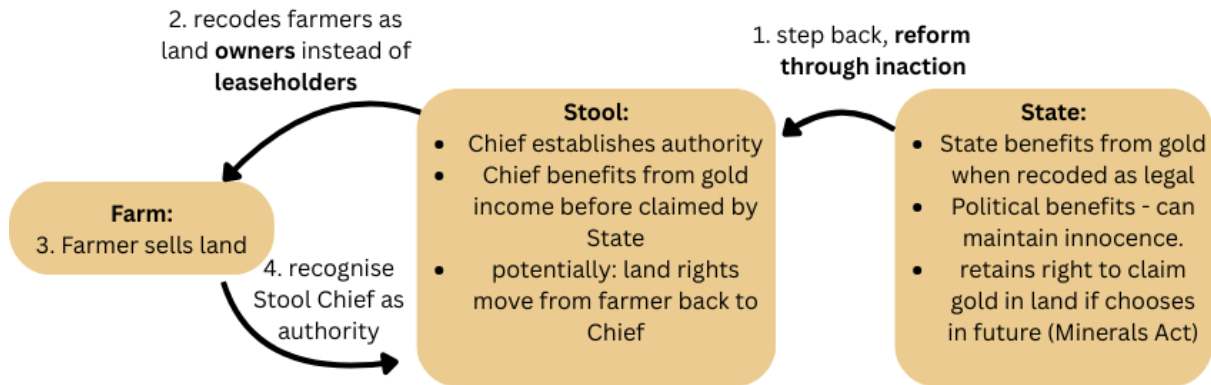


Figure 7: Recursiveness of Power

However, the authority of the Chiefs relies on the state: Ghana's 1992 Constitution formally recognizes the Chieftaincy as institution and establishes the Houses of Chiefs which provides the traditional authorities with formal authority to participate in governance processes and legal authority in land administration and customary law matters (Adotey, 2019; Amanor, 2022). Officially, the state delegitimises the Stools' authority over galamsey miners by continuing to label them as illegal. Yet, by allowing the Stool Chiefs to ignore the Constitution's section on minerals and give farmers the right to sell their land, the state allows this process of legitimisation.

Just as the Stool on the surface appears to be giving up control in exchange for benefit, the same can be said for the State. The State does not have the capacity to operationalize a legal mining operation on the same scale and enforce environmental and human rights regulation (Ampaw et al., 2023; Koomson et al., 2025; Siaw et al., 2023). Therefore, by allowing the Chiefs to allow the recoding of farmers' rights, the state is able to benefit from an illegal system while avoiding direct accountability. A clear example is the flow of gold into official markets without proper checks on its source, as licenced buying agents are not required to check where the gold they purchase has come from, before it is then bought by the national Precious Metals and Minerals Company (PMMC) (Stacey, 2025). This also further legitimises the activities of galamsey operators. Galamsey also brings political and financial benefits to individuals within the system. Corruption is frequently reported across all levels (Ampaw et al., 2023; Crawford and Botchwey, 2017). At the higher level, Komsoon et al. (2025) find that different miners are linked to key political figures who can intervene to secure their release if arrested. Further, Stærfeldt and Stacey (2025) demonstrate how competition between powerful actors in order to benefit from the financial opportunities of galamsey continues to permit the mining and its environmental degradation. This reflects a broader 'frontier' dynamic whereby "the sovereign can vacate previously ordered spaces in order to allow for extraction and commodification to occur

beyond the usual regulatory frameworks” (Rasmussen and Lund, 2018, p. 391). Despite the seemingly passive nature of the State in this context, in fact the SES transformation is in this way catalysed by a reform *through inaction*.

6.2. New Feedbacks

An SES is transformed when the internal feedbacks that keep a SES on a particular trajectory are changed (Olsson et al., 2022). This means that transformations entail “a change that restructures, reconnects, and remakes the meanings of relationships between people and between people and the ecosystems in which they are embedded” (Moore and Milkoreit, 2020, p. 4). The SES resilience framework helps understand how system attributes shape these changes. It is not just a recoding driven by those in power; it interacts with past activities and new dynamics of the system. Understanding that each level of the SES has its own cycle of change, influenced by processes at higher and lower scales, can be helpful in this analysis. Figure 8 below provides more detail on the processes at the cyclical level depicted in Figure 6, demonstrating adaptive cycles at the farm and community level. Historically, for the establishment of the cocoa SES basin, resilience was built as a farmer and the community transitioned into cocoa, which was then maintained, in many cases, across generations. Following a catalytic event, as low costs and high prices for gold production interacts with a shifting rights regime, a farmer may decide to convert their land to galamsey. In this scenario, at the farm level, the cocoa collapses, and the farm reorganises into a galamsey operation. As the pollution and destruction involved in galamsey make any other uses for that piece of land impossible, this basin of attraction is very resilient, and a new ‘growth’ phase occurs.

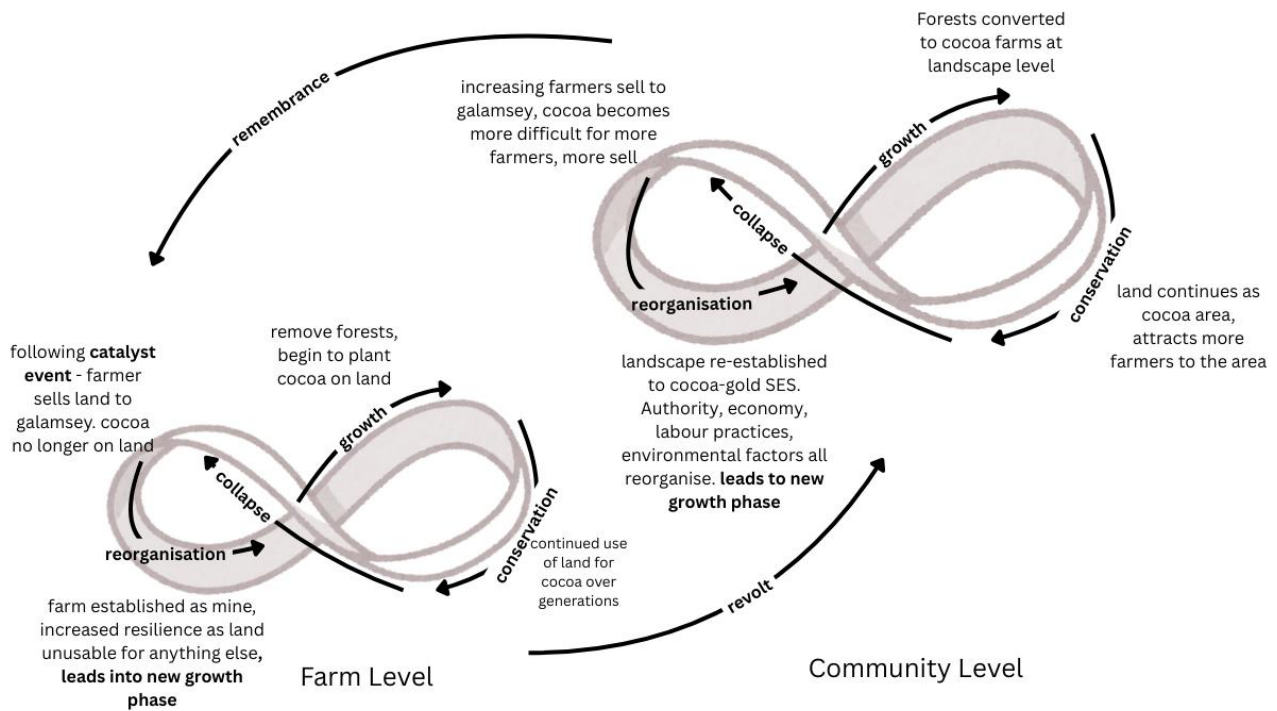


Figure 8: Complex Adaptive Cycles at the Farm and Community Level

As more farmers sell, a new reorganised system emerges: rivers absorb displaced mud and mercury and communities straddle both activities. However, this is likely not a stable basin of attraction, as remaining farmers experience pressure from both inside and outside of the system. Understanding how farm-level transformations propagate to the community requires examining these cross-scale interactions, the factors that facilitate or constrain change, and the feedbacks that reshape the system.

Revolts

If a revolt is understood as the cascading of a change up the hierarchy of levels (Olsson et al., 2022), here it can be seen as the factors which encourage a change in land use at the farm level to induce change at the community and regional levels. In this case, a farmer selling their rights to gold miners has the potential to increase the pressures on the remaining farmers, leading to increasing farmers selling and fundamentally altering the SES as the landscape and ecological structures change (*theme 1.1: Changes to the Farming Environment*). Water pollution from the mercury used in the galamsey is potentially a core revolt dynamic; “Because mining is all around, the water passing through a river it is polluted, so we have lower yield” (farmers), see also: (Barenblitt et al., 2021; Gyamfi et al., 2019; Gyimah, 2019)). This is referred to as the ‘unlucky locals’ phenomenon, as proximity to polluted lands forces a farmer’s hand to abandon farming (Ofosu et al., 2020). In some areas it has even been found to be a purposeful tactic to persuade farmers to sell their land (Siaw et al., 2023; Stacey, 2025).

These new feedbacks can also interact with the history of a place – a farmer who can’t afford to feed their family (*theme 1.2: Relationship to the Land*), a miner who can’t find employment elsewhere nor the equipment to follow a legal route into gold – and its future. In particular, respondents expressed worry about the future of farming, both concerning climate change and the threat of further pollution (*theme 1.1. Changes to the Farming Environment*). Almost two thirds of farmers asked³ expressed worry about galamsey overtaking cocoa: “*Farming is not the solution long-term, think of these challenges, weather and pests*” (Men’s FGD); “*people sell happily - the money is a lot more than farming and cocoa is dying*” (Farmer interview); “*That is why most of the famers are selling their land to galamsey. They look into the future and they see it getting worse*” (Farmer Katta). In other frontier situations, it is common that “past activities and people are erased as new valuations are enacted” (Rasmussen and Lund, 2018, p. 390). While this may apply to state-led, concession-based mining, the more widespread non-concession mining involves collaboration between miners, traditional leaders, and, crucially, the farmers themselves. As such, the erasure of the past is not as straightforward. In opposition to larger scale disposessions, in this context the past activity is applied in contrast to potential future ones as ammunition to sell.

Other new feedbacks identified in this study, which potentially push a change across scales include the reliance on herbicide and new inability to spray against pests as reported by many farmers (*theme 4.1: Knowledge and Learning*). Farmers are forced into practices that are counterproductive due to changes elsewhere in the system. Historic poverty combines with the more recent difficulty in accessing labour due to galamsey to make beneficial agricultural practices like manual weeding unattainable. Poverty and reliance on rainfed agriculture also pairs with the more recent water pollution to make effective pesticide and herbicide spraying similarly difficult. As a result, increased herbicide use could lead to a decline in soil fertility over time, while reduced pesticide spraying may allow pest infestations to rise, especially with climate change fuelling more pest activity. Both factors could cause future yields to drop, further diminishing the chances of farmers being able to adopt the practices they know will improve their situation and keep them in farming. In this way, the feedbacks operate cross-temporally.

³ Only 21 farmers were explicitly asked this question.

System memory

The system's ability to produce food acts as a crucial link across scales – farmers both contribute to and benefit from local food production. This can help regulate the cascading effects of the revolts, acting as a remembrance. Farmers directly experience the consequences of reduced food production, whether through rising prices in their own markets or higher costs for their produce sold to neighbouring villages that have shifted to primarily galamsey-based economies (*theme 2.2: Food Availability*). This awareness can help curb the growing trend of land sales, functioning as a form of system learning. As one farmer put it, “*I don't want to sell my land to galamseymen and when I get to the market then I can't even afford to eat*”. However, as with many SES, there may be a potential threshold point where a particular process may cease to operate in the same way (Chaffin et al., 2016; Walker et al., 2006). If the pressures of climate change or pollution get too high, the ability of the farm to provide unpolluted crops no longer holds, and the memory collapses.

Another powerful form of system memory that limits the cascading of revolts up the scale is the connection farmers have to their land (*theme 1.2: Relationship to the Land*), much of which is rooted in their belief that it will continue to provide in the future. Farmers view it as an alternative to social security or as a legacy to pass on to their children. In contrast to the one-time payment from galamsey, which many farmers noted they wouldn't know how to use and that it would eventually run out, cocoa farming offers a steady income into the future: “*it is better to be eating always, than to eat your cake once*”. This is a strong motivating factor, demonstrated by the fact that all the farmers interviewed, who had been approached to sell, refused to do so. However, this motivation is closely tied to the food security dynamic mentioned earlier and faces similar potential threshold challenges. If pollution or climate change make agriculture unfeasible anyway, the remembrance dynamic breaks down.

System memory manifests itself in other ways, for instance in how historical inequities shape future ones. The changes to the SES can impact some more than others – sharecropping farmers for instance are more precarious (*theme 2.1: Control over Land*). While some had an ongoing agreement, others who could farm until the trees died may be disproportionately impacted by climate and mining compared to farmers who owned (or had a longer lease directly from the Stool) their land. These changes cause tree death, potentially expediting their contract end-date and therefore the risk of either not renewing the contract or being offered less favourable terms. This is especially important as galamsey not only heightens the risk of tree death but also raises land prices, amplifying the opportunity cost for landowners between selling their land or continuing to lease it to sharecroppers. Financial inequities also influence the adaptive capacity of farmers in their ability to implement what

is needed to be less vulnerable to future shocks (*theme 2.3: Coping Mechanisms*). Households lacking resources may be unable to weed effectively, plant shade trees, or secure clean water, pushing a new feedback in which future yields – and therefore income – is more susceptible to climatic or environmental stressors than better-resourced farmers (*theme 4.1: Knowledge and Learning*). Shorter term coping strategies can heighten this: for instance, some households reported that they pause sending their children to school in a bad year (for instance where drought or other unusual weather patterns reduce the yield). Similarly, farmers without savings in the bank or a strong social network that can provide support or low-interest loans are further exposed to risk.

While memory can serve as a powerful regulating force in a system undergoing change, these impacts from the fallout of a new land-use interacting with historical inequities highlight how it can also hinder adaptation and limit positive outcomes. The customary land tenure system has evolved over centuries of activities in which one user has limited impact on those around them. This primarily relates to agriculture, but traditional, pre-colonial mining practices were also in place in which Chiefs granted mining rights and were entitled to proportions of the gold found (Mensah, 2021; Nyame and Blocher, 2010). In this way, the farmer is left behind because of limitations in the Stool land governance system, in which a modern and destructive mining-use is almost directly transposed over the previous agriculture or low-intensity uses, without considering the inherent differences in impact. As mentioned previously, resilience, understood through strong remembrance, is not always positive, especially if changes are imposed on top of a system with “institutional structures that are embedded in certain values [that] can perpetuate unsustainable and inequitable outcomes” (Olsson et al., 2022, p. 158). In this case, the resilience of the Stool system and memory of previous land use heightens inequities and contributes to the restructuring of wealth, discussed below.

6.3.A New Configuration

Following these dynamics of collapse, reorganisation and growth, the SES can be said to have traversed into a new ‘basin’, where galamsey and cocoa exist side by side and new feedbacks are in play, interacting with the memory of older ones. While resilience theory accepts that SES can move between basins, sometimes a particular basin can “becom[e] so wide, and so deep, that movement to a new basin or sufficient reconfiguration of the existing basin becomes extremely difficult” (Walker et al., 2004, p. 6). The structure of the new ‘basin’, or system configuration, and the potentials for traversing out of it, are explored below.

Desirable for whom?

“Systems are unable to provide for the needs of all” (Ingalls and Stedman, 2016, p. 3). Therefore, it is important to ask for whom the new system configuration is desirable. As above, pre-existing inequities are made worse for farmers through the impacts of galamsey and its interactions with the system. At a higher level, the recoding of property rights and rights subjects impacts how wealth and value feeds back and around to those in the system. Farmers who don’t sell their land, while still subject to a potential recoding, maintain the core asset properties of good soil, young and resilient trees, in a pest free area. However, the *value of that asset* decreases as the frontier advances and farms and water are polluted. As this study shows, this is compounded by other internal feedbacks such as labour availability, and external drivers such as climate change, which further decrease the value of cocoa land (more expensive inputs, lower yield), but not that of the mining alternative. This puts the accumulators (mining companies) in an advantageous position – as they continue to work, the value of what they want decreases for the sellers, but increases for the buyers, especially as gold prices continue to rise. This demonstrates how recoding happens “simultaneously [to a] restructuring of wealth in society” (Lund, 2024, p. 5).

Peluso suggests that small-scale mining can be seen as a modern equivalent of the traditional "smallholder slot" once occupied by peasants and small farmers (Peluso, 2019). However, the situation in Ghana today challenges this idea. While mining in the country is still labelled as "small-scale," it often involves large groups managed by outside actors – most commonly Chinese investors or Ghanaians from other regions (own observations; Crawford and Botchwey (2017)). This form of mining does not represent a simple shift in practice by individual smallholders. Instead, it signals a deeper transformation in both the local economy and governance structures. Farmers, who once held long-term use rights to land (if not outright ownership), are losing access to these lands. In their place, illegal mining groups are extracting value and accumulating wealth.

What’s more, land is no longer a productive asset held by individuals or families; it is being turned into a commodity. Ownership and use rights are increasingly transferred to outsiders in exchange for one-time payments to landowners or daily wages to workers. This shift mirrors other historical cases of dispossession. For instance, in a parallel to how those “labelled “communists in the 1960s and 1970s in New Order Indonesia were used as forced labour in plantations on land “freed up” by their own dispossession” (Lucas & Warren, 2013 in (Rasmussen and Lund, 2018, p. 392)), a similar pattern is emerging in Ghana. Farmers who sell their land to galamsey operations sometimes end up working in those same mines, no longer as owners but as wage labourers (farmers, galamsey interviews).

Rather than producing on their own terms, they now depend on a small share of the gold they extract, while Chinese and Ghanaian elites capture most of the profits.

This transformation is part of a broader trend. As Chimhowu (2019) notes, the neoliberal push and growing commodification of land over the past thirty years has given rise to a ‘new’ kind of land tenure system in Africa, “a product of an interplay between spontaneous adaptations to changing local and global opportunities on the one hand and state directed neoliberal reforms designed to craft a more market friendly ‘customary tenure’ ... on the other” (p.897). This dynamic in the mining sector creates fertile ground for rentier politics, with elites able to manipulate land and capital for their own gain (Mensah, 2021). Although nearly all farmers bemoan the *galamsey* (of the farmers themselves, 89% reported that farming and mining cannot coexist), as one *galamseyer* put it “*most Chiefs, 98%, are happy for galamsey, because of the price of cocoa they don't get anything*”. As above, the Chiefs are now able to extract rents through the 10% they receive from the land sales and the subsequent taxes they impose on the *galamsey* operators, whereas in the previous cocoa-system they received either no or very little rent (45 cedis per acre, split between the various authorities). Through the legitimising power they have over the land deals and the operations they are also able to reassert their authority. The State equally benefits. The stepping back of the State from enforcing the law in terms of how land is owned and sold is shown here to be a top-down *reform through inaction*. It has combined with global changes (gold prices, the climate crisis) and in-system feedback loops to make customary land more market-friendly.

Finally, while there is a temptation to see gold mining as existential threat, especially among farmers, its appeal to the wider community cannot be ignored. Informal mining can offer employment, income, and local economic stimulation – important factors in rural Ghana where formal job opportunities are limited (Ampaw et al., 2023; Wilson et al., 2015). This raises the possibility of coexistence between farming and small-scale mining. As Verbrugge (2016) argues, ASM can be understood as both a product and a driver of broader rural transformation. In Wassa Amenfi, this appears to be partially true. A few farmers explained that mining can serve as a safety net during poor harvests or as a source of income in the off-season. However, the extent of this benefit seems limited. Most interviewees claimed that few farmers engage in *galamsey*, and few miners practice farming, despite the potential for crossover. More research is needed on the interaction between the two sectors, but what is clear is that pollution and competition for labour are already having serious negative effects on farming livelihoods. These pressures may be pushing more farmers to sell their land, contributing the widening and deepening of the current basin.

Steering System Change

As discussed here and elsewhere (Nyame and Blocher, 2010; Stacey, 2025), the coexistence of parallel governance systems – where farmers and miners often operate under customary rather than state law – means that environmental impacts frequently go unregulated. While there were some reported attempts within customary systems to manage environmental concerns – for example, farmers reported that Chiefs occasionally restrict mining near rivers – these measures appear both inconsistently enforced and largely ineffective. Mercury pollution, for instance, inevitably reaches water sources regardless of such informal rules. In reality, the only environmentally meaningful intervention a Chief can make is to prohibit land sales for mining within their jurisdiction (Stool). While this may protect remaining farmers, it also limits their autonomy, as they are no longer free to decide whether to sell their land. As one odikro reported, this has already led to tensions between the Stool and its farmers. Additionally, they are not isolated from the decisions of farmers in other Stools, as the Chief also reported that farmers close to waterbodies are already experiencing issues if there is mining upstream (*theme 3.1: Tenure Agreements and Land Transfer Arrangements*). Nor are they immune from the impacts of climate change that are already pushing farmers in Ghana to find other non-farm employment (Oppong-Kyeremeh and Bannor, 2018) or out of farming entirely (Azumah and Ahmed, 2023). In a scenario in which yield drops too low, or farms and produce become poisoned or poisonous, these farmers have nothing.

Some scholars have suggested that formalisation could help resolve these issues, such as in attempts to give customary authorities a formal role like in the hybrid approach used in neighbouring Côte d'Ivoire, where the state mining company SODEMI entered into cooperative agreements with local Chiefs to manage artisanal diamond mining (De Jong and Sauerwein, 2021). However, as this research shows, the application of customary law varies considerably – both between Stools with and without galamsey, and within Stools, where some, but not all, odikro Chiefs have begun to regulate its occurrence. Deciding which customary laws should be formalised is therefore far from straightforward. Further, customary law should not be idealised. While it can offer more transparency than large-scale state-led land deals where communities are often left in the dark (Nyame and Blocher, 2010), it is not inherently democratic or egalitarian. As Crawford et al. (2017) document, traditional authorities in northern Ghana have collaborated with political elites to transfer land to wealthy businessmen and Chinese ASM firms, sidelining local miners and farmers in the process. The absence of accountability mechanisms – similar to Ubink's (2007) observation of the decline of the council of elders – is reflected in this study's findings of limited transparency and low levels of trust in relation

to supposed community benefits from mining (*theme 3.2: Chief-Miner Collaboration*). For instance, despite the formal-seeming tax collection books used by the Chief as in Image 11 above, farmers in that village reported that “*they take money from the galamseymen but don’t use it for any development projects*” (farmer). And as the Galamsey Master put it, “*they say it is for the community, but they don’t use it for that. It feeds them themselves. Some of it also has to go upwards*”. While the odikro does most of the negotiating and collecting at the village level, a lot of this likely moves up the chain of command, to the Stool and Paramount Chiefs, and potentially sideways to government agencies and individuals (GO, ID, see also: on corruption (Crawford and Botchwey, 2017; Standing and Hilson, 2013)).

Other formalisation attempts promote bringing all actors under a unified legal framework. Rather than criminalizing small-scale miners, they are more easily granted licences and property rights, tied up in the ‘dead capital’ of poor farmers, are shifted to a formal state system in order to take full advantage of the potential of the land (De Soto, 2007). However, this research finds that miners and farmers are not simply choosing the customary routes out of familiarity or overly bureaucratic processes, but because these systems offer them tangible rights, particularly farmers’ landowning rights. Any attempt to reform land and mining governance must therefore acknowledge this reality. The research also finds that legitimacy on the ground is already being produced through informal but meaningful processes: miners pay taxes to Chiefs and engage in negotiations over access and operations, giving miners an ‘air of legality’ (Lund, 2023). Without a clear incentive to choose a new hybrid approach over the current, and if the newly coded rights are not respected, the customary system is therefore likely to continue prevailing over formal structures. This has happened before: in Uganda, for instance, small-scale mining continued to operate outside of formal structures even following attempts to ease formalisation (Siegel and Veiga, 2009). As elements of the changing SES compound pressures onto farmers, pushing the system further in the direction of galamsey, there is even less incentive for a farmer to choose a system over one in which they are able to more fully benefit from their land.

For attempts to control galamsey from a top-down perspective, therefore, enforcement may seem the most viable option. However, as reported above, traditional leaders and the state both gain from galamsey, not just in financial terms, but also in power consolidation. As noted by Mensah (2021), policies like harsher sentencing have over the years proven to be “counterproductive, short-lived and unsustainable” (p.6.). These strategies focus on the most disadvantaged – poor, casual labourers – leaving untouched the funders and local elite drivers of galamsey. Additionally, although galamsey

undoubtedly affects farmers, it also offers economic opportunities to the wider community— not just to the Chiefs and elite. Under these circumstances, it is unrealistic to expect enforcement of meaningful restrictions by the authorities who benefit, but also from the community members and traditional leaders, particularly when many depend on it for income (Mensah, 2021). Hilson and Garforth (2012) describe how the "pull" of labour into artisanal mining is reinforced by the "push" out of farming, driven by widespread agricultural poverty. This paper demonstrates how further environmental degradation from the galamsey itself, climate stress, and poverty intersect with governance structures to drive the conversion of cocoa farmland into mining sites. As one Chief described in their village: *"it was always mostly people doing farming, but because of galamsey, farmers sell their land to miners... because of that, if you grow any crop it doesn't grow because of the chemicals.... only few people farm now, now it is mostly galamsey which is giving people jobs"*. As galamsey becomes relied on more by the communities who have been pushed into mining, controlling it becomes increasingly less feasible. Considering the difficulties of shifting the direction of change of the SES through top-down mechanisms such as relying on the state legal system or improved enforcement of galamsey, attention should be directed towards understanding and harnessing elements within the system which can accelerate or slow down the change or improve the conditions and structure from within.

7. Strengths and Limitations

This study employs a range of qualitative methods, including Semi-Structured Interviews (SSI), Focus Group Discussions (FGD) and Key Informant Interviews (KII), which provide a rich, contextualized understanding of the issues at hand. With a suitable number of respondents for a qualitative study, the research achieves depth while maintaining breadth. The inductive-deductive hybrid approach used allowed for a rigorous, data-driven analysis (Fereday and Muir-Cochrane, 2006). This approach – an in-depth case study and attention given to processes as they occurred – was a suitable application of the framework, which was itself developed with insights from a thorough literature review. However, there are several limitations. Non-random sampling of respondents may have introduced bias into the study, meaning responses may not be fully representative of the communities researched. Additionally, as discussed, the use of local translators (on top of my own positionality) may have influenced participants' willingness to share their views on some topics openly, though this method was essential for addressing the more sensitive topics. A major limitation is that no farmers who have sold their land were interviewed directly, as many have left the region and there were no networks to draw on, and so we simply did not manage to find anyone within the time period. While many different stakeholders discussed the reasons for selling and there was much triangulation between respondents, including pressures on remaining farmers, these insights are still largely based on analysis rather than direct accounts from those who have sold their land.

Future research could investigate the different levels of galamsey in areas where Chiefs allow the recoding of property rights versus those that do not. A better understanding of how farming and galamsey interact in terms of livelihood opportunities and security would complement this study, as would a more in-depth investigation into how system attributes limit the uptake of new practices and adaptation to change. This is crucial to building resilience, but the thorough investigation the topic requires was outside the scope of this study. Additionally, this research underscores the importance of system memory in controlling the speed of change. Understanding how close the system is to a threshold point, including factors such as pollution levels and reductions in yield, would provide valuable insights into the potential future trajectory of the region, and enable appropriate and adaptive management decisions to be made.

8. Conclusion

This study has examined the transformation of Ghana's cocoa landscapes through the lens of social-ecological systems (SES) resilience and Lund's regimes of possession. It has demonstrated that land-use change in this context is not a linear outcome of external shocks such as climate change or market shifts alone, but that recoding of property rights and shaping of authority operates in tandem with new dynamics within the system to determine the mechanisms of change, for instance the speed at which a decision at the household level can cascade up and influence the wider SES, and the characteristics of the transformed system. At the core of this transformation is the recoding of authority over land. The reconfiguration of rights – from cocoa farming to artisanal gold mining – is enabled through shifting legitimacy structures in which Chiefs allow the sell-off of land by endowing farmers with land-ownership rights. This study demonstrates that, paradoxically, what guides the change in the SES relies on if the State authorizes the mining or not, and only through unauthorized processes are the rights of farmers or smallholder miners realized.

The transformation of institutional authority is accompanied by a generation of new feedback loops that either consolidate or undermine the emergent land-use regime. Environmental degradation caused by mining, especially mercury pollution, has cascading effects on cocoa yields and the viability of food production. These ecological pressures, in turn, reduce the attractiveness of farming as a livelihood and reinforce the economic logic of land sales for mining. Labour competition further compounds these dynamics, as the mining sector absorbs the workforce traditionally engaged in cocoa cultivation. These interconnected feedbacks demonstrate a shift in the SES's basin of attraction. The ways in which some actors can disproportionately influence those around them, primarily through pollution, has changed faster than the governance system which allowed it. This has heightened inequalities, restructuring wealth and power, and potentially “approaching a threshold with unknown or undesirable consequences” (Chaffin et al., 2016, p. 10).

Despite this, many farmers resist selling land due to an awareness of what is lost when it is converted: namely future intergenerational income and food security. Yet this resistance is fragile. The convergence of declining yields, reduced rainfall, and mounting financial pressure means that the system may be approaching a critical threshold. If cocoa and food production become untenable, land-use decisions will increasingly be made under duress rather than through long-term planning, further entrenching the mining trajectory. These remembrance dynamics may be useful to managers or planners of the landscape. For instance, it is important to recognise that, in the absence of legitimate enforcement from authorities such as the State or Chieftaincy, decision makers may find that they

have natural barriers within the system itself, but that these need support to not collapse. For example, enhancing farm profitability – whether through supplemental pricing mechanisms beyond the state-set cocoa price, improved access to inputs, subsidised irrigation, or targeted credit support – could make farming a more viable and attractive livelihood. Thresholds, particularly regarding the system's capacity to provide food, need to be supported at the community level – their effectiveness depends on collective participation and coordination among all members. While such pressures can be stressful, they also create opportunities for empowerment, as bottom-up, community-led initiatives could be encouraged instead of the top-down strategies that have so far been ineffective.

The research demonstrates that most farmers don't *want* to sell their land. Therefore, targeted interventions that enable them to retain and productively use their land are both feasible and necessary. It is, however, equally important to recognise the proximity of potential thresholds, and that, to ensure a sustainable cocoa supply while safeguarding farmer livelihoods, some farmers may ultimately choose to transition out of cocoa. The goal should not be to prevent this at all costs, but to ensure that such decisions are made from a position of agency rather than crisis. The rights to sell land does offer farmers a form of autonomy, but this agency should be supported – not undermined – by interventions that make farming a viable and dignified option. Where transitions are necessary, they should be accompanied by pathways into alternative, secure livelihoods, rather than resulting from conditions that render farming untenable. Supporting farmers in this way helps avoid farmers being locked into an undesirable basin and maintains the broader resilience of the cocoa landscape.

The conceptual framework developed here provides a useful approach for actors engaged in land and resource governance, recognising that both environmental and social factors influence each other at different scales, and also the role that power and authority plays in the change unfolding. In particular, it offers a way to frame cause-and-effect dynamics and trade-offs at different scales, which can be weak in a traditional SES analysis but pervasive in reality. It encourages a move away from one-size-fits-all formalisation strategies and toward more nuanced, context-specific approaches that engage with the actual governance, social and ecological processes on the ground. The framework is applicable beyond the Ghanaian context. In settings where land-use change is accompanied by ownership or authority change, ecological pressure, and inequalities, it offers a method for tracing the recursive and cross-scalar nature of system change. By incorporating both ecological feedbacks and institutional dynamics, the approach supports an understanding of resilience that is attuned to the politics of land, the agency of local actors, and the possibility of transformation from within.

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Annex 1: Farmer Semi-Structured Interview (SSI) Guide

Verbal preamble:

- Welcome and introduction (me and translator)
- This research is about how societies are affected by, and able to adapt to, changes to their environment. I am especially interested in mining but also other changes such as climate, weather, pests etc.
- The research will be focused on the region, no personal information will be stored and anything you tell me will be anonymous.
- Interview should take maximum an hour. If you want to stop it or take a break at any point that is completely fine.
- The questions are designed to be open and a guide, so if there is anything you want to tell me that is not specifically asked, to expand on a point or ask me any questions at any time that is also encouraged.
- The survey questions refer to all household members and to decisions made on behalf of the whole household

Demographic

1. Gender
2. Age range
3. Community / village name
4. Years farming
5. Is farming your primary occupation?
6. How many people are in your household?
7. Are you certified (e.g. RA)? With who?

Place

8. How big is your farm? Over how many plots is it spread out?
 - a. Do you own the land/share crop? If own: did you inherit it from your parents or buy it?
9. What changes have you noticed in your cocoa farm in recent years? how does this affect you?
 - a. Examples: Soil colour, water availability, tree health, pests and diseases.
 - b. What do you think is causing these changes?
10. Have you seen mining ('galamsey') near your farm?
 - a. Has it affected your land or water?
11. What are other ways the increase in mining has affected you
 - a. If mention labour: how do you cope (e.g. family helps more, take loans, second job).
 - b. What has been the impact of this? Does this make you question whether you can continue cocoa farming into the future?
12. What other crops do you grow?
 - a. E.g. Cassava, yam, cocoyam, plantain, rice, rubber
 - b. Do you grow these on your cocoa farm (intercropping) or another plot of land?

- c. Do you grow these to sell or consume? What proportion of these do you sell/consume?
 - d. Have you made any recent changes? Why?
- 13. Have you lost any land to mining?
 - a. Did you own the land or rent? How did this decision get made?
 - b. Did you receive compensation?
- 14. Does anyone in this community gain additional income from mining?
 - a. How many (roughly)?
 - b. Is your impression that it is local people or people from other places? Is it often farmers (side job, seasonal (i.e. in the off-season), as a response to a bad yield) or people who only mine?
- 15. Did you have any trees that died over the last year? What proportion of your trees?
 - a. Do you plan to replant these? Why?
- 16. How easy is it to access healthcare and education for your family? Has this changed due to farming or mining activities?
- 17. Does your family help you in the farm?

Human Agency

- 18. Do you or your family have other sources of income besides cocoa farming? What are they?
 - a. How have these changed in the last 5 years? why did this change happen?
 - b. (if not answered) Is anyone in your household employed in mining? what about your wider family? Does this income support you in continuing to farm?
- 19. Did you have periods in the last year when it was difficult to get enough food for your household? What do you do to cope?
 - a. (e.g. eat less, send family members to work, collect from forest etc.)
- 20. Do you own your land, rent it, or work under another arrangement?
 - a. (if own) Why have you not sold land rights to miners?
 - b. (if sharecrop/other) How secure do you feel about future use of this land? Does this influence decisions you make? *(if not mentioned, prompt: shade trees and other long term mgmt practices; prompt: diversification of livelihoods (e.g. joining mining, starting other work))*
 - c. Who in your household decides whether to sell land to miners?
- 21. What storage or drying facilities do you have access to? Are they sufficient for your needs?
- 22. Do you own any livestock? Which, How many, Why? What are the challenges of this compared to other activities?
- 23. Have you taken loans or used credit for farming?
 - a. If yes: was it through a VSLA or other? How much did you take? What was the interest? On what did you spend the loan?
 - b. If not, what prevents you from doing so?

Collective Action

24. Do farmers in your community share communal labour, tools or equipment? If so, how does this arrangement work?
25. Has your community taken any steps to prevent land from being sold for mining? If so, with what effects?
26. Are there disagreements over land or mining in your area? How do people solve them?
 - a. Examples: Family fights, chief's court, government

Local knowledge and learning

27. Where did you learn how to farm cocoa?
28. Have you tried new farming techniques?
 - a. Where did you learn about them?
 - i. If trainings – how helpful have you found these?
 - b. What worked or failed?
 - c. How do you decide when to adopt new farming methods vs. rely on existing knowledge?
 - d. Have you changed how you farm in response to environmental or other changes?
29. If you had better access to money/credit or other resources, what farming changes would you make? What about off-farm changes?

Institutions

30. Do government/NGO programs (e.g., free fertiliser) help you farm better? Does this support influence whether or not you will continue to farm cocoa (is it sufficient)?
31. What support do you wish they gave instead (farm and non-farm).
32. Are you a member of any farming organisations (e.g. VSLA)?
 - a. If yes, what does the group do? Has it helped you? Is there a leader? What do they do? How are they elected?
 - b. If no, why not?
33. Do you believe cocoa and mining can exist side-by-side here? How?